

ENGINEERING
TOMORROW



Programming Guide

VLT® Aqua Drive FC 202

Software Version 5.81



Contents

1 Introduction

1.1 Purpose of the Programming Guide	15
1.2 Supported Software Versions	15
1.3 Document Version	15
1.4 Type Approvals and Certifications	15

2 Safety

2.1 Safety Symbols	17
2.2 Safety Precautions	17
2.3 Protection Mode	19

3 Electrical Wiring

3.1 Electrical Wiring - Control Cables	20
3.1.1 Wiring Diagram	20
3.1.2 Input Polarity of Control Terminals	21
3.1.3 Grounding of Shielded/Armored Cables	22
3.2 Other Wiring Examples	22
3.2.1 Start/Stop	22
3.2.2 Pulse Start/Stop	23
3.2.3 Speed Up/Down	24
3.2.4 Potentiometer Reference	25

4 How to Program

4.1 The Local Control Panel	27
4.1.1 Overview of the LCP	27
4.1.2 LCD Display	27
4.1.3 LCP Keys	29
4.1.4 Quick Transfer of Parameter Settings between Multiple Drives	31
4.1.5 Transferring Data	31
4.1.5.1 Transferring Data from the Drive to the LCP	31
4.1.5.2 Transferring Data from the LCP to the Drive	31
4.1.6 Display Mode	31
4.1.7 Display Mode - Selection of Readouts	31
4.1.8 Status Views	34

4.1.8.1	Status View I	34
4.1.8.2	Status View II	34
4.1.8.3	Status View III	35
4.1.9	Quick Menu Key Functions	35
4.1.10	Q2 Quick Setup	36
4.1.11	Programming in the Quick Setup	37
4.1.12	Q3 Function Set-ups	38
4.1.13	Function Set-ups Overview	38
4.1.13.1	Function Set-up Q3-1 General Settings	38
4.1.13.2	Function Set-up Q3-2 Open-loop Settings	39
4.1.13.3	Function Set-up Q3-3 Closed-loop Settings	39
4.1.14	Quick Menu, Q4 SmartStart	39
4.1.15	Main Menu Mode	40
4.1.16	Parameter Selection	40
4.1.17	Changing Data	40
4.1.18	Changing a Text Value	41
4.1.19	Changing a Data Value	41
4.1.20	Infinitely Variable Change of Numeric Data Value	41
4.1.21	Value, Step by Step	42
4.1.22	Readout and Programming of Indexed Parameters	42
4.1.23	Changing Values of Indexed Parameters	42
4.2	The Numerical Control Panel	43
4.2.1	Overview of the Numerical LCP	43
4.2.2	LCP Keys, Numerical LCP	43
4.3	Restoring Factory Default Settings	45
4.3.1	Restoring Factory Default Settings Using the Recommended Initialization	45
4.3.2	Restoring Factory Default Settings Using Manual Initialization	46
4.3.3	Resetting all Parameters	46

5 Parameter Descriptions

5.1	Selecting Parameters	48
5.2	Parameter Group 0-** Operation and Display	48
5.2.1	Introduction to Parameter Group 0-** Operation and Display	48
5.2.2	0-0* Basic Settings	48
5.2.3	0-1* Set-up Operations	50
5.2.4	0-2* LCP Display	53

5.2.5 0-3* LCP Custom Readout	61
5.2.6 0-4* LCP Keypad	65
5.2.7 0-5* Copy/Save	67
5.2.8 0-6* Password	68
5.2.9 0-7* Clock Settings	69
5.2.10 0-9* Varia	73
5.3 Parameter Group 1-** Load and Motor	75
5.3.1 1-0* General Settings	75
5.3.2 Motor Setups	78
5.3.2.1 Asynchronous Motor Setup	78
5.3.2.2 PM Motor Setup	79
5.3.2.3 Programming of PM Motors	79
5.3.2.4 SynRM and PMaSynRM Motor Setup	81
5.3.2.5 Programming of SynRM and PMaSynRM Motors	81
5.3.3 1-1* Motor Selection	82
5.3.4 1-1* VVC+ for Synchronous Motors	83
5.3.5 1-2* Motor Data	84
5.3.6 1-3* Adv. Motor Data	89
5.3.7 1-5* Load Indep. Setting	96
5.3.8 1-6* Load Depend. Setting	100
5.3.9 1-7* Start Adjustments	103
5.3.10 1-8* Stop Adjustments	106
5.3.11 1-9* Motor Temperature	109
5.3.11.1 Connections Related to Motor Temperature Control	113
5.4 Parameter Group 2-** Brakes	116
5.4.1 2-0* DC Brakes	116
5.4.2 2-1* Brake Energy Funct.	117
5.5 Parameter Group 3-** Reference/Ramps	121
5.5.1 3-0* Reference Limits	121
5.5.2 3-1* References	122
5.5.3 3-4* Ramp 1	128
5.5.4 3-5* Ramp 2	129
5.5.5 3-8* Other Ramps	129
5.5.6 3-9* Digital Pot.Meter	132
5.6 Parameter Group 4-** Limits/Warnings	134
5.6.1 4-1* Motor Limits	134

5.6.2	4-4* Motor Monitoring	136
5.6.3	4-5* Adj. Warnings	137
5.6.4	4-6* Speed Bypass	139
5.6.5	Semi-automatic Bypass Speed Setup	140
5.7	Parameter Group 5-** Digital In/Out	141
5.7.1	5-0* Digital I/O Mode	141
5.7.2	5-1* Digital Inputs	142
5.7.3	5-3* Digital Outputs	162
5.7.4	5-4* Relays	169
5.7.5	5-5* Pulse Input	177
5.7.6	5-6* Pulse Outputs	179
5.7.7	5-8* I/O Options	182
5.7.8	5-9* Bus-controlled	183
5.8	Parameter Group 6-** Analog In/Out	185
5.8.1	6-0* Analog I/O Mode	185
5.8.2	6-1* Analog Input 1	187
5.8.3	6-2* Analog Input 2	188
5.8.4	6-3* Analog Input X30/11	190
5.8.5	6-4* Analog Input X30/12	191
5.8.6	6-5* Analog Output 1	193
5.8.7	6-6* Analog Output X30/8	198
5.8.8	6-7* Analog Output X45/1	201
5.8.9	6-8* Analog Output X45/3	204
5.9	Parameter Group 7-** Controllers	206
5.9.1	Speed PID Droop	206
5.9.2	Speed Trim	208
5.9.3	7-0* Speed PID Ctrl.	209
5.10	Parameter Group 8-** Comm. and Options	212
5.10.1	8-0* General Settings	212
5.10.2	8-1* Ctrl. Word Settings	215
5.10.3	8-2* Counters	223
5.10.4	8-3* FC Port Settings	223
5.10.5	8-4* Telegram Selection	226
5.10.6	8-5* Digital/Bus	228
5.10.7	8-7* BACnet	231

5.10.8	8-8* FC Port Diagnostics	232
5.10.9	8-9* Bus Jog	233
5.11	Parameter Group 9-** PROFIdrive	234
5.12	Parameter Group 10-** CAN Fieldbus	252
5.12.1	10-0* Common Settings	252
5.12.2	10-1* DeviceNet	253
5.12.3	10-2* COS Filters	260
5.12.4	10-3* Parameter Access	261
5.13	Parameter Group 12-** Ethernet	263
5.13.1	12-0* IP Settings	263
5.13.2	12-1* Ethernet Link Parameters	264
5.13.3	12-2* Process Data	266
5.13.4	12-3* EtherNet/IP	271
5.13.5	12-4* Modbus TCP	273
5.13.6	12-4* Fieldbus Extension	274
5.13.7	12-7* BACnet	275
5.13.8	12-8* Other Ethernet Services	276
5.13.9	12-9* Advanced Ethernet Services	278
5.14	Parameter Group 13-** Smart Logic	280
5.14.1	Introduction to Smart Logic Control	280
5.14.2	13-0* SLC Settings	282
5.14.3	13-1* Comparators	289
5.14.4	13-1* RS Flip Flops	296
5.14.5	13-2* Timers	304
5.14.6	13-4* Logic Rules	305
5.14.7	13-5* States	317
5.14.8	13-9* User-defined Alerts and Readouts	339
5.15	Parameter Group 14-** Special Functions	344
5.15.1	14-0* Inverter Switching	344
5.15.2	14-1* Mains On/Off	346
5.15.3	14-2* Trip Reset	354
5.15.4	14-3* Current Limit Control	357
5.15.5	14-4* Energy Optimizing	358
5.15.6	14-5* Environment	359
5.15.7	14-6* Auto Derate	363

5.15.8	14-8* Options	365
5.15.9	14-9* Fault Settings	366
5.16	Parameter Group 15-** Drive Information	367
5.16.1	15-0* Operating Data	367
5.16.2	15-1* Data Log Settings	369
5.16.3	Service Log	375
5.16.4	Clearing the Service Log	376
5.16.5	Service Log Indication	376
5.16.6	Reading the Service Log Information	376
5.16.7	Alarms that Trigger a Service Log Record	377
5.16.8	15-2* Historic Log	378
5.16.9	15-2* Operating Data Log	380
5.16.10	15-3* Alarm Log	380
5.16.11	15-4* Drive Identification	383
5.16.12	15-6* Option Ident.	386
5.16.13	15-9* Parameter Info	388
5.17	Parameter Group 16-** Data Readouts	389
5.17.1	16-0* General Status	389
5.17.2	16-1* Motor Status	390
5.17.3	16-3* Drive Status	393
5.17.4	16-5* Ref. & Feedb.	397
5.17.5	16-6* Inputs and Outputs	398
5.17.6	16-8* Fieldbus & FC Port	402
5.17.7	16-9* Diagnosis Readouts	404
5.18	Parameter Group 18-** Data Readouts 2	407
5.18.1	18-0* Maintenance Log	407
5.18.2	18-1* Emergency Mode Log	408
5.18.3	18-1* Parameter Log	408
5.18.4	18-3* Analog Readouts	410
5.18.5	18-4* PGIO Data Readouts	411
5.18.6	18-4* Last Warning	413
5.18.7	18-5* Ref. & Feedb.	413
5.18.8	18-6* Inputs & Outputs 2	413
5.18.9	18-6* Motor Status 2	414
5.18.10	18-6* Diagnosis Readout 2	414

5.18.11	18-7* Rectifier Status	415
5.19	Parameter Group 20-** FC Closed Loop	417
5.19.1	Introduction to FC Closed Loop Parameters	417
5.19.2	20-0* Feedback	418
5.19.3	20-2* Feedback/Setpoint	429
5.19.4	20-5* DRC	433
5.19.5	20-6* Sensorless	434
5.19.6	20-7* Autotuning	435
5.19.7	20-8* PID Basic Settings	438
5.19.8	20-9* PID Controller	439
5.20	Parameter Group 21-** Extended Closed Loop	441
5.20.1	Introduction to Extended Closed Loop	441
5.20.2	21-0* Extended CL Autotuning	441
5.20.3	21-1* Closed Loop Ref/Feedback	444
5.20.4	21-2* Closed Loop 1 PID	448
5.20.5	21-3* Closed Loop 2 Ref/Fb	450
5.20.6	21-4* Closed Loop 2 PID	454
5.20.7	21-5* Closed Loop 3 Ref/Fb	456
5.20.8	21-6* Closed Loop 3 PID	460
5.21	Parameter Group 22-** Application Functions	461
5.21.1	22-0* Miscellaneous	461
5.21.2	22-2* No-flow Detection	462
5.21.3	22-3* No-flow Power Tuning	469
5.21.4	22-4* Sleep Mode	472
5.21.5	22-5* End of Curve	476
5.21.6	22-6* Broken Belt Detection	478
5.21.7	22-7* Short Cycle Protection	479
5.21.8	22-8* Flow Compensation	480
5.22	Parameter Group 23-** Time-based Functions	485
5.22.1	23-0* Timed Actions	485
5.22.2	23-0* Timed Actions Settings	492
5.22.3	23-1* Maintenance	493
5.22.4	23-5* Energy Log	497
5.22.5	23-6* Trending	500
5.22.6	23-8* Payback Counter	504

5.23	Parameter Group 24-** Application Functions 2	506
5.23.1	24-0* Emergency Mode	506
5.23.2	24-1* Drive Bypass	514
5.23.3	24-4* Emergency Mode 2	516
5.24	Parameter Group 25-** Cascade Controller	518
5.24.1	Introduction to Cascade Controller Parameters	518
5.24.2	25-0* System Settings	519
5.24.3	25-2* Bandwidth Settings	521
5.24.4	25-4* Staging Settings	526
5.24.5	25-5* Alternation Settings	530
5.24.6	25-8* Status	534
5.24.7	25-9* Service	535
5.25	Parameter Group 26-** Analog I/O Option MCB 109	536
5.25.1	Introduction to Parameters Related to the VLT® Analog I/O Option MCB 109	536
5.25.2	26-0* Analog I/O Mode	538
5.25.3	26-1* Analog Input X42/1	539
5.25.4	26-2* Analog Input X42/3	541
5.25.5	26-3* Analog Input X42/5	542
5.25.6	26-4* Analog Out X42/7	543
5.25.7	26-5* Analog Out X42/9	545
5.25.8	26-6* Analog Out X42/11	547
5.26	Parameter Group 27-** Cascade CTL Option	548
5.26.1	Introduction to Cascade Controller Option Parameters	548
5.26.2	Master/Follower Configuration	550
5.26.3	Mixed-pump Configuration	550
5.26.4	Unequal Pump Size Configuration	551
5.26.5	Using Soft Starters for Fixed-speed Pumps	551
5.26.6	27-0* Control & Status	551
5.26.7	27-1* Configuration	553
5.26.8	27-2* Bandwidth Settings	555
5.26.9	27-3* Staging Speed	559
5.26.10	27-4* Staging Settings	561
5.26.11	27-5* Alternate Settings	565
5.26.12	27-6* Digital Inputs	567
5.26.13	27-7* Connections	570

5.26.14	27-8* Advanced Settings	573
5.26.15	27-9* Readouts	573
5.27	Parameter Group 29-** Water Application Functions	575
5.27.1	29-0* Pipe Fill Function	575
5.27.2	29-1* Deragging Function	577
5.27.3	29-2* Derag Power Tuning	580
5.27.4	29-4* Pre/Post-Lube Function	584
5.27.5	29-5* Flow Confirmation	585
5.27.6	29-6* Flow Meter	587
5.28	Parameter Group 30-** Special Features	592
5.28.1	30-2* Adv. Start Adjust	592
5.28.2	30-5* Unit Configuration	593
5.28.3	30-8* Compatibility (I)	593
5.29	Parameter Group 31-** Bypass Option	593
5.30	Parameter Group 34-** MCO Data Readouts	595
5.30.1	34-0* PCD Write Par.	595
5.30.2	34-2* PCD Read Par.	597
5.31	Parameter Group 35-** Sensor Input Option	598
5.31.1	35-0* Temp. Input Mode (MCB 114)	598
5.31.2	35-1* Temp. Input X48/4 (MCB 114)	600
5.31.3	35-2* Temp. Input X48/7 (MCB 114)	601
5.31.4	35-3* Temp. Input X48/10 (MCB 114)	602
5.31.5	35-4* Analog Input X48/2 (MCB 114)	603
5.32	Parameter Group 36-** Programmable I/O Option	604
5.32.1	36-0* I/O Mode	604
5.32.2	36-1* Analog Input X49/1	606
5.32.3	36-2* Analog Input X49/3	607
5.32.4	36-3* Analog Input X49/5	609
5.32.5	36-4* Output X49/7	610
5.32.6	36-5* Output X49/9	618
5.32.7	36-6* Output X49/11	624
5.33	Parameter Group 40-** Special Settings	629
5.33.1	40-1* Aux. Functions Control	629
5.33.2	40-2* PM Motor Specific	631
5.33.3	40-3* Fieldbus Profile	631

5.33.4	40-4* Extend. Alarm Log	632
5.33.5	40-5* Advanced Control Settings	633
5.33.6	40-6* IPv6 Settings	635
5.33.7	40-8* IoT Settings	636
5.33.8	40-9* Security	637
5.34	Parameter Group 43-** Unit Readouts	637
5.34.1	43-0* Component Status	637
5.34.2	43-1* Power Card Status	638
5.34.3	43-2* Fan Pow.Card Status	639
5.34.4	43-3* Warning Log	640
5.34.5	43-6* Audit Log	644
5.35	Parameter Group 45-** Condition Based Monitoring	646
5.35.1	45-0* Cockpit: Monitor	646
5.35.2	45-1* Cockpit: Actl Status	650
5.35.3	45-2* Baseline Settings	654
5.35.4	45-3* Threshold Config.	657
5.35.5	45-4* Threshold Generation	662
5.35.6	45-5* Sensor Config.	663
5.35.7	45-6* Stator Res. Setting	665
5.35.8	45-8* Cavitation Config.	666
5.35.9	45-9* Actual Readouts	667
5.36	Parameter Group 46-** CBM Adv. Thresholds	669
5.36.1	46-0* History	669
5.36.2	46-0* General	669
5.36.3	46-1* Timing	670
5.36.4	46-2* Stator	671
5.36.5	46-3* Load	672
5.36.6	46-4* Sensor 1	674
5.36.7	46-5* Sensor 2	675
5.36.8	46-6* Sensor 3	676
5.36.9	46-7* Sensor 4	677
5.36.10	46-8* Cavitation	678
5.37	Parameter Group 47-** CBM Baseline Data	678
5.37.1	47-0* History	678
5.37.2	47-0* Speeds	679

5.37.3	47-0* Stator	679
5.37.4	47-1* Stator Res. Active	681
5.37.5	47-2* Stator Res. Load	682
5.37.6	47-3* Load	683
5.37.7	47-4* Sensor 1	685
5.37.8	47-5* Sensor 2	687
5.37.9	47-6* Sensor 3	688
5.37.10	47-7* Sensor 4	690
5.37.11	47-8* Cavitation	692
5.37.12	47-9* Min Max Speed	693
5.38	Parameter Group 48-** CBM Applications	694
5.38.1	48-0* Cavitation Control	694
5.39	Parameter Group 49-** CBM Sine Wave Filter	697
5.39.1	49-0* Cockpit: Monitoring	697
5.39.2	49-1* Baseline Settings	701
5.39.3	49-2* Threshold Config.	704
5.39.4	49-3* Adv Monitoring Readouts 1	706
5.40	Parameter Group 50-** License	707
5.41	Parameter Group 600-** PROFIsafe	707

6 Troubleshooting

6.1	Status Messages	708
6.1.1	Warnings and Alarms	708
6.1.2	Alarm/Warning Code List	708
6.1.3	Indicator Light	722
6.1.4	Alarm Word, Warning Word, and Extended Status Word	722
6.1.5	Alarm and Warning Words - CBM SWF	727
6.1.6	Alarm and Warning Words - CBM Cavitation	727
6.2	Descriptions of Warnings and Alarms	728

1 Introduction

1.1 Purpose of the Programming Guide

This programming guide provides information required for setting up parameters in a drive. The guide contains the following main areas:

- How to use the local control panel (LCP)
- Detailed descriptions of all parameters
- Troubleshooting

1.2 Supported Software Versions

Supported software versions: 5.8X

This programming guide can be used for all FC 202 drives. The software version number can be read from parameter **15-43 Software Version**.

1.3 Document Version

This guide is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this guide is in English.

Version	Remarks	Software Version
AU361182657213, version 22	Update to new software version including cybersecurity and condition-based monitoring of cavitation and sine-wave filters.	5.81

1.4 Type Approvals and Certifications

The following table shows examples of possible type approvals and certifications for Danfoss drives.

NOTICE	
Drives of enclosure size T7 (525–690 V) are not UL listed.	

Table 1: Type Approvals and Certifications

Table 1: Type Approvals and Certifications - (continued)

NOTICE

The specific approvals and certification for the drive are on the nameplate of the drive. For more information, contact the local Danfoss office or partner.

For more information on UL 508C thermal memory retention requirements, refer to the section Motor Thermal Protection in the product-specific design guide.

For more information on compliance with the European Agreement concerning International Carriage of Dangerous Goods by Inland Waterways (AND), refer to the section AND-compliant Installation in the product-specific design guide.

2 Safety

2.1 Safety Symbols

The following symbols are used in Danfoss documentation and products.

 DANGER	
Indicates a hazardous situation which, if not avoided, will result in death or serious injury.	
 WARNING	
Indicates a hazardous situation which, if not avoided, could result in death or serious injury.	
 CAUTION	
Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.	
NOTICE	
Indicates information considered important, but not hazard-related (for example, messages relating to property damage).	
	ISO warning symbol for general warnings
	ISO warning symbol for hot surfaces and burn hazard
	ISO warning symbol for high voltage and electric shock
	Symbol for indicating the required discharge time of the capacitors in the product.
	ISO action symbol for referring to the instructions

2.2 Safety Precautions

 WARNING
LACK OF SAFETY AWARENESS This guide provides important information on preventing injury and damage to the equipment or the system. Ignoring this information can lead to death, serious injury, or severe damage to the equipment. • Make sure to fully understand the dangers and safety measures present in the application. • Before performing any electrical work on the drive, lock out and tag out all power sources to the drive.

WARNING

HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

WARNING
UNINTENDED START

When the drive is connected to AC mains, DC supply, or load sharing, the motor may start at any time. The motor may start by activation of an external switch, a fieldbus command, an input reference signal from the LCP or LOP, via remote operation using MCT 10 Set-up software, or after a cleared fault condition. Unintended start during programming, service, or repair work can result in death, serious injury, or property damage.

- Disconnect the drive from the mains.
- Press *[Off/Reset]* on the LCP before programming parameters.
- Ensure that the drive is fully wired and assembled when it is connected to AC mains, DC supply, or load sharing.

WARNING

DISCHARGE TIME

The drive contains DC-link capacitors, which can remain charged even when the drive is not powered. High voltage can be present even when the warning indicator lights are off.

Failure to wait the specified time after power has been removed before performing service or repair work could result in death or serious injury.

- Stop the motor.
- Disconnect AC mains, permanent magnet type motors, and remote DC-link supplies, including battery backups, UPS, and DC-link connections to other drives.
- Wait for the capacitors to discharge fully before performing any service or repair work. The discharge time is specified on the drive product label.
- Use a measuring device to make sure that there is no voltage before opening the drive or performing any work on the cables.

NOTICE
USING THE SAFE TORQUE OFF

When using the Safe Torque Off, always follow the instructions in the VLT® Frequency Converters - Safe Torque Off Operating Guide.

NOTICE
CONTROL SIGNALS

Control signals from, or internally within, the drive may in rare cases be activated in error, be delayed, or fail to occur entirely. When used in situations where safety is critical, for example, when controlling the electromagnetic brake function of a hoist application, do not rely on these control signals exclusively.

NOTICE

HAZARDOUS SITUATIONS

Hazardous situations must be identified by the machine builder/integrator who is responsible for considering the necessary preventive means. More monitoring and protective devices may be included, always according to valid national safety regulations, for example, law on mechanical tools and regulations for the prevention of accidents.

2.3 Protection Mode

Once a hardware limit on motor current or DC-link voltage is exceeded, the drive enters protection mode. Protection mode means a change of the PWM modulation strategy and a low switching frequency to minimize losses. This continues for 10 s after the last fault and increases the reliability and robustness of the drive while re-establishing full control of the motor.

The following situations cause the drive to enter protection mode:

- Undervoltage, the voltage has dropped below the low limit.
- Overvoltage, the voltage has exceeded the upper limit. Protection mode can be avoided by activating overvoltage control in parameter **2-17 Overvoltage Control**. However, activating overvoltage control extends the ramp times.
- Overcurrent, the current has exceeded the limit defined in parameter **4-18 Current Limit**.
- Ground fault, a ground fault has appeared.

To remove protection mode, set parameter **14-26 Trip Delay at Inverter Fault** to 0.

3 Electrical Wiring

3.1 Electrical Wiring - Control Cables

3.1.1 Wiring Diagram

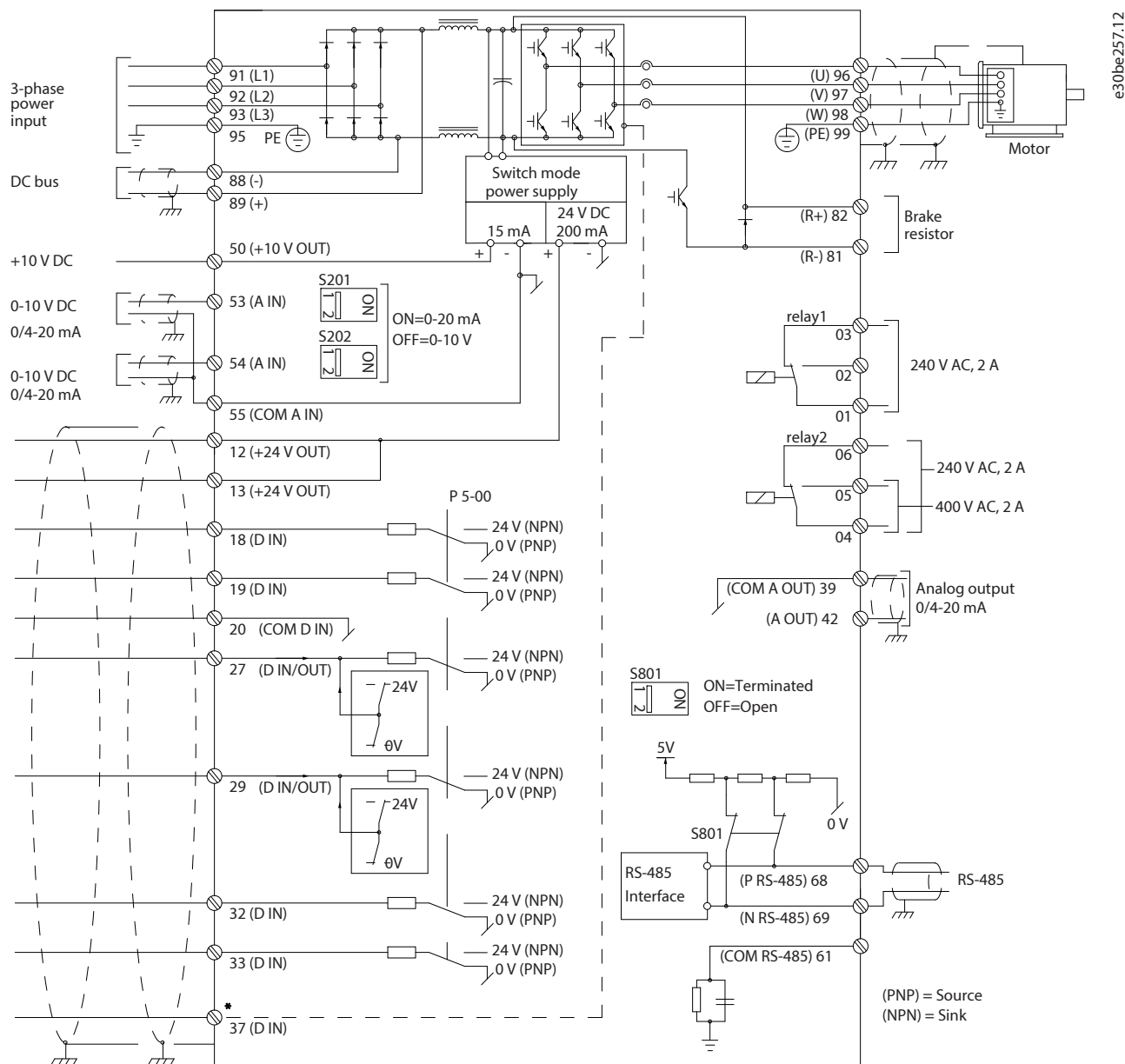


Figure 1: Wiring Diagram

A = Analog, D = Digital

Terminal 37 is used for Safe Torque Off. For Safe Torque Off installation instructions, refer to the VLT® Frequency Converters - Safe Torque Off Operating Guide.

Long control cables and analog signals may in rare cases, and depending on installation, result in 50/60 Hz ground loops due to noise from mains supply cables.

If this occurs, it may be necessary to break the shield or insert a 100 nF capacitor between shield and enclosure. Connect the digital and analog inputs and outputs separately to the common inputs (terminals 20, 55, and 39) of the drive to avoid ground currents from both groups to affect other groups. For example, switching on the digital input may disturb the analog input signal.

3.1.2 Input Polarity of Control Terminals

NOTICE

Control cables must be shielded.

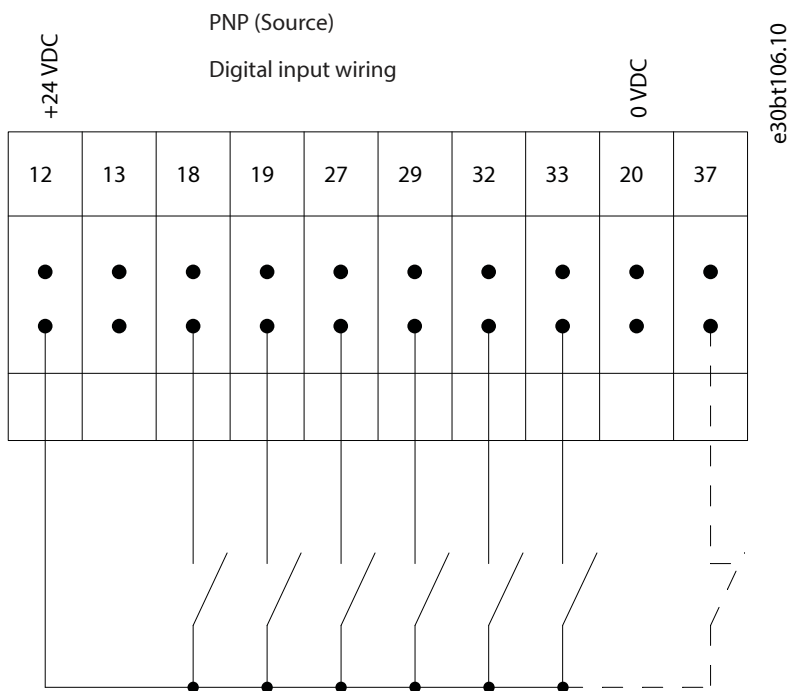


Figure 2: PNP (Source)

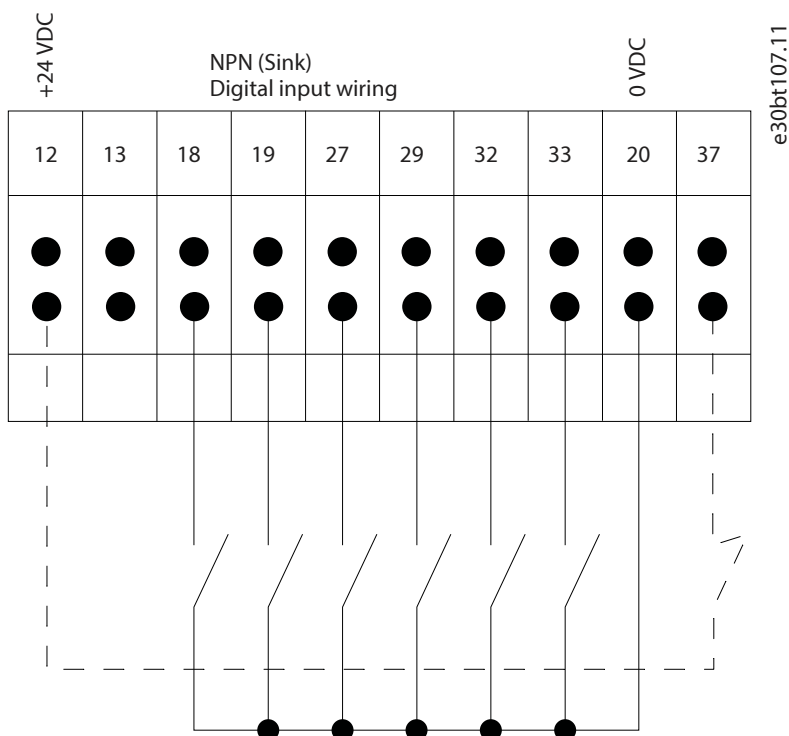


Figure 3: NPN (Sink)

3.1.3 Grounding of Shielded/Armored Cables

See the section *Grounding* in the design guide for the correct termination of control cables.

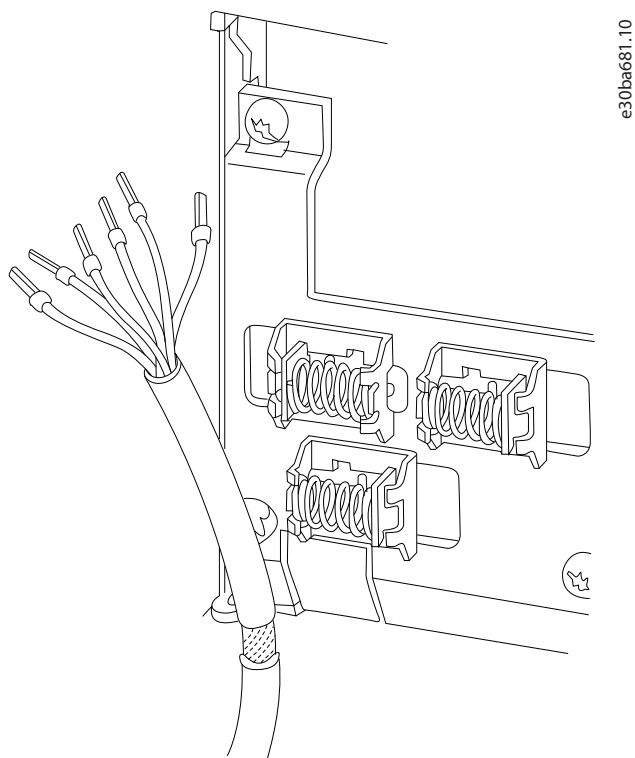


Figure 4: Grounding of Shielded/Armored Cables

3.2 Other Wiring Examples

3.2.1 Start/Stop

Terminal 18 = Parameter 5-10 *Terminal 18 Digital Input*, [8] *Start*.

Terminal 27 = Parameter 5-12 *Terminal 27 Digital Input*, [0] *No Operation* (default [2] *Coast inverse*).

Terminal 37 = Safe Torque Off (where available).

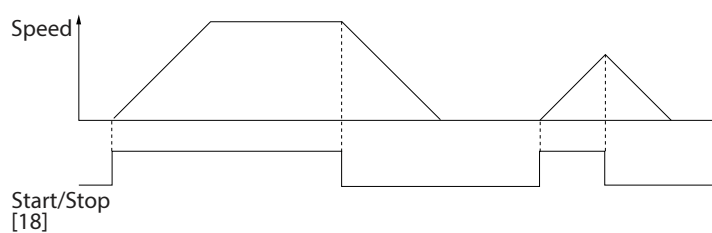
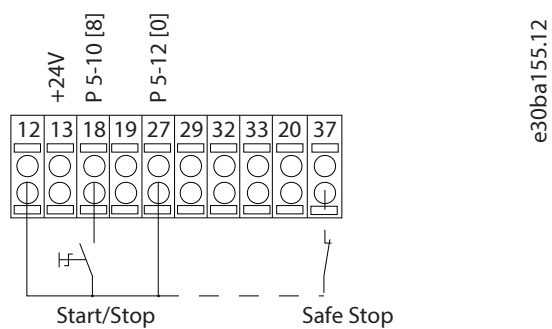


Figure 5: Start/Stop

3.2.2 Pulse Start/Stop

Terminal 18 = Parameter 5-10 Terminal 18 Digital Input, [9] Latched start.

Terminal 27 = Parameter 5-12 Terminal 27 Digital Input, [6] Stop inverse.

Terminal 37 = Safe Torque Off (where available).

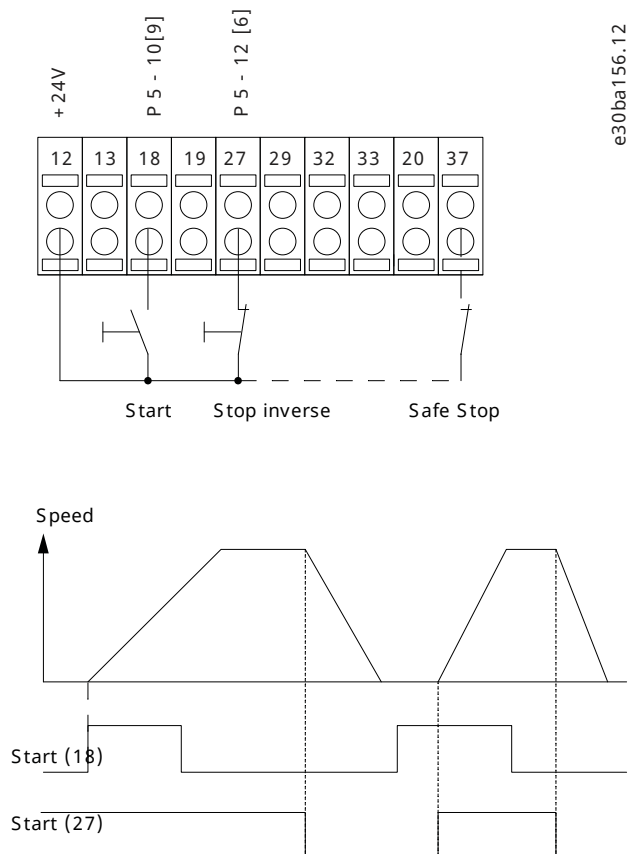


Figure 6: Pulse Start/Stop

3.2.3 Speed Up/Down

Terminals 29/32 = Speed up/down

Terminal 18 = Parameter 5-10 Terminal 18 Digital Input, [9] Start (default).

Terminal 27 = Parameter 5-12 Terminal 27 Digital Input, [19] Freeze reference.

Terminal 29 = Parameter 5-13 Terminal 29 Digital Input, [21] Speed up

Terminal 32 = Parameter 5-14 Terminal 32 Digital Input, [22] Speed down

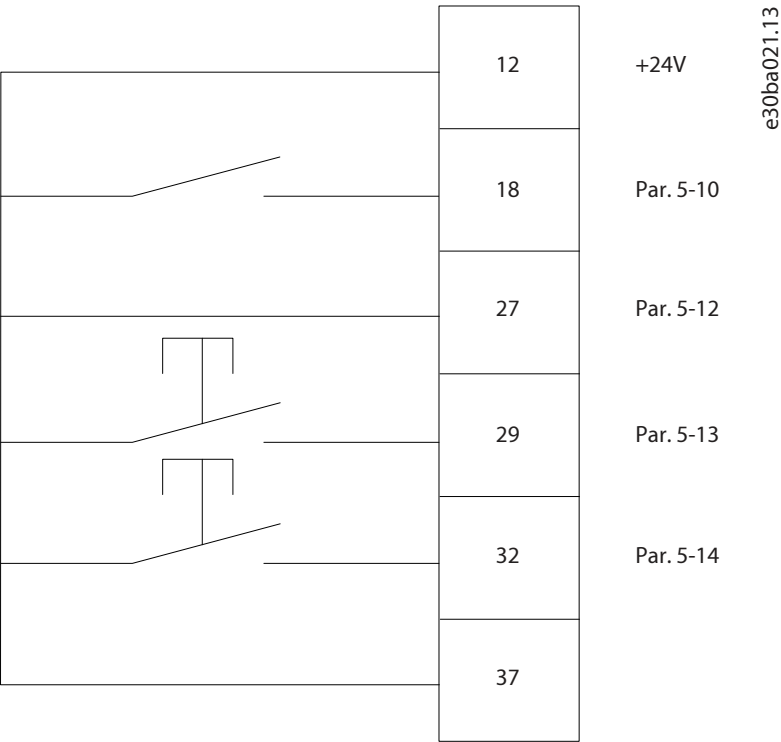


Figure 7: Speed Up/Down

3.2.4 Potentiometer Reference

Voltage reference via a potentiometer

Reference source 1= [1] *Analog input 53* (default).

Terminal 53, Low Voltage = 0 V.

Terminal 53, High Voltage = 10 V.

Terminal 53, Low Ref./Feedback = 0 RPM.

Terminal 53, High Ref./Feedback = 1500 RPM.

Switch S201 = OFF (U).

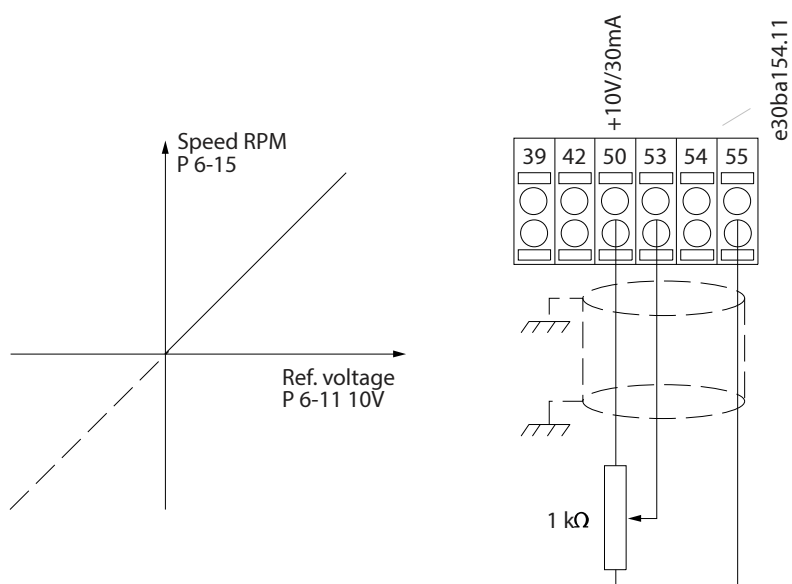


Figure 8: Potentiometer Reference

4 How to Program

4.1 The Local Control Panel

4.1.1 Overview of the LCP

Easily program the drive via the local control panel (LCP).

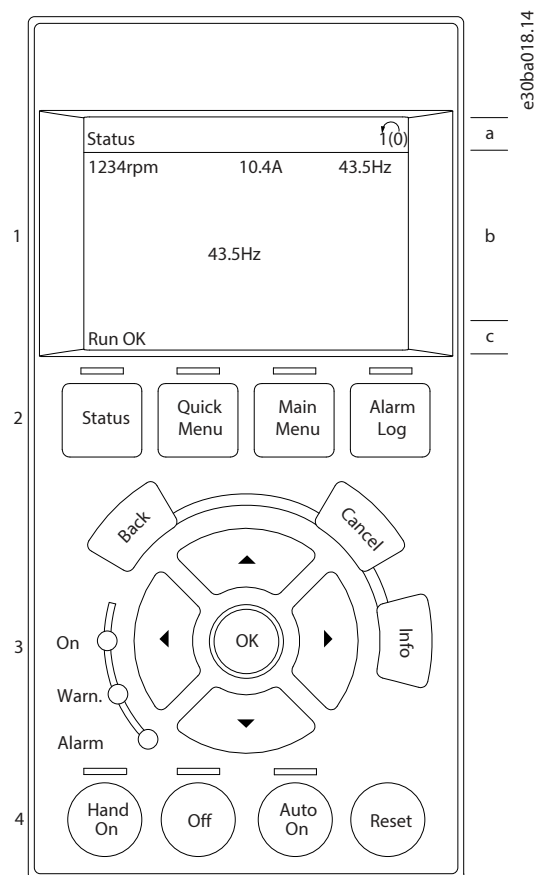


Figure 9: The LCP

1	Graphical display with status lines.	2	Menu keys and indicator lights - changing parameters and switching between display functions.
3	Navigation keys and indicator lights.	4	Operation keys and indicator lights.
a	Status line: Status message showing icons and graphics.	b	Line 1–2: Operator data lines showing data defined or selected. Add up to 1 extra line by pressing [Status].
c	Status line: Status messages showing text.		

The LCP display can show up to 5 items of operating data while showing *Status*.



NOTE: If start-up is delayed, the LCP shows the INITIALIZING message until it is ready. Adding or removing options can delay the start-up.

4.1.2 LCD Display

The display has backlight and a total of 6 alpha-numeric lines. The display lines show the direction of rotation (arrow), the selected setup, and the programming setup. The display is divided into 3 sections.

Top section

The top section shows up to 2 measurements in normal operating status.



NOTE: The EM-x number in the middle of the top line indicates the active setup in parameter groups **24-0x Emergency Mode** and **24-4x Emergency Mode 2**. The active emergency mode setup can also be read in parameter **0-17 Active Emergency Setup**.

Middle section

The top line shows up to 5 measurements with related unit, regardless of status (except in the case of alarm/warning).

Bottom section

The bottom section always shows the state of the drive in *Status* mode.

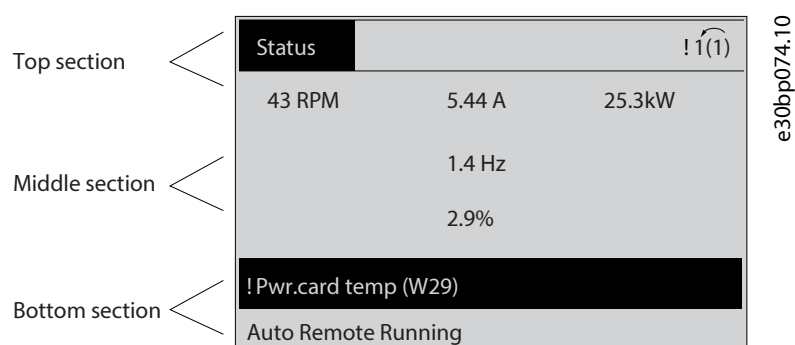


Figure 10: Overview of the Display

The active setup (selected as the active setup in parameter **0-10 Active Set-up**) is shown. When programming another setup than the active setup, the number of the programmed setup appears to the right.

Display contrast adjustment

Press [Status] and [▲] for darker display.

Press [Status] and [▼] for brighter display.

Most parameter setups can be changed immediately via the LCP, unless a password has been created via parameter **0-60 Main Menu Password** or via parameter **0-65 Quick Menu Password**.

Indicator lights

If certain threshold values are exceeded, the alarm and/or warning indicator lights up. A status and alarm text appear on the LCP. The ON indicator light is activated when the drive receives mains voltage, via a DC bus terminal, or 24 V external supply. At the same time, the back indicator light is on.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.

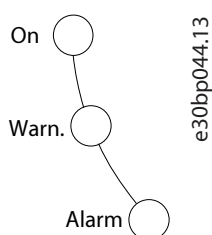


Figure 11: Indicator Lights

4.1.3 LCP Keys

Control keys

The control keys are divided into functions. The keys below the display and indicator lights are used for parameter setup, including option of display indication during normal operation.

Table 2: LCP Keys and Description

LCP keys	Description
[Status]	Indicates the status of the drive and/or the motor. Select between 3 different readouts by pressing [Status]: 5 line readouts, 4 line readouts, or smart logic control. Press [Status] for selecting the mode of display or for changing back to display mode from either the quick menu mode, the main menu mode, or the alarm mode. Also use [Status] to toggle single or double readout mode.
[Quick Menu]	Allows quick access to different quick menus such as: • My personal menu • Quick set-up • Function set-ups • SmartStart • Changes made • Loggings • Water and pumps Press [Quick Menu] to program the parameters belonging to the Quick Menu. It is possible to switch directly between quick menu mode and main menu mode.
[Main Menu]	Use the main menu for programming all parameters. It is possible to switch directly between main menu mode and quick menu mode. Parameter shortcut can be carried out by pressing down [Main Menu] for 3 s. The parameter shortcut allows direct access to any parameter.
[Alarm Log]	Shows an alarm list of the 5 latest alarms (numbered A1–A5). To obtain more details about an alarm, press the navigation keys to maneuver to the alarm number and press [OK]. Information about the condition of the drive before it enters the alarm mode is shown.
[Back]	Returns to the previous step or layer in the navigation structure.
[Cancel]	Last change or command is canceled as long as the display has not been changed.

Table 2: LCP Keys and Description - (continued)

LCP keys	Description
[Info]	Supplies information about a command, parameter, or function in any display window. <i>[Info]</i> provides detailed information whenever help is needed. Exit info mode by pressing either <i>[Info]</i> , <i>[Back]</i> , or <i>[Cancel]</i> .
Navigation keys	The 4 navigation keys are used to navigate between the different options available in Quick Menu, Main Menu, and Alarm Log. Press the keys to move the cursor.
[OK]	Press to select a parameter marked by the cursor and to enable the change of a parameter.

Local control keys

Local control keys are at the bottom of the control panel.

Table 3: Local Control Keys and Description

LCP keys	Description
[Hand On]	Enables control of the drive via the LCP. <i>[Hand On]</i> also starts the motor, and it is now possible to enter the motor speed data with the navigation keys. The key can be selected as <i>[1] Enable</i> or <i>[0] Disable via parameter 0-40 [Hand On] Key on LCP</i>. External stop signals activated with control signals or a fieldbus override a start command via the LCP. The following control signals are still active when <i>[Hand On]</i> is activated: • <i>[Hand On]</i> - <i>[Off]</i> - <i>[Auto On]</i> • Reset • Coast stop inverse • Setup select bit 0 - Setup select bit 1 • Stop command from serial communication • Quick stop • DC brake
[Off]	Stops the connected motor. The key can be selected as <i>[1] Enable</i> or <i>[0] Disable via parameter 0-41 [Off] Key on LCP</i>. If the external stop function is not selected and the <i>[Off]</i> key is inactive, the motor can be stopped by disconnecting the voltage.

Table 3: Local Control Keys and Description - (continued)

LCP keys	Description
[Auto On]	Enables the drive to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the drive starts. The key can be selected as [1] Enable or [0] Disable via parameter 0-42 [Auto On] Key on LCP.  NOTE: An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand On] – [Auto On].
[Reset]	Use [Reset] for resetting the drive after an alarm (trip). It can be selected as [1] Enable or [0] Disable via parameter 0-43 [Reset] Key on LCP. The parameter shortcut can be carried out by pressing down the [Main Menu] key for 3 s. The parameter shortcut provides direct access to any parameter.

4.1.4 Quick Transfer of Parameter Settings between Multiple Drives

When setup of a drive is completed, store the data in the LCP. Then connect the LCP to another drive and copy the parameter settings to the new drive.

4.1.5 Transferring Data

4.1.5.1 Transferring Data from the Drive to the LCP

1. Go to parameter **0-50 LCP Copy**.
2. Press **[OK]**
3. Select **[1] All to LCP**.
4. Press **[OK]**.

4.1.5.2 Transferring Data from the LCP to the Drive

1. Go to parameter **0-50 LCP Copy**.
2. Press **[OK]**.
3. Select **[2] All from LCP**.
4. Press **[OK]**.

4.1.6 Display Mode

In normal operation, up to 5 different operating variables can be indicated continuously in the middle section: 1.1, 1.2, and 1.3, as well as 2 and 3.

4.1.7 Display Mode - Selection of Readouts

It is possible to toggle between 3 status readout screens by pressing **[Status]**.

Operating variables with different formatting are shown in each status view (status view I, status view II, and status view III).

Refer to [Table 4](#) to see the measurements that can be linked to each of the operating variables. When options are mounted, more measurements are available.

Define the links:

- Parameter **0-20 Display Line 1.1 Small**.
- Parameter **0-21 Display Line 1.2 Small**.
- Parameter **0-22 Display Line 1.3 Small**.
- Parameter **0-23 Display Line 2 Large**.
- Parameter **0-24 Display Line 3 Large**.

Access the parameters via [Quick Menu], Q3 Function Set-ups, Q3-1 General Settings, Q3-11 Display Settings.

Each readout parameter selected in parameter **0-20 Display Line 1.1 Small** to parameter **0-24 Display Line 3 Large** has its own scale and digits after a possible decimal point. The larger the numeric value of parameter is, the fewer digits are shown after the decimal point.

Example: Current readout 5.25 A, 15.2 A, 105 A.

Table 4: Units

Operating variable	Unit
Parameter 16-00 Control Word	hex
Parameter 16-01 Reference [Unit]	[Unit]
Parameter 16-02 Reference [%]	%
Parameter 16-03 Status Word	hex
Parameter 16-05 Main Actual Value [%]	%
Parameter 16-06 Actual Position	
Parameter 16-09 Custom Readout	
Parameter 16-10 Power [kW]	[kW]
Parameter 16-11 Power [hp]	[hp]
Parameter 16-12 Motor Voltage	[V]
Parameter 16-13 Frequency	[Hz]
Parameter 16-14 Motor current	[A]
Parameter 16-15 Frequency [%]	%
Parameter 16-16 Torque [Nm]	Nm
Parameter 16-17 Speed [RPM]	[RPM]
Parameter 16-18 Motor Thermal	%
Parameter 16-20 Motor Angle	
Parameter 16-21 Torque [%] High Res.	%
Parameter 16-22 Torque [%]	%
Parameter 16-23 Motor Shaft Power [kW]	kW
Parameter 16-24 Calibrated Stator Resistance	Ω
Parameter 16-25 Torque [Nm] High	Nm
Parameter 16-30 DC Link Voltage	V
Parameter 16-32 Brake Energy /s	kW
Parameter 16-33 Brake Energy Average	kW
Parameter 16-34 Heatsink Temp.	°C

Table 4: Units - (continued)

Operating variable	Unit
Parameter 16-35 Inverter Thermal	%
Parameter 16-36 Inv. Nom. Current	A
Parameter 16-37 Inv. Max. Current	A
Parameter 16-38 SL Controller State (This is an array parameter with the selections 16-38.0–16-38.3).	
Parameter 16-39 Control Card Temp.	°C
Parameter 16-40 Logging Buffer Full	
Parameter 16-42 Service Log Counter	
Parameter 16-43 Timed Actions Status	
Parameter 16-45 Motor Phase U Current	A
Parameter 16-46 Motor Phase V Current	A
Parameter 16-47 Motor Phase W Current	A
Parameter 16-48 Speed Ref. After Ramp [RPM]	RPM
Parameter 16-49 Current Fault Source	
Parameter 16-50 External Reference	
Parameter 16-51 Pulse Reference	
Parameter 16-52 Feedback[Unit]	[Unit]
Parameter 16-53 Digi Pot Reference	
Parameter 16-57 Feedback [RPM]	RPM
Parameter 16-60 Digital Input	bin
Parameter 16-61 Terminal 53 Switch Setting	V
Parameter 16-62 Analog Input 53	
Parameter 16-63 Terminal 54 Switch Setting	V
Parameter 16-64 Analog Input 54	
Parameter 16-65 Analog Output 42 [mA]	[mA]
Parameter 16-66 Digital Output [bin]	[bin]
Parameter 16-67 Pulse Input #29 [Hz]	[Hz]
Parameter 16-68 Freq. Input #33 [Hz]	[Hz]
Parameter 16-69 Pulse Output #27 [Hz]	[Hz]
Parameter 16-70 Pulse Output #29 [Hz]	[Hz]
Parameter 16-71 Relay Output [bin]	
Parameter 16-72 Counter A	
Parameter 16-73 Counter B	
Parameter 16-74 Prec. Stop Counter	
Parameter 16-80 Fieldbus CTW 1	hex
Parameter 16-82 Fieldbus REF 1	hex
Parameter 16-84 Comm. Option STW	hex

Table 4: Units - (continued)

Operating variable	Unit
Parameter 16-85 FC Port CTW 1	hex
Parameter 16-86 FC Port REF 1	hex
Parameter 16-87 Bus Readout Alarm/Warning (This is an array parameter with the selections 16-87.0–16.87.2).	
Parameter 16-88 Fieldbus Torque FF.	
Parameter 16-89 Configurable Alarm/Warning Word	
Parameter 16-90 Alarm Word	hex
Parameter 16-92 Warning Word	hex
Parameter 16-93 Warning Word 2	hex
Parameter 16-94 Ext. Status Word	hex
Parameter 16-95 Ext. Status Word 2	hex
Parameter 16-96 Maintenance Word	hex
Parameter 16-97 Alarm Word 3	hex
Parameter 16-98 Warning Word 3	hex

4.1.8 Status Views

4.1.8.1 Status View I

The readout state is standard after start-up or initialization. Press [Info] to obtain information about the units linked to the shown operating variables (1.1, 1.2, 1.3, 2, and 3). See the operating variables in the following illustration.

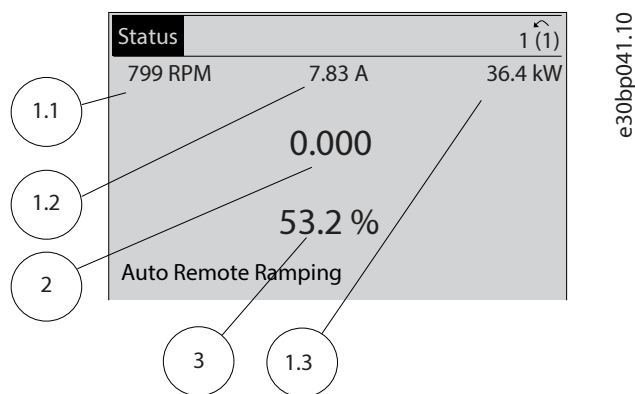


Figure 12: Status View I

4.1.8.2 Status View II

See the operating variables (1.1, 1.2, 1.3, and 2) shown in the following illustration. In the example, speed, motor current, motor power, and frequency are selected in the 1st and 2nd lines.

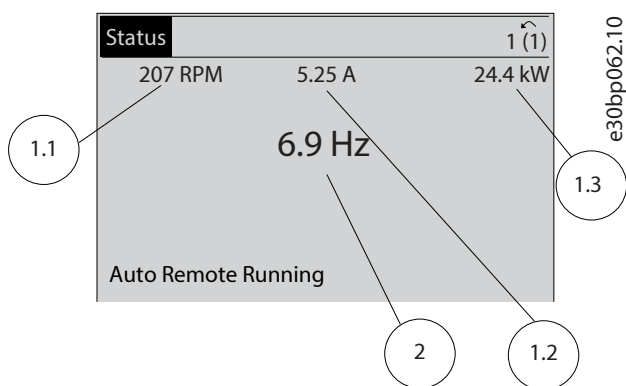


Figure 13: Status View II

4.1.8.3 Status View III

This state shows the event and action of the smart logic control.

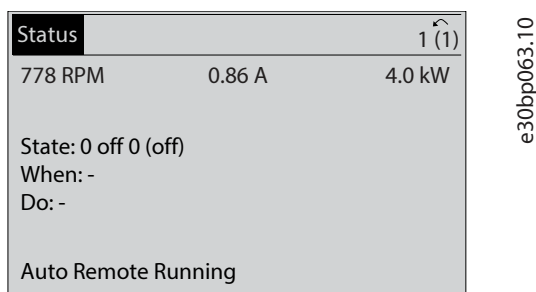


Figure 14: Status View III

4.1.9 Quick Menu Key Functions

Press [Quick Menu] to enter a list of different areas contained in the Quick Menu.

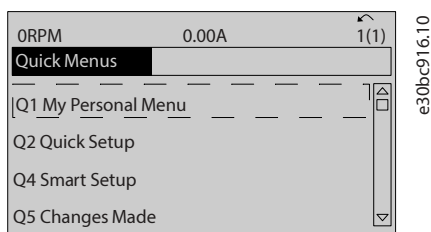


Figure 15: Quick Menu

Select *Q1 My Personal Menu* to show the selected personal parameters. These parameters are selected in parameter **0-25 My Personal Menu**. Up to 50 different parameters can be added in this menu.

Select *Q2 Quick Setup* to go through a selection of parameters to get the motor running almost optimally. The default settings for the other parameters consider the required control functions and the configuration of signal inputs/outputs (control terminals).

Parameters are selected via the navigation keys. The parameters in [Table 5](#) are accessible.

Table 5: Selection of Parameter

Parameter	Setting
Parameter 0-01 <i>Language</i>	Select the language. Default is [0] <i>English</i> .
Parameter 1-20 <i>Motor Power [kW]</i>	[kW]
Parameter 1-22 <i>Motor Voltage</i>	[V]
Parameter 1-23 <i>Motor Frequency</i>	[Hz]
Parameter 1-24 <i>Motor Current</i>	[A]
Parameter 1-25 <i>Motor Nominal Speed</i>	[RPM]
Parameter 5-12 <i>Terminal 27 Digital Input</i>	[0] <i>No function</i>
Parameter 1-29 <i>Automatic Motor Adaptation (AMA)</i>	[1] <i>Enable complete AMA</i>
Parameter 3-02 <i>Minimum Reference</i>	[RPM]
Parameter 3-03 <i>Maximum Reference</i>	[RPM]
Parameter 3-41 <i>Ramp 1 Ramp Up Time</i>	[s]
Parameter 3-42 <i>Ramp 1 Ramp Down Time</i>	[s]
Parameter 3-13 <i>Reference Site</i>	Select whether to control the drive via digital inputs, LCP, or remote control.

1) If terminal 27 is set to [0] *No operation*, no connection to +24 V on terminal 27 is necessary.

Select *Changes made* to get the information about:

- The last 10 changes. Use the [▲] [▼] navigation keys to scroll between the last 10 changed parameters.
- The changes made since default setting.

Select *Loggings* to get information about the shown line readouts. The information is shown as graphs. Only parameters selected in parameter 0-20 *Display Line 1.1 Small* and parameter 0-24 *Display Line 3 Large* can be viewed. It is possible to store up to 120 samples in the memory for later reference.

4.1.10 Q2 Quick Setup

The parameters can easily be set up for most applications only by using the Quick Setup. After pressing [Quick Menu], the different options in the Quick Menu are listed.

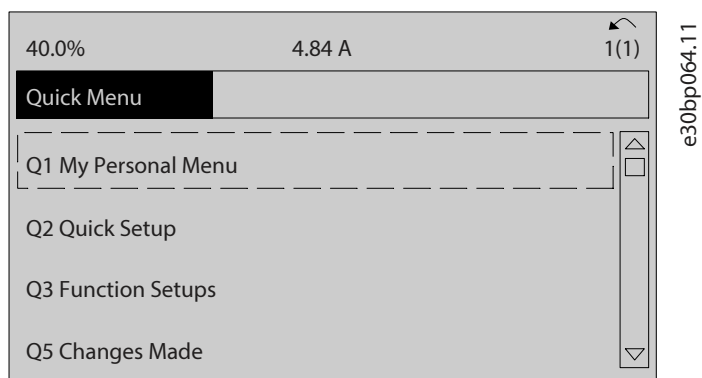


Figure 16: Quick Menu View

The Quick Setup provides access to the 18 most important setups in the drive.

Table 6: Quick Setup Parameters

Parameter		[Unit]
Parameter 0-01 <i>Language</i>		
Parameter 1-20 <i>Motor Power [kW]</i>		[kW]
Parameter 1-21 <i>Motor Power [HP]</i>		[hp]
Parameter 1-22 <i>Motor Voltage</i> ⁽¹⁾		[V]
Parameter 1-23 <i>Motor Frequency</i>		[Hz]
Parameter 1-24 <i>Motor Current</i>		[A]
Parameter 1-25 <i>Motor Nominal Speed</i>		[RPM]
Parameter 1-28 <i>Motor Rotation Check</i>		[Hz]
Parameter 3-41 <i>Ramp 1 Ramp Up Time</i>		[s]
Parameter 3-42 <i>Ramp 1 Ramp Down Time</i>		[s]
Parameter 4-11 <i>Motor Speed Low Limit [RPM]</i>		[RPM]
Parameter 4-12 <i>Motor Speed Low Limit [Hz]</i> ⁽¹⁾		[Hz]
Parameter 4-13 <i>Motor Speed High Limit [RPM]</i>		[RPM]
Parameter 4-14 <i>Motor Speed High Limit [Hz]</i> ⁽¹⁾		[Hz]
Parameter 3-19 <i>Jog Speed [RPM]</i>		[RPM]
Parameter 3-11 <i>Jog Speed [Hz]</i> ⁽¹⁾		[Hz]
Parameter 5-12 <i>Terminal 27 Digital Input</i>		
Parameter 5-40 <i>Function Relay</i>		

1) The information shown in the display depends on the selections made in parameter 0-02 *Motor Speed Unit* and parameter 0-03 *Regional Settings*. The default settings of parameter 0-02 *Motor Speed Unit* and parameter 0-03 *Regional Settings* depend on which region of the world the drive is supplied to, but can be reprogrammed as required.

2) Parameter 5-40 *Function Relay* is an array. Select between [0] *Relay1* or [1] *Relay2*. Standard setting is [0] *Relay1* with the default option [9] *Alarm*.



NOTE: If [0] *No Operation* is selected in parameter 5-12 *Terminal 27 Digital Input*, start can be enabled without connecting +24 V on terminal 27.

4.1.11 Programming in the Quick Setup

This procedure shows an example of how to program the ramp-down time in the Quick Setup.

Procedure

1. Select *Quick Setup*.



Parameter 0-01 *Language* appears in Quick Setup.

2. Press [▼] repeatedly until parameter 3-42 *Ramp 1 Ramp Down Time* appears with the default setting of 20 s.
3. Press [OK].
4. Press [◀] to highlight the 3rd digit before the comma.
5. Change 0 to 1 by pressing [▲].

6. Press [▶] to highlight the digit 2.
7. Change 2 to 0 by pressing [▼].
8. Press [OK].

➡ The new ramp-down time is now set to 100 s.

4.1.12 Q3 Function Set-ups

The Function Set-ups provide quick access to all parameters required for most water and wastewater applications, including:

- Variable torque
- Constant torque
- Pumps
- Dosing pumps
- Well pumps
- Booster pumps
- Mixer pumps
- Aeration blowers

The Function Set-up parameters are grouped as follows:

- Other pumps
- Fan applications

Among other features, the Function Set-ups also include parameters for selecting the following:

- Which variables to show on the LCP.
- Digital preset speeds.
- Scaling of analog references.
- Closed-loop single-zone and multi-zone applications.
- Specific functions related to water.
- Wastewater applications.

4.1.13 Function Set-ups Overview

4.1.13.1 Function Set-up Q3-1 General Settings

Table 7: Q3-1 General Settings

Q3-1 General settings			
Q3-10 Clock settings	Q3-11 Display settings	Q3-12 Analog output	Q3-13 Relays
Parameter 0-70 <i>Date and Time</i>	Parameter 0-20 <i>Display Line 1.1 Small</i>	Parameter 6-50 <i>Terminal 42 Output</i>	Relay 1 ⇒ Parameter 5-40 <i>Function Relay</i>
Parameter 0-71 <i>Date Format</i>	Parameter 0-21 <i>Display Line 1.2 Small</i>	Parameter 6-51 <i>Terminal 42 Output Min Scale</i>	Relay 2 ⇒ Parameter 5-40 <i>Function Relay</i>
Parameter 0-72 <i>Time Format</i>	Parameter 0-22 <i>Display Line 1.3 Small</i>	Parameter 6-52 <i>Terminal 42 Output Max Scale</i>	Option relay 7 ⇒ Parameter 5-40 <i>Function Relay</i>
Parameter 0-74 <i>DST/Summertime</i>	Parameter 0-23 <i>Display Line 2 Large</i>	–	Option relay 8 ⇒ Parameter 5-40 <i>Function Relay</i>

Table 7: Q3-1 General Settings - (continued)

Q3-1 General settings			
Q3-10 Clock settings	Q3-11 Display settings	Q3-12 Analog output	Q3-13 Relays
Parameter 0-76 <i>DST/Summertime Start</i>	Parameter 0-24 <i>Display Line 3 Large</i>	–	Option relay 9 ⇒ Parameter 5-40 <i>Function Relay</i>
Parameter 0-77 <i>DST/Summertime End</i>	Parameter 0-37 <i>Display Text 1</i>	–	–
–	Parameter 0-38 <i>Display Text 2</i>	–	–
–	Parameter 0-39 <i>Display Text 3</i>	–	–

4.1.13.2 Function Set-up Q3-2 Open-loop Settings

Table 8: Q3-2 Open-loop Settings

Q3-2 Open-loop settings	
Q3-20 Digital reference	Q3-21 Analog reference
Parameter 3-02 <i>Minimum Reference</i>	Parameter 3-02 <i>Minimum Reference</i>
Parameter 3-03 <i>Maximum Reference</i>	Parameter 3-03 <i>Maximum Reference</i>
Parameter 3-10 <i>Preset Reference</i>	Parameter 6-10 <i>Terminal 53 Low Voltage</i>
Parameter 5-13 <i>Terminal 29 Digital Input</i>	Parameter 6-11 <i>Terminal 53 High Voltage</i>
Parameter 5-14 <i>Terminal 32 Digital Input</i>	Parameter 6-14 <i>Terminal 53 Low Ref./Feedb. Value</i>
Parameter 5-15 <i>Terminal 33 Digital Input</i>	Parameter 6-15 <i>Terminal 53 High Ref./Feedb. Value</i>

4.1.13.3 Function Set-up Q3-3 Closed-loop Settings

Table 9: Q3-3 Closed-loop Settings

Q3-3 Closed-loop Settings	
Q3-30 Feedback settings	Q3-31 PID settings
Parameter 1-00 <i>Configuration Mode</i>	Parameter 20-81 <i>PID Normal/Inverse Control</i>
Parameter 20-12 <i>Reference/Feedback Unit</i>	Parameter 20-82 <i>PID Start Speed [RPM]</i>
Parameter 3-02 <i>Minimum Reference</i>	Parameter 20-21 <i>Setpoint 1</i>
Parameter 3-03 <i>Maximum Reference</i>	Parameter 20-93 <i>PID Proportional Gain</i>
Parameter 6-20 <i>Terminal 54 Low Voltage</i>	Parameter 20-94 <i>PID Integral Time</i>
Parameter 6-21 <i>Terminal 54 High Voltage</i>	–
Parameter 6-24 <i>Terminal 54 Low Ref./Feedb. Value</i>	–
Parameter 6-25 <i>Terminal 54 High Ref./Feedb. Value</i>	–
Parameter 6-00 <i>Live Zero Timeout Time</i>	–
Parameter 6-01 <i>Live Zero Timeout Function</i>	–

4.1.14 Quick Menu, Q4 SmartStart

SmartStart runs automatically on the 1st power-up of the drive or after a reset to factory settings. SmartStart guides users through a series of steps to ensure correct and most efficient motor control. SmartStart can also be started directly via the Quick Menu.

The following settings are available via SmartStart:

- Single pump/motor: In open loop or closed loop.
- Motor alternation: 2 motors share 1 drive.
- Basic cascade control: Speed control of a single pump in a multi-pump system. For example, this can be a cost-effective solution in booster sets.
- Master/follower: Control of up to 8 drives and pumps to ensure smooth operation of the overall pump system.

4.1.15 Main Menu Mode

Press [Main Menu] to enter the main menu mode. The readout in the following illustration appears on the display. The middle and bottom sections in the display show a list of parameter groups, which can be selected by toggling the [▲] and [▼] keys.

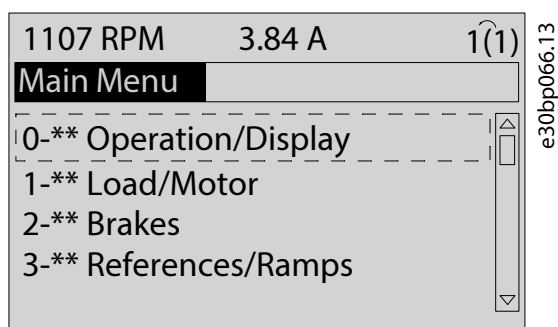


Figure 17: Main Menu Mode

Each parameter has a name and number which remain the same regardless of the programming mode. In the main menu mode, the parameters are divided into groups. The 1st digit of the parameter number (from the left) indicates the parameter group number.

All parameters can be changed in the Main Menu. However, depending on the choice of configuration (parameter **1-00 Configuration Mode**), some parameters can be hidden. For example, open loop hides all the PID parameters, and other enabled options make more parameter groups visible.

4.1.16 Parameter Selection

In the main menu mode, the parameters are divided into groups. Select a parameter group with the navigation keys.

After selecting a parameter group, select a parameter with the navigation keys.

The middle section on the display shows the parameter number and name, and the selected parameter value.

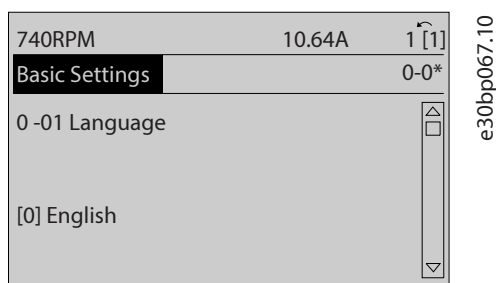


Figure 18: Parameter Selection

4.1.17 Changing Data

The procedure for changing data in the quick menu mode and the main menu mode is the same. Press [OK] to change the selected parameter.

The procedure for changing data depends on whether the selected parameter represents a numeric data value or a text value.

4.1.18 Changing a Text Value

If the selected parameter is a text value, change the text value with the [▲] [▼] keys.

Place the cursor on the value to save and press [OK].

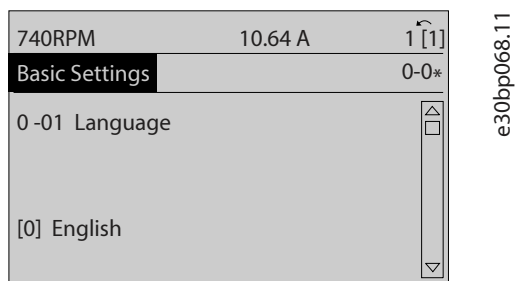


Figure 19: Changing a Text Value

4.1.19 Changing a Data Value

If the selected parameter shows a numeric data value, change the selected data value with the [◀] [▶] and the [▲] [▼] navigation keys. Press the [◀] [▶] keys to move the cursor horizontally.

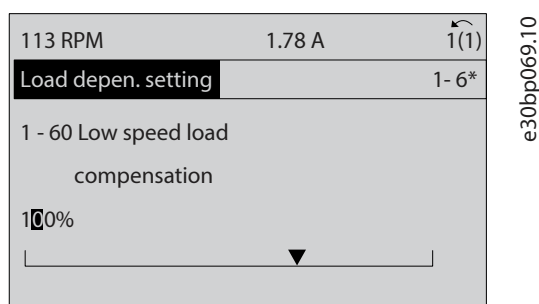


Figure 20: Changing a Data Value

Press the [▲] [▼] keys to change the data value. [▲] increases the data value, and [▼] decreases the data value. Place the cursor on the value to save and press [OK].

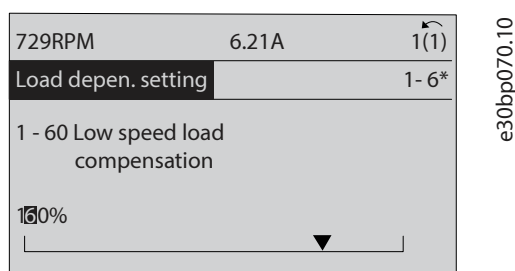


Figure 21: Saving a Data Value

4.1.20 Infinitely Variable Change of Numeric Data Value

If the selected parameter shows a numeric data value, select a digit with [◀] [▶].

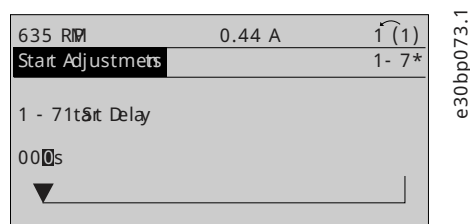


Figure 22: Selecting a Digit

Change the selected digit infinitely variably with [▲] [▼]. The cursor indicates the selected digit. Place the cursor on the digit to save and press [OK].

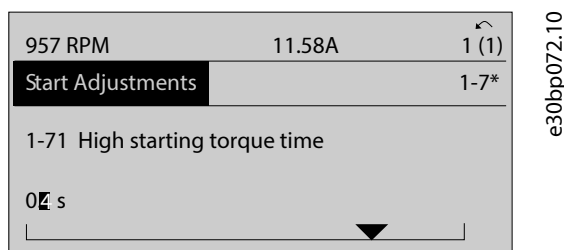


Figure 23: Saving

4.1.21 Value, Step by Step

Certain parameters can be changed step by step. This applies to:

- Parameter **1-20 Motor Power [kW]**.
- Parameter **1-22 Motor Voltage**.
- Parameter **1-23 Motor Frequency**.

The parameters are changed both as a group of numeric data values and as numeric data values that are infinitely varying.

4.1.22 Readout and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack. Parameter **15-30 Fault Log: Error Code** to parameter **15-32 Alarm Log: Time** contain a fault log, which can be read out. Select a parameter, press [OK], and press the [▲] [▼] keys to scroll through the value log.

4.1.23 Changing Values of Indexed Parameters

Change parameter **3-10 Preset Reference** as an example.

Procedure

1. Select the parameter, press [OK], and press [▲] [▼] to scroll through the indexed values.
2. To change the parameter value, select the indexed value and press [OK].
3. Change the value by pressing [▲] [▼].
4. Press [OK] to accept the new setting.
5. Press [Cancel] to abort. Press [Back] to leave the parameter.

4.2 The Numerical Control Panel

4.2.1 Overview of the Numerical LCP

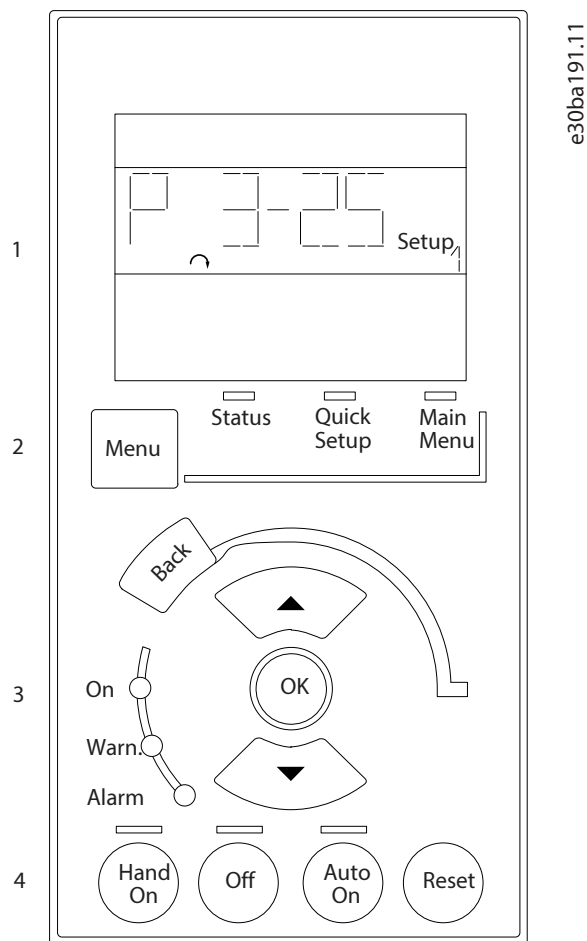


Figure 24: NLCP

1	Numeric display.	2	Menu keys and indicator lights - changing parameters and switching between display functions.
3	Navigation keys and indicator lights.	4	Operation keys and indicator lights.

Display line

Status messages showing icons and numeric value.

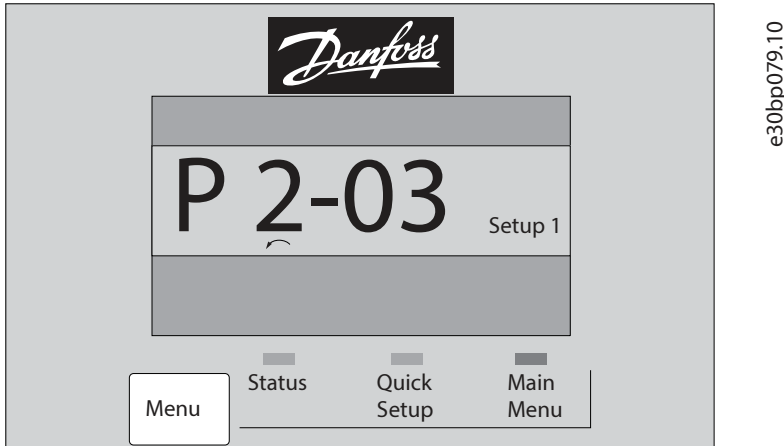
Indicator lights

- Green LED/On: indicates if control section is on.
- Yellow LED/Wrn: indicates a warning.
- Flashing red LED/Alarm: indicates an alarm.

4.2.2 LCP Keys, Numerical LCP

The control keys are divided into functions. The keys below the display and indicator lights are used for parameter setup, including option of display indication during normal operation.

Table 10: LCP Keys and Description

LCP keys	Description
[Status]	Indicates the status of the drive and/or the motor. If an alarm occurs, the NLCP automatically switches to status mode. Several alarms can be shown.  NOTE: Parameter copy is not possible with LCP 101 numerical local control panel.  Figure 25: Status Mode  Figure 26: Alarm
[Quick Menu]/[Main Menu]	Used for programming the parameters in the Quick Menu and Main Menu, respectively. When the value flashes, press [▲] or [▼] to change parameter values. Parameters with functional options show values such as [1], [2], and so on. For a description of the different options, see the individual parameter descriptions in the section <i>Parameter Descriptions</i>.  Figure 27: Main Menu/Quick Setup
[Back]	Returns to the previous step or layer in the navigation structure.
Navigation keys	The 2 navigation keys are used to navigate between the different options available in Quick Menu and Main Menu. Press the keys to move the cursor.
[OK]	Press to select a parameter marked by the cursor and to enable the change of a parameter.

Local control keys: Local control keys are at the bottom of the control panel.

Table 11: Local Control Keys and Description

LCP keys	Description
[Hand On]	Enables control of the drive via the LCP. [Hand On] also starts the motor, and it is now possible to enter the motor speed data with the navigation keys. The key can be selected as [1] Enable or [0] Disable via parameter 0-40 [Hand on] Key on LCP. External stop signals activated with control signals or a fieldbus override a start command via the LCP. The following control signals are still active when [Hand On] is activated: • [Hand On] - [Off] - [Auto On] • Reset • Coast stop inverse • Reversing • Setup select lsb - Setup select msb • Stop command from serial communication • Quick stop • DC brake
[Off]	Stops the connected motor. The key can be selected as [1] Enable or [0] Disable via parameter 0-41 [Off] Key on LCP. If the external stop function is not selected and the [Off] key is inactive, the motor can be stopped by disconnecting the voltage.
[Auto On]	Enables the drive to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals and/or the bus, the drive starts. The key can be selected as [1] Enable or [0] Disable via parameter 0-42 [Auto on] Key on LCP.  NOTE: An active HAND-OFF-AUTO signal via the digital inputs has higher priority than the control keys [Hand On] – [Auto On].
[Reset]	Is used for resetting the drive after an alarm (trip). It can be selected as [1] Enable or [0] Disable via parameter 0-43 [Reset] key on LCP.

4.3 Restoring Factory Default Settings

4.3.1 Restoring Factory Default Settings Using the Recommended Initialization

NOTICE

LOSS OF DATA

Restoring default settings results in a loss of programming, motor data, localization, and monitoring records.

- To create a backup, upload data to the LCP before initialization.

1. Press [Main Menu] twice to access parameters.
2. Go to parameter **14-22 Operation Mode** and press [OK].

Parameter **14-22 Operation Mode** does not reset the following settings:

- Running hours.
- Serial communication options.
- Personal menu settings.
- Fault log, alarm log, and other monitoring functions.

3. Scroll to *Initialization* and press [OK].
4. Remove power to the unit and wait for the display to turn off.
5. Apply power to the unit. Default parameter settings are restored during start-up. Start-up takes slightly longer than normal.
6. After *alarm 80, Drive initialized* appears, press [Reset].

4.3.2 Restoring Factory Default Settings Using Manual Initialization

NOTICE

LOSS OF DATA

Restoring default settings results in a loss of programming, motor data, localization, and monitoring records.

- To create a backup, upload data to the LCP before initialization.



NOTE: A manual initialization also resets serial communication, RFI filter settings, and fault log settings.

Procedure

1. Remove power to the unit and wait for the display to turn off.
2. Press and hold [Status], [Main Menu], and [OK] simultaneously while applying power to the unit (approximately 5 s or until an audible click sounds and the fan starts).

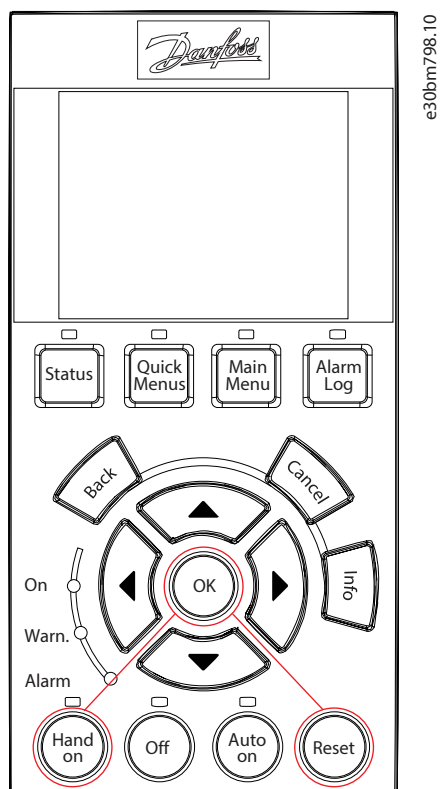
Manually initializing does not reset the following parameter settings:

- Parameter **15-00 Operating Hours**
- Parameter **15-03 Power Up's**
- Parameter **15-04 Over Temp's**
- Parameter **15-05 Over Volt's**

Start-up takes slightly longer than normal.

4.3.3 Resetting all Parameters

1. Press [Hand on]+[OK]+[Reset] simultaneously.



➞ All parameters are reset and the security file is deleted.

5 Parameter Descriptions

5.1 Selecting Parameters

The parameters are grouped into various parameter groups for easy selection of the correct parameter for optimal operation of the drive.

Parameter descriptions and selections are shown in the LCP. Access the parameters by pressing [Quick Menu] or [Main Menu] on the LCP. The Quick Menu is used mainly for commissioning the unit at start-up by providing parameters necessary to start operation. The Main Menu provides access to all parameters for detailed application programming.

All digital input/output and analog input/output terminals are multi-functional. All terminals have factory setting functions suitable for a wide range of relevant applications. If other special functions are required, they must be programmed in parameter groups **5-** Digital In/Out** or **6-** Analog In/Out**.

An asterisk (*) following an option number in a parameter indicates a default setting.

5.2 Parameter Group 0-** Operation and Display

5.2.1 Introduction to Parameter Group 0-** Operation and Display

Parameters related to the basic functions of the drive, function of the LCP keys, and configuration of the LCP display.

5.2.2 0-0* Basic Settings

0-01 Language

Default value:	[0] English	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Defines the language to be used in the display. The drive is delivered with 4 different language packages. English and German are included in all packages. English cannot be erased or manipulated.

Option	Name	Description
[0]*	English	Part of language packages 1–4.
[1]	Deutsch	Part of language packages 1–4.
[2]	Français	Part of language package 1.
[3]	Dansk	Part of language package 1.
[4]	Español	Part of language package 1.
[5]	Italiano	Part of language package 1.
[6]	Svenska	Part of language package 1.
[7]	Nederlands	Part of language package 1.
[10]	Chinese	Part of language package 2.
[20]	Suomi	Part of language package 1.
[22]	English US	Part of language package 4.
[27]	Greek	Part of language package 4.
[28]	Bras. Port	Part of language package 4.
[36]	Slovenian	Part of language package 3.
[39]	Korean	Part of language package 2.

Option	Name	Description
[40]	Japanese	Part of language package 2.
[41]	Turkish	Part of language package 4.
[42]	Trad.Chinese	Part of language package 2.
[43]	Bulgarian	Part of language package 3.
[44]	Srpski	Part of language package 3.
[45]	Romanian	Part of language package 3.
[46]	Magyar	Part of language package 3.
[47]	Czech	Part of language package 3.
[48]	Polski	Part of language package 4.
[49]	Russian	Part of language package 3.
[50]	Thai	Part of language package 2.
[51]	Bahasa Indonesia	Part of language package 2.
[52]	Hrvatski	Part of language package 2.

0-02 Motor Speed Unit

Default value:	[0] RPM	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Changing the motor speed unit resets certain parameters to their initial value. Select the motor speed unit before modifying other parameters.

The information shown in the display depends on the settings in parameter **0-02 Motor Speed Unit** and parameter **0-03 Regional Settings**. The default settings of parameter **0-02 Motor Speed Unit** and parameter **0-03 Regional Settings** depend on the region to which the drive is supplied.

Option	Name	Description
[0]*	RPM	Select to show motor speed variables and parameters using motor speed (RPM).
[1]	Hz	Select to show motor speed variables and parameters using output frequency (Hz).

0-03 Regional Setting

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

The display output depends on the settings in parameter **0-02 Motor Speed Unit** and parameter **0-03 Regional Settings**. The default settings of parameter **0-02 Motor Speed Unit** and parameter **0-03 Regional Settings** depend on which region of the world the frequency converter is supplied to. Reprogram the settings as required. The settings not used are made invisible.

Option	Name	Description
[0]	International	Activate parameter 1-20 Motor Power [kW] for setting the motor power in kW and set the default value of parameter 1-23 Motor Frequency to 50 Hz.
[1]	North America	Activate parameter 1-21 Motor Power [HP] for setting the motor power in hp and set the default value of parameter 1-23 Motor Frequency to 60 Hz.

0-04 Operating State at Power-up (Hand)

Default value:	[0] Resume	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the operating mode upon reconnection of the drive to mains voltage after power-down in hand-on mode.

Option	Name	Description
[0]*	Resume	Restart the drive, maintaining the start/stop settings (applied by <i>[Hand On]/[Off]</i>) selected before the power-down of the drive.
[1]	Forced stop, ref=old	Restart the drive with a saved local reference after mains voltage reappears and after pressing <i>[Hand On]</i> .

0-05 Local Mode Unit

Default value:	[0] As motor speed	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data Type:	Uint8	Change during operation:	False

This parameter defines if the local reference unit should be shown as the motor shaft speed (in RPM/Hz) or as percent.

Option	Name	Description
[0]*	As motor speed unit	
[1]	%	

5.2.3 0-1* Set-up Operations

Define and control the individual parameter setups. The drive has 4 parameter setups that can be programmed independently of each other. This makes the drive flexible in use and able to meet the requirements of many different water system control schemes, often saving the cost of external control equipment. For example, the setups can be used to program the drive to operate according to 1 control scheme in 1 setup and another control scheme in another setup. Alternatively, they can be used by an air handling unit or an OEM unit to identically program all their factory-fitted drives for different equipment models within a range to have the same parameters. During production/commissioning, select a specific setup depending on the drive model. Select the active setup (the setup in which the drive is operating) in parameter **0-10 Active Set-up**. The LCP then shows the selected active setup. Using multi

setup, it is possible to switch between setups when the drive running or stopped, via digital input, or serial communication commands (for example, for night setback). If it is necessary to change setups while running, ensure that parameter **0-12 This Set-up Linked to** is programmed as required. For most water/wastewater applications, it is not necessary to program parameter **0-12 This Set-up Linked to** even if change of setup is required when running. However, for complex applications using the full flexibility of the multiple setups, it may be required. Using parameter **0-11 Programming Set-up**, it is possible to edit parameters within any of the setups while continuing the drive operation in the active setup. The active setup can be a different setup to the one being edited. Using parameter **0-51 Set-up Copy**, it is possible to copy parameter settings between the setups to enable quicker commissioning if similar parameter settings are required in different setups.

0-10 Active Set-up

Default value:	[1] Set-up 1	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the setup to control the drive functions.

Option	Name	Description
[0]	Factory setup	Cannot be changed. It contains the data set and can be used as a data source when returning the other setups to a known state.
[1]*	Set-up 1	[1] Set-up 1 to [4] Set-up 4 are the 4 separate parameter setups within which all parameters can be programmed.
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]	Multi Set-up	Remote setup selections using digital inputs and the serial communication port. This setup used the settings from parameter 0-12 This Set-up Linked to . Stop the drive before making changes to open-loop and closed-loop functions.

0-11 Edit Set-up

Default value:	[9] Active set-up	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the setup to be edited (that is programmed) during operation, either the active setup or 1 of the inactive setups.

Option	Name	Description
[0]	Factory setup	Cannot be edited, but it is useful as a data source to return the other setups to a known state.
[1]	Set-up 1	[1] Set-up 1 to [4] Set-up 4 can be edited freely during operation, independently of the active setup.
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]*	Active Set-up	Can also be edited during operation. Edit the selected setup from a range of sources: LCP, FC RS-485, FC USB, or up to 5 fieldbus sites.

0-12 This Set-up Linked to

Default value:	[0] Not linked	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

To enable conflict-free changes from 1 setup to another during operation, link setups containing parameters which are not changeable during operation. The link ensures synchronizing of the not changeable during operation-parameter values when moving from 1 setup to another during operation. Not changeable during operation-parameters can be identified by the label FALSE in the *Change during operation* field. Parameter **0-12 This Set-up Linked to** is used by **[9] Multi set-up** in parameter **0-10 Active Set-up**. Multi setup is used to move from 1 setup to another during operation.

Option	Name	Description
[0]*	Not linked	
[1]	Set-up 1	
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	

0-13 Readout: Linked Set-ups

Default value:	0	Parameter type:	Readout, Array [5]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

View a list of all the setups linked by parameter **0-12 This Set-up Linked to**. The parameter has 1 index for each parameter setup. The value for each index shows which setups are linked to that parameter setup.

Table 12: Setup Link Example

Index	LCP value
0	{0}
1	{1,2}
2	{1,2}
3	{3}
4	{4}

0-14 Readout: Edit Set-ups/Channel

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the setting of parameter **0-11 Edit Set-up** for each of the 4 different communication channels. When the number is shown as a hex number, as it is in the LCP, each number represents 1 channel. Numbers 1–4 represent a setup number; F means factory setting; and A means active setup. The channels are, from right to left: LCP, FC bus, USB, HPFB1-5.

0-15 Readout: Actual Setup

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

Makes it possible to read out the active setup, also when [9] *Multi Set-up* is selected in parameter 0-10 *Active Set-up*.

0-17 Active Emergency Setup

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

Read out the active emergency setup selected by either digital inputs or via fieldbus.

5.2.4 0-2* LCP Display

Define the variable shown in the LCP.



NOTE: For information on how to write display texts, refer to:

- Parameter 0-37 *Display Text 1*
- Parameter 0-38 *Display Text 2*
- Parameter 0-39 *Display Text 3*

0-20 Display Line 1.1 Small

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

Select a variable for display in line 1, left position.

Option	Name	Description
[0]	None	No display value selected.
[15]	Readout: actual setup	
[17]	Active emergency setup	
[37]	Display text 1	Enables an individual text string to be written for showing in the LCP or to be read via serial communication.
[38]	Display text 2	Enables an individual text string to be written for showing in the LCP or to be read via serial communication.
[39]	Display text 3	Enables an individual text string to be written for showing in the LCP or to be read via serial communication.
[89]	Date and time readout	Shows the current date and time.
[592]	Application bus control	
[953]	PROFIBUS Warning Word	Shows the PROFIBUS communication warnings.

Option	Name	Description
[1005]	Readout transmit error counter	Shows the number of CAN control transmission errors since the last power-up.
[1006]	Readout receive error counter	Shows the number of CAN control receipt errors since the last power-up.
[1007]	Readout bus off counter	Shows the number of bus off-events since the last power-up.
[1013]	Warning parameter	Shows a DeviceNet-specific warning word. One separate bit is assigned to every warning.
[1230]	Warning parameter	Shows the EtherNet/IP-specific status word.
[1397]	Alert alarm word	Shows the alert alarm word in hex code.
[1398]	Alert warning word	Shows the alert warning word in hex code.
[1399]	Alert status word	Shows the alert status word in hex code.
[1500]	Operating hours	Shows how many hours the drive has run. The value is saved when the drive is turned off.
[1501]	Running hours	Shows the number of running hours of the motor.
[1502]	kWh counter	Shows the mains power consumption in kWh.
[1580]	Fan running hours	Shows how many hours the external fan has run. The value is saved when the drive is turned off.
[1587]	kWh counter hires	Shows the motor power consumption in kWh as a mean value over 1 hour. Reset the counter in parameter 15-06 Reset kWh Counter . Decimal places are reset at power-up.
[1600]	Control word	Shows the control word sent from the drive via the serial communication port in hex code.
[1601]	Reference [Unit]	Total reference (sum of digital/analog/preset/bus/freeze reference/catch up and slow down) in selected unit.
[1602]	Reference %	Total reference (sum of digital/analog/preset/bus/freeze reference/catch up and slow down) in percent.
[1603]	Status word	Present status word.
[1605]	Main actual value [%]	Shows the 2-byte word sent with the status word to the bus master reporting the main actual value in %.
[1609]	Custom readout	Shows the user-defined readouts as defined in: - Parameter 0-30 Custom Readout Unit - Parameter 0-31 Custom Readout Min Value - Parameter 0-32 Custom Readout Max Value
[1610]	Power [kW]	Actual power consumed by the motor in kW.
[1611]	Power [hp]	Actual power consumed by the motor in hp.
[1612]	Motor voltage	Voltage supplied to the motor.
[1613]	Frequency	Motor frequency, that is, the output frequency from the drive in Hz.
[1614]	Motor current	Phase current of the motor measured as effective value.
[1615]	Frequency [%]	Motor frequency, that is, the output frequency from the drive in percent.

Option	Name	Description
[1616]	Torque [Nm]	Actual motor torque in Nm.
[1617]	Speed [RPM]	Speed in RPM (revolutions per minute), that is, the motor shaft speed in closed loop.
[1618]	Motor thermal	Thermal load on the motor calculated by the ETR function.
[1619]	Thermistor sensor temperature	Returning the actual temperature on a KTY/Pt 1000 thermistor sensor built in the motor.
[1620]	Motor angle	Shows the current encoder/resolver angle offset relative to the index position. The value range of 0–65535 corresponds to 0–2 x pi (radians).
[1622]	Torque [%]	Present motor load as a percentage of the rated motor torque.
[1623]	Motor shaft power [kW]	Shows the power applied to the motor shaft. This is an estimate based on the motor shaft torque and motor speed. The motor speed is estimated unless operating in a speed-closed-loop mode.
[1624]	Calibrated stator resistance	Shows the calibrated stator resistance.
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	DC-link voltage in the drive.
[1631]	System temp.	Shows the combined (highest) internal system temperature measurement.
[1632]	Brake energy /s	Present brake power transferred to an external brake resistor. Stated as an instant value.
[1633]	Brake energy average	Brake power transferred to an external brake resistor. The mean power is calculated continuously for the most recent 120 s.
[1634]	Heatsink temp.	Present heat sink temperature of the drive. The cutout limit is 95 ±5 °C (203 ±9 °F); cutting back in occurs at 70 ±5 °C (158 ±9 °F).
[1635]	Inverter thermal	Percentage load of the inverters.
[1636]	Inv. nom. current	Nominal current of the drive.
[1637]	Inv. max. current	Maximum current of the drive.
[1638]	SL controller state	State of the event executed by the control.
[1639]	Control card temp.	Temperature of the control card.
[1642]	Service log counter	Shows the number of logs stored in the Service Log file.
[1643]	Timed actions status	See parameter group 23-0* Timed Actions .
[1644]	Speed error [RPM]	Shows the speed error in RPM.
[1645]	Motor phase U current	Shows the motor phase U current.
[1646]	Motor phase V current	Shows the motor phase V current.
[1647]	Motor phase W current	Shows the motor phase W current.
[1648]	Speed ref. after ramp [RPM]	Shows the reference given to the drive after the speed ramp in RPM.
[1650]	External reference	Sum of the external reference as a percentage, that is, the sum of analog/pulse/bus.

Option	Name	Description
[1652]	Feedback [Unit]	Reference value from programmed digital inputs.
[1653]	Digi pot reference	Shows the contribution of the digital potentiometer to the actual reference feedback.
[1654]	Feedback 1 [Unit]	
[1655]	Feedback 2 [Unit]	
[1656]	Feedback 3 [Unit]	
[1658]	PID output [%]	
[1659]	Adjusted setpoint	
[1660]	Digital input	Signal states from the 6 digital terminals (18, 19, 27, 29, 32, and 33). There are 16 bits in total, but only 6 of them are used. Input 18 corresponds to the far left of the used bits. Signal low=0; Signal high=1.
[1661]	Terminal 53 switch setting	Setting of input terminal 54. Current=0; Voltage=1.
[1662]	Analog input 53	Actual value at input 53 either as a reference or protection value.
[1663]	Terminal 54 switch setting	Setting of input terminal 54. Current=0; Voltage=1.
[1664]	Analog input 54	Actual value at input 54 either as reference or protection value.
[1665]	Analog output 42 [mA]	Actual value at output 42 in mA. Use parameter <i>6-50 Terminal 42 Output</i> to select the value to be shown.
[1666]	Digital output [bin]	Binary value of all digital outputs.
[1667]	Pulse input #29 [Hz]	Actual value of the frequency applied at terminal 29 as an impulse input.
[1668]	Pulse input #33 [Hz]	Actual value of the frequency applied at terminal 33 as an impulse input.
[1669]	Pulse output #27 [Hz]	Actual value of impulses applied to terminal 27 in digital output mode.
[1670]	Pulse output #29 [Hz]	Actual value of impulses applied to terminal 29 in digital output mode.
[1671]	Relay output [bin]	Shows the settings of all relays.
[1672]	Counter A	Application-dependent (for example, SLC control).
[1673]	Counter B	Application-dependent (for example, SLC control).
[1675]	Analog in X30/11	Actual value at input X30/11 either as reference or protection value.
[1676]	Analog in X30/12	Actual value at input X30/12 either as reference or protection value.
[1677]	Analog out X30/8 [mA]	Actual value at output X30/8 in mA. Use parameter <i>6-60 Terminal X30/8 Output</i> to select the value to be shown.
[1678]	Analog out X45/1 [mA]	Returns the output value on terminal X45/1.
[1679]	Analog out X45/3 [mA]	Returns the output value on terminal X45/3.
[1680]	Fieldbus CTW 1	Control word (CTW) received from the bus master.
[1682]	Fieldbus REF 1	Mains reference value sent with control word from the bus master.

Option	Name	Description
[1684]	Comm. option STW	Extended fieldbus communication option status word.
[1685]	FC port CTW 1	Control word (CTW) received from the bus master.
[1686]	FC port REF 1	Status word (STW) sent to the bus master.
[1687]	Bus readout alarm/warning	Shows the human-readable alarm and warning numbers in hex code as shown in the alarm log.
[1689]	Configurable alarm/warning word	Shows the configurable alarm and warning word.
[1690]	Alarm word	One or more alarms in a hex code.
[1691]	Alarm word 2	One or more alarms in a hex code.
[1692]	Warning word	One or more warnings in a hex code.
[1693]	Warning word 2	One or more warnings in a hex code.
[1694]	Ext. status word	One or more status conditions in a hex code.
[1695]	Ext. status word 2	One or more status conditions in a hex code.
[1696]	Maintenance word	The bits reflect the status for the programmed preventive maintenance events in parameter group 23-1* Maintenance .
[1697]	Alarm word 3	Shows alarm word 3 as a hexadecimal value.
[1698]	Warning word 3	Shows warning word 3 as a hexadecimal value.
[1699]	Ext. status word 3	Shows extended status word 3 as a hexadecimal value.
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog input X42/7 [V]	
[1834]	Analog input X42/9 [V]	
[1835]	Analog input X42/11	
[1836]	Analog input X48/2 [mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	Shows the last warning.
[1848]	Last warning count	Shows how many times the last warning has been active.
[1850]	Sensorless readout [Unit]	

Option	Name	Description
[1860]	Digital input 2	
[1866]	Actual switching frequency	
[1867]	Alarm word 4	
[1868]	Warning word 4	
[1870]	Mains voltage	Shows the mains voltage measurement.
[1871]	Mains frequency	Shows the mains frequency measurement.
[1872]	Mains imbalance	Shows the maximum measured imbalance for the 3 mains line-to-line measurements.
[1873]	Worst inrush	Identifies which active inrush is producing the data shown in parameters 18-70 Mains Voltage , 18-71 Mains Frequency , 18-72 Mains Imbalance , and 18-75 Rectifier DC Volt . 1 = inrush 1, 2 = inrush 2, and so on.
[1874]	Inrush mode	The reported mode of each inrush board. Values: 0 = unknown, 1 = inrush, 2 = running. Indexes: 0 = inrush 1, 1 = inrush 2, and so on.
[1875]	Rectifier DC volt.	Shows the DC voltage measurement from the rectifier module.
[1876]	Mains voltage2	Shows the mains voltage measurement. Indexes: 0 = inrush1 average, 1 = inrush2 average, 4 = inrush1 L1, 5 = inrush2 L1, 8 = inrush1 L2, and so on.
[1877]	Mains frequency2	Shows the mains frequency measurement. Indexes: 0 = inrush1 average, 1 = inrush2 average, 4 = inrush1 L1, 5 = inrush2 L1, 8 = inrush1 L2, and so on.
[1878]	Mains imbalance2	Shows the maximum measured imbalance for the 3 mains line-to-line measurements. Indexes: 0 = inrush1 average, 1 = inrush2 average, 4 = inrush1 L1, 5 = inrush2 L1, 8 = inrush1 L2, and so on.
[1879]	Rectifier DC volt.2	Shows the DC voltage measurement from the rectifier module. Indexes: 0 = inrush1 average, 1 = inrush2 average, 4 = inrush1 L1, 5 = inrush2 L1, 8 = inrush1 L2, and so on.
[2117]	Ext. 1 reference [Unit]	
[2118]	Ext. 1 feedback [Unit]	
[2119]	Ext. 1 output [%]	
[2137]	Ext. 2 reference [Unit]	
[2138]	Ext. 2 feedback [Unit]	
[2139]	Ext. 2 output [%]	
[2157]	Ext. 3 reference [Unit]	
[2158]	Ext. 3 feedback [Unit]	
[2159]	Ext. 3 output [%]	
[2230]	No-flow power	
[2316]	Maintenance text	Shows customized messages for maintenance item and action.

Option	Name	Description
[2580]	Cascade status	
[2581]	Pump status	
[2587]	Inverse interlock	
[2791]	Cascade reference	
[2792]	% of total capacity	
[2793]	Cascade option status	
[2794]	Cascade system status	
[2795]	Advanced cascade relay output [bin]	
[2796]	Extended cascade relay output [bin]	
[2920]	Derag power [kW]	
[2921]	Derag power [HP]	
[2965]	Totalized volume	
[2966]	Actual volume	
[2969]	Flow	
[3110]	Bypass status word	Shows the status of the bypass as a hexadecimal value.
[3111]	Bypass running hours	Shows the number of hours in which the motor has run in bypass mode. Reset the counter in parameter 15-07 Reset Running Hours Counter . The value is saved when the drive is turned off.
[3401]	PCD 1 write to MCO	
[3402]	PCD 2 write to MCO	
[3403]	PCD 3 write to MCO	
[3404]	PCD 4 write to MCO	
[3405]	PCD 5 write to MCO	
[3406]	PCD 6 write to MCO	
[3407]	PCD 7 write to MCO	
[3408]	PCD 8 write to MCO	
[3409]	PCD 9 write to MCO	
[3410]	PCD 10 write to MCO	
[3421]	PCD 1 read from MCO	
[3422]	PCD 2 read from MCO	
[3423]	PCD 3 read from MCO	
[3424]	PCD 4 read from MCO	
[3425]	PCD 5 read from MCO	
[3426]	PCD 6 read from MCO	
[3427]	PCD 7 read from MCO	
[3428]	PCD 8 read from MCO	
[3429]	PCD 9 read from MCO	

Option	Name	Description
[3430]	PCD 10 read from MCO	
[4521]	Status	
[4522]	Progress	
[4523]	Baseline result info	
[4589]	Cavitation [%]	
[4590]	Stator [%]	
[4591]	Load [%]	
[4592]	Sensor 1 [%]	
[4593]	Sensor 1 [unit]	
[4594]	Sensor 2 [%]	
[4595]	Sensor 2 [unit]	
[4596]	Sensor 3 [%]	
[4597]	Sensor 3 [unit]	
[4598]	Sensor 4 [%]	
[4599]	Sensor 4 [unit]	
[4901]	Autonomous status	
[4902]	Autonomous capacitance value	
[4911]	Baseline status	
[4916]	Baseline progress	

0-21 Display Line 1.2 Small

The options are the same as those listed for parameter *0-20 Display Line 1.1 Small*. Select a variable to show in line 1, center position.

0-22 Display Line 1.3 Small

The options are the same as those listed for parameter *0-20 Display Line 1.1 Small*. Select a variable to show in line 1, right position.

0-23 Display Line 2 Large

The options are the same as those listed for parameter *0-20 Display Line 1.1 Small*. Select a variable to show in line 2.

0-24 Display Line 3 Large

The options are the same as those listed for parameter *0-20 Display Line 1.1 Small*. Select a variable to show in line 3.

0-25 My Personal Menu

Default value:	Size related	Parameter type:	Array [50]
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Define up to 50 parameters to appear in the *Q1 Personal Menu*, accessible via the [Quick Menu] key on the LCP. The parameters are shown in the *Q1 Personal Menu* in the order they are programmed into this array parameter. Delete parameters by setting the value to 0000. For example, this can be used to provide quick, simple access to just 1 or up to 50 parameters, which require changing on a regular basis (for example, for plant maintenance reasons) or by an OEM to enable simple commissioning of their equipment.

5.2.5 0-3* LCP Custom Readout

It is possible to customize the display elements for various purposes:

- Custom readout. Value proportional to speed (linear, squared, or cubed depending on the unit selected in parameter **0-30 Custom Readout Unit**.
- Display text. Text string stored in a parameter.

Custom readout

The calculated value to be shown is based on the settings in:

- Parameter **0-30 Custom Readout Unit**.
- Parameter **0-31 Custom Readout Min Value** (linear only).
- Parameter **0-32 Custom Readout Max Value**.
- Parameter **4-13 Motor Speed High Limit [RPM]**.
- Parameter **4-14 Motor Speed High Limit [Hz]**.
- Actual speed.

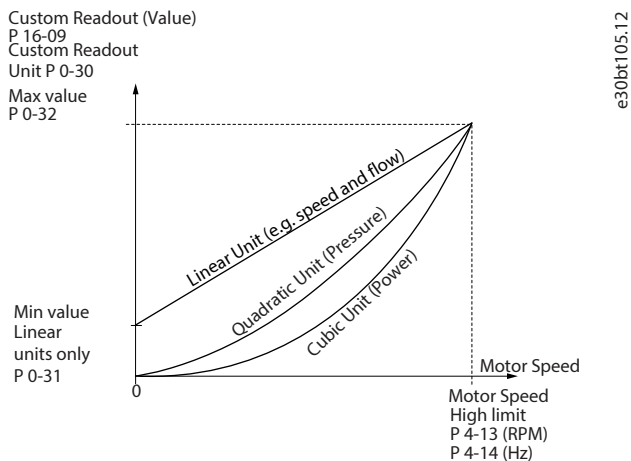


Figure 28: Custom Readout

The relation depends on the type of unit selected in parameter **0-30 Custom Readout Unit**.

Table 13: Speed Relations for Different Unit Types

Unit type	Speed relation
Dimensionless	Linear
Speed	
Flow, volume	
Flow, mass	
Velocity	
Length	
Temperature	
Pressure	Quadratic
Power	Cubic

0-30 Custom Readout Unit

Default value:	[1] %	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

It is possible to program a value to be shown in the display of the LCP. The value has a linear, squared, or cubed relation to speed. This relation depends on the unit selected (see *table Speed Relations for Different Unit Types*). The actual calculated value can be read in parameter **16-09 Custom Readout**, and/or shown in the display by selecting **[16-09] Custom Readout** in parameter **0-20 Display Line 1.1 Small** to parameter **0-24 Display Line 3 Large**.

Option	Name	Description
[0]	None	
[1]*	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	

Option	Name	Description
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	
[180]	hp	

0-31 Min Value of User-defined Readout

Default value:	Size related	Parameter type:	Range, -999999.99 CustomReadoutUnit - 100.00 CustomReadoutUnit
Setup:	All setup	Conversion index:	-2
Data type:	Int32	Change during operation:	True

This parameter sets the minimum value of the custom-defined readout (occurs at 0 speed). It is only possible to set different from 0 when selecting a linear unit in parameter **0-30 Unit for User-defined Readout**. For quadratic and cubic units, the minimum value is 0.

0-32 Custom Readout Max Value

Default value:	100 CustomReadoutUnit	Parameter type:	Range, par. 0-31 -999999.99 CustomReadoutUnit
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

This parameter sets the maximum value to be shown when the speed of the motor has reached the set value for parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]** (depends on setting in parameter **0-02 Motor Speed Unit**).

0-34 System Use Notification Text

Default value:	Size related	Parameter type:	Range, 0 - 250
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[240]	Change during operation:	True

Enter a text notifying users about the need for authorization to operate the device and informing about the liability of actions taken.

Parameter 0-37 Display Text 1

Default value:	0	Parameter type:	Range, 0 - 25
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

Enter a text which can be viewed in the graphical display by selecting **[37] Display Text 1** in

- Parameter **0-20 Display Line 1 Small**
- Parameter **0-21 Display Line 1.2 Small**
- Parameter **0-22 Display Line 1.3 Small**
- Parameter **0-23 Display Line 2 Large**
- Parameter **0-24 Display Line 3 Large**

0-38 Display Text 2

Default value:	0	Parameter type:	Range, 0–25
Setup:	1 setup	Conversion index	0
Data type:	VisStr[25]	Change during operation:	True

Enter a text which can be viewed in the graphical display by selecting **[38] Display Text 2** in

- Parameter **0-20 Display Line 1 Small**
- Parameter **0-21 Display Line 1.2 Small**
- Parameter **0-22 Display Line 1.3 Small**
- Parameter **0-23 Display Line 2 Large**
- Parameter **0-24 Display Line 3 Large**

0-39 Display Text 3

Default value:	0	Parameter type:	Range, 0–25
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

Enter a text which can be viewed in the graphical display by selecting **[39] Display Text 3** in

- Parameter **0-20 Display Line 1 Small**
- Parameter **0-21 Display Line 1.2 Small**
- Parameter **0-22 Display Line 1.3 Small**
- Parameter **0-23 Display Line 2 Large**
- Parameter **0-24 Display Line 3 Large**

5.2.6 0-4* LCP Keypad

Enable, disable, and password protect individual keys on the LCP.

0-40 [Hand On] Key on LCP

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	Disabled	No effect when [Hand On] is pressed. Select [0] Disabled to avoid accidental start of the drive in hand-on mode.
[1]*	Enabled	The LCP switches to hand-on mode directly when [Hand On] is pressed.
[2]	Password	After pressing [Hand On], a password is required. If parameter 0-40 [Hand on] Key on LCP is included in <i>My Personal Menu</i> , define the password in parameter 0-65 Personal Menu Password . Otherwise define the password in parameter 0-60 Main Menu Password .
[3]	Enabled without OFF	
[4]	Password without OFF	
[5]	Enabled with OFF	
[6]	Password with OFF	
[9]	Enabled, ref=0	When switching to [Hand On], the reference is set to 0.

0-41 [Off] Key on LCP

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	Disabled	Avoids accidental stop of the drive.
[1]*	Enabled	
[2]	Password	Avoids unauthorized stop. If parameter 0-41 [Off] Key on LCP is included in the Quick Menu, define the password in parameter 0-65 Personal Menu Password .

0-42 [Auto On] Key on LCP

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	Disabled	Avoids accidental stop of the drive in auto-on mode.
[1]*	Enabled	
[2]	Password	Avoids unauthorized start in auto-on mode. If parameter 0-42 [Auto on] Key on LCP is included in the Quick Menu, define the password in 0-65 Personal Menu Password .

0-43 [Reset] Key on LCP

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	Disabled	No effect when [Reset] is pressed. Avoids accidental alarm reset.
[1]*	Enabled	
[2]	Password	Avoids unauthorized start in auto-on mode. If parameter 0-43 [Reset] Key on LCP is included in the Quick Menu, define the password in parameter 0-65 Personal Menu Password .
[3]	Enabled without OFF	Resets the drive without setting it in Off mode.
[4]	Password without OFF	Resets the drive without setting it in Off mode. A password is required when pressing [Reset] (see option [2] Password).
[5]	Enable with OFF	
[6]	Password with OFF	

0-44 [Off/Reset] Key on LCP

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is only available when a VLT® Bypass Option MCB 104 is installed in the drive.

Enable or disable the [Off/Reset] key.

Option	Name	Description
[0]	Disabled	No effect when [Reset] is pressed. Avoids accidental alarm reset.
[1]*	Enabled	
[2]	Password	Avoids unauthorized start in auto-on mode. If parameter 0-43 [Reset] Key on LCP is included in the Quick Menu, define the password in parameter 0-65 Personal Menu Password .

0-45 [Drive Bypass] Key on LCP

Default value:	[1] Enabled	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is only available when a VLT® Bypass Option MCB 114 is installed in the drive.

Press [Off] and select [0] **Disabled** to avoid unintended stop of the drive. Press [Off] and select [2] **Password** to avoid unauthorized bypass of the drive. If parameter **0-45 [Drive Bypass] Key on LCP** is included in the Quick Menu, define the password in parameter **0-65 Personal Menu Password**.

Option	Name	Description
[0]	Disabled	Disables the key.
[1]*	Enabled	
[2]	Password	

5.2.7 0-5* Copy/Save

Copy parameters from and to the LCP. Use these parameters for saving and copying setups from 1 drive to another.

0-50 LCP Copy

Default value:	[0] No copy	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Option	Name	Description
[0]*	No copy	
[1]	All to LCP	Copies all parameters in all setups from the drive memory to the LCP memory.
[2]	All from LCP	Copies all parameters in all setups from the LCP memory to the drive memory.
[3]	Size indep. from LCP	Copy only the parameters that are independent of the motor size. This selection can be used to program several drives with the same function without disturbing motor data.
[10]	Delete LCP copy data	Use to delete the copy after the transfer is complete.
[11]	Security to LCP	Copy only the <i>Security Configuration File</i> to the LCP.
[12]	Security from LCP	NOTE: This option requires an authorized account with permission to update. Update the <i>Security Configuration File</i> from the LCP.
[13]	Security&Params to LCP	Create a backup of the <i>Security Configuration File</i> and all application parameters to the LCP.
[14]	Security&Params from LCP	Copy the <i>Security Configuration File</i> and all application parameters from the LCP.

0-51 Set-up Copy

Default value:	[0] No copy	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

Option	Name	Description
[0]*	No copy	No function.
[1]	Copy to set-up 1	Copies all parameters in the present programming setup (defined in parameter 0-11 Edit Set-up) to set-up 1.
[2]	Copy to set-up 2	Copies all parameters in the present programming setup (defined in parameter 0-11 Edit Set-up) to set-up 2.
[3]	Copy to set-up 3	Copies all parameters in the present programming setup (defined in parameter 0-11 Edit Set-up) to set-up 3.
[4]	Copy to set-up 4	Copies all parameters in the present programming setup (defined in parameter 0-11 Edit Set-up) to set-up 4.
[9]	Copy to all	Copies the parameters in the present setup to each of the setups 1 to 4.

5.2.8 0-6* Password

0-60 Main Menu Password

Default value:	100	Parameter type:	Range, -9999 - 9999
Setup:	1 setup	Conversion index:	0
Data type:	Int16	Change during operation	True

Define the password for access to the Main Menu via the [Main Menu] key. If parameter **0-61 Access to Main Menu w/o Password** is set to [0] **Full access**, this parameter is ignored.

0-61 Access to Main Menu w/o Password

Default value:	[0] Full access	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]*	Full access	Disables password defined in parameter 0-60 Main Menu Password .
[1]	LCP: Read only	Prevent unauthorized editing of Main Menu parameters.
[2]	LCP: No access	Prevent unauthorized viewing and editing of Main Menu parameters.
[3]	Bus: Read only	Read-only functions for parameters on fieldbus and/or FC standard bus.
[4]	Bus: No access	No access to parameters is allowed via fieldbus and/or FC standard bus.

Option	Name	Description
[5]	All: Read only	Read-only function for parameters on LCP, fieldbus, or FC standard bus.
[6]	All: No access	No access from LCP, fieldbus, or FC standard bus is allowed.

0-65 Personal Menu Password

Default value:	200	Parameter type:	Range, -9999 - 9999
Setup:	1 setup	Conversion index:	0
Data type:	Int16	Change during operation:	True

Define the password for access to the Quick Menu via the [Quick Menu] key. If parameter **0-66 Access to Personal Menu w/o Password** is set to **[0] Full access**, this parameter is ignored.

0-66 Access to Personal Menu w/o Password

Default value:	[0] Full access	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

If parameter **0-61 Access to Main Menu w/o Password** is set to **[0] Full access**, this parameter is ignored.

Option	Name	Description
[0]*	Full access	Disables password defined in parameter 0-65 Personal Menu Password .
[1]	LCP: Read only	Prevent unauthorized editing of Quick Menu parameters.
[3]	Bus: Read only	Read-only functions for Quick Menu parameters on fieldbus and/or FC standard bus.
[5]	All: Read only	Read-only function for Quick Menu parameters on LCP, fieldbus, or FC standard bus.

0-67 Bus Password Access

Default value:	0	Parameter type:	Range, 0 - 9999
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Use this parameter to unlock the drive via fieldbus or VLT® Motion Control Tool MCT 10.

When a valid password is entered, the drives is unlocked for 30 minutes.

5.2.9 0-7* Clock Settings

Set the time and date of the internal clock. The internal clock can be used for functions such as:

- Timed actions
- Energy log
- Trend analysis
- Date/time stamps on alarms
- Logged data

- Preventive maintenance

It is possible to program the clock for daylight saving time/summertime, weekly working days/non-working days including 20 exceptions, for example, holidays. Although the clock settings can be set via the LCP, they can also be set along with timed actions and preventive maintenance functions using the VLT Motion Control Tool MCT 10.



NOTE: The drive has no back-up of the clock function and the set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with back-up is installed. If no module with back-up is installed, only use the clock function if the drive is integrated into the BMS using serial communications, with the BMS maintaining synchronization of control equipment clock times. In parameter **0-79 Clock Fault**, it is possible to program the occurrence of a warning if the clock has not been set properly, for example, after a power-down.



NOTE: If mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

0-70 Date and Time

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

Sets the date and time of the internal clock. The format to be used is set in parameter **0-71 Date Format** and parameter **0-72 Time Format**. When using the VLT® Real-time Clock MCB 117 option, the time is synchronized at 15:00 every day.

0-71 Date Format

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the date format to be used in the LCP.

Option	Name	Description
[0]	YYYY-MM-DD	
[1]	DD-MM-YYYY	
[2]	MM/DD/YYYY	

0-72 Time Format

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	24 h	
[1]	12 h	

0-73 Time Zone Offset

Default value:	0 min	Parameter type:	Range, -780...780 min
Setup:	2 setups	Conversion index:	70
Data type:	Int16	Change during operation:	False

Enter the time zone offset relative to UTC. This parameter is required for the automatic daylight saving time adjustment.

0-74 DST/Summertime

Default value:	[0] Off	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select how to handle daylight saving time/summer time. For manual setting of DST/summer time, enter the start date and end date in parameter **0-76 DST/Summertime Start** and parameter **0-77 DST/Summertime End**.

Option	Name	Description
[0]*	Off	
[2]	Manual	

0-75 Last Power Off Time

Default value:	Size related	Parameter type:	Readout, Array [5]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter stores the last 5 drive power-off timestamps. Index [0] is the latest power-off time, and index [4] is the oldest.

0-76 DST/Summertime Start

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	1 setup	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

Sets the date and time when DST/summer time starts. The date is programmed in the format selected in parameter **0-71 Date Format**.

0-77 DST/Summertime End

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	1 setup	Data type:	TimeOfDay
Change during operation:	True		

Sets the date and time when DST/summer time ends. The date is programmed in the format selected in parameter **0-71 Date Format**.

0-79 Clock Fault

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Enables or disables the clock warning when the clock has not been set, or has been reset due to a power-down and no backup is installed.

Option	Name	Description
[0]	Disabled	
[1]	Enabled	

0-81 Working Days

Default value:	–	Parameter type:	Option, Array [7]
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Array with 7 elements [0]–[6] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼]. Set for each weekday if it is a working day or a non-working day. The first element of the array is Monday. The working days are used for timed actions.

Option	Name	Description
[0]	No	
[1]	Yes	

0-82 Additional Working Days

Default value:	Size related	Parameter type:	Array [5]
Setup:	1 setup	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

Array with 5 elements [0]–[4] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼]. Defines dates for additional working days that would normally be non-working days according to parameter **0-81 Working Days**.

0-83 Additional Non-working Days

Default value:	Size related	Parameter type:	Array [15]
Setup:	1 setup	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

Array with 15 elements [0]–[14] shown below the parameter number in the display. Press [OK] and step between elements with [▲] and [▼]. Defines dates for additional working days that would normally be non-working days according to parameter **0-81 Working Days**.

0-84 Time for Fieldbus

Default value:	0	Parameter type:	Array [2]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

Shows the time for fieldbus.

0-85 Summer Time Start for Fieldbus

Default value:	0	Parameter type:	Array [2]
Setup:	All setups	Conversion index:	0

Parameter type:	Uint32	Change during operation:	True

Shows the summer time start for fieldbus.

0-86 Summer Time End for Fieldbus

Default value:	0	Parameter type:	Array [2]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Shows the summer time end for fieldbus.

0-88 Clock Restore at Powerup

Default value:	[0] Disabled	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Disabled	Restoring the time at power-up is disabled.
[1]	Enabled	Restoring the time at power-up is enabled. Date and time will be stored at power down. When the drive is powered up, the previous time is used. As the previous time is incorrect, <i>warning 98, Clock Fault</i> is issued and stays active until date and time are set again.

0-89 Date and Time Readout

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

Shows the current date and time. The date and time is updated continuously. The clock does not begin counting until a setting different from default has been made in parameter **0-70 Date and Time**.

5.2.10 0-9* Varia

0-91 Integrity Check at Power-up

Default value:	[0] No check	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter controls the behavior of the boot time integrity check of installed software. The boot loader checks the integrity of the application firmware before loading and executing, both AOC and DTM. If the integrity check fails for AOC, the boot process is stopped. On the next power-up, the drive will try to execute Testmonitor instead. Testmonitor mode can be used to flash another software. However, if the integrity check also fails for Testmonitor, the control card cannot be recovered on the field and must be replaced.

The integrity of the *Security Configuration File* (SCF) is always checked on every power-up and on every update of the file. If this parameter is set to **[2] Always**, the integrity of the SCF is checked before being loaded.



NOTE: Make sure that this parameter is set to **[0] No check** before flashing an older frozen software version that does not support cybersecurity.

Option	Name	Description
[0]*	No check	There is no boot time integrity check of the firmware. However, a check of the SCF takes place.
[1]	After firmware update	The integrity of the firmware is only checked once on the next power-up after a software update.
[2]	Always	The integrity of software and the SCF is checked at every power-up. Depending on the size of the software and SCF, the integrity check may delay the start-up time by 2–3 s.

0-92 Checksum (SHA256)

Default value:	0	Parameter type:	Readout, Array [5]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[64]	Change during operation:	False

This is a readout parameter for integrity hash values (256-bit value produced by SHA-2 algorithm represented as 64 hexadecimal symbols). Each index shows a calculated hash of an installed application firmware or stored file that is a fundamental corner stone maintaining the integrity and security of the device.

Index values correspond to the following:

- [0] Checksum of the installed Application Oriented Controller (AOC) software.
- [1] Checksum of the *Security Configuration File*, 0 if the security file is not uploaded to the drive, or it is not in use/invalid.
- [2] 0, reserved.
- [3] Checksum of the installed Testmonitor software.
- [4] Always 0, reserved.

0-93 Session Timeout (in Seconds)

Default value:	300 s	Parameter type:	Range, 30 - 3000000
Setup:	1 setup	Conversion index:	0
Data type:	UInt32	Change during operation:	True

Set for how many seconds a session of a logged-in user is kept active after a period of inactivity. Inactivity is measured differently for different access ports. For the LCP, a user is defined as inactive if no keys are pressed. Serial or network communication is inactive if no requests are sent to the drive.

0-94 Max Login Attempts

Default value:	5	Parameter type:	Range, 1 - 255
Setup:	1 setup	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Set the number of failed login attempts that are allowed on a given interface before a rate-limited cool-down is activated on that interface. When an interface is in cool-down for the 1st time, no user sessions can be started on that access port for 30 s. Following authentication failures on the channel will increase the cool-down time geometrically until reaching a sealing limit of approximately 8 minutes. During the cool-down time, all user log-on actions will fail. This is a measure to protect the drive from brute force attacks using the hardware of the unit. To avoid a denial of service attack, a cool-down can be ended prematurely on a given interface if an authorized person logs in on another channel and changes the value of this parameter.

Changing the value of this parameter resets all the cool-down timers for all the interfaces.

The factory setting is 5 failed attempts before cool-down is activated. If the cool-down behavior is not acceptable, set the parameter to a maximum value of 255.

0-95 Warning LED Blinking

Default value:	[0] Constant on	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]*	Constant on	
[1]	Blinking	Use [1] Blinking to identify a drive when many drives are mounted together.

5.3 Parameter Group 1-** Load and Motor

5.3.1 1-0* General Settings

Define whether the drive operates in open or closed loop.

1-00 Configuration Mode

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: This parameter cannot be changed while the motor is running.



NOTE: When set to **[3] Closed loop**, the commands reversing and start reversing do not reverse the motor direction.

Select the application control principle to be used when a remote reference (that is via analog input or fieldbus) is active. A remote reference can only be active when parameter **3-13 Reference Site** is set to **[0] Linked to Hand/Auto** or **[1] Remote**.

Option	Name	Description
[0]	Open loop	Motor speed is determined by applying a speed reference or by setting the speed when in hand-on mode. Open loop is also used if the drive is part of a closed-loop system based on an external PID controller providing a speed reference signal as output.
[3]	Closed loop	Motor speed is determined by a reference from the built-in PID controller varying the motor speed as in a closed-loop control process (for example, constant pressure or flow). Configure the PID controller in parameter group 20-** <i>Feedback</i> or via the Function Set-ups accessed by pressing [Quick Menu].

1-01 Motor Control Principle

Default value:	[1] VVC+	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Select which motor control principle to employ.



NOTE: Flux sensorless is not available as default must be activated via a license code or ordered from factory.

Option	Name	Description
[0]	U/f	Special motor mode for parallel-connected motors in special motor applications. When U/f is selected, the characteristic of the control principle can be edited in parameters 1-55 <i>U/f Characteristic - U</i> and 1-56 <i>U/f Characteristic - F</i> .
[1]*	VVC+	Voltage vector control principle is suitable for most applications. The main benefit of VVC+ operation is that it uses a robust motor model.
[2]	Flux sensorless	Flux vector control without encoder feedback, for simple installation and robustness against sudden load changes.

1-03 Torque Characteristics

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Parameter 1-03 *Torque Characteristics* has no effect when parameter 1-10 *Motor Construction* = [1] *PM, non-salient SPM*.

Select the torque characteristic required. VT and AEO are both energy-saving operations.

Option	Name	Description
[0]	Constant torque	For speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 10 Hz.
[1]	Variable torque	For speed control of centrifugal pumps and fans. Also to be used when controlling more than 1 motor from the same drive (for example, multiple condenser fans or cooling tower fans). Provides a voltage which is optimized for a squared torque load characteristic of the motor.
[2]	Auto energy optim. CT	For optimum energy-efficient speed control of screw and scroll compressors. Provides a voltage which is optimized for a constant torque load characteristic of the motor in the entire range down to 15 Hz. In addition, the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in parameter 14-43 Motor Cosphi . The parameter has a default value, which is automatically adjusted when the motor data is programmed. These settings ensure optimum motor voltage. If the motor power factor cos phi requires tuning, an AMA function can be carried out using parameter 1-29 Automatic Motor Adaptation (AMA) . It is rarely necessary to adjust the motor power factor parameter manually.
[3]	Auto energy optim. VT	For optimum energy-efficient speed control of centrifugal pumps and fans. Provides a voltage optimized for a squared torque load characteristic of the motor. In addition, the AEO feature adapts the voltage exactly to the current load situation, thereby reducing energy consumption and audible noise from the motor. To obtain optimum performance, set the motor power factor cos phi correctly. This value is set in parameter 14-43 Motor Cosphi . The parameter has a default value and is automatically adjusted when the motor data is programmed. These settings ensure optimum motor voltage. If the motor power factor cos phi requires tuning, an AMA function can be carried out using parameter 1-29 Automatic Motor Adaptation (AMA) . It is rarely necessary to adjust the motor power factor parameter manually.

1-04 Overload Mode

Default value:	[1] Normal torque	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Use this parameter to configure the drive for either high or normal overload. When selecting the drive size, always review the technical data in the operating guide or the design guide to know the available output current.

Option	Name	Description
[0]	High torque	Allows up to 160% overtorque.
[1]*	Normal torque	For oversized motor. Allows up to 110% overtorque.

1-05 Local Mode Configuration

Default value:	[0] Open loop	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select which application configuration mode (parameter **1-00 Configuration Mode**), that is application control principle, to use when a local (LCP) reference is active. A local reference can be active only when parameter **3-13 Reference Site** is set to **[0] Linked to Hand/Auto** or **[2] Local**. By default the local reference is active in hand-on mode only.

Option	Name	Description
[0]*	Open loop	This selection controls motor speed from 0 to maximum speed.
[2]	As mode par. 1-00	This selection controls motor speed from minimum to maximum reference.

1-06 Clockwise Direction

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

This parameter defines the term clockwise corresponding to the LCP direction arrow. Used for easy change of direction of shaft rotation without swapping motor wires.

Option	Name	Description
[0]*	Normal	The motor shaft turns in clockwise direction when the drive is connected U⇒U, V⇒V, and W⇒W to the motor.
[1]	Inverse	The motor shaft turns in counterclockwise direction when the drive is connected U⇒U, V⇒V, and W⇒W to the motor.
[2]	Inverse all	Inverts motor direction, feedback direction, and angle offset on PM motor.

5.3.2 Motor Setups

5.3.2.1 Asynchronous Motor Setup

Enter the following motor data. Find the information on the motor nameplate.

- Parameter **1-20 Motor Power [kW]** or parameter **1-21 Motor Power [HP]**.
- Parameter **1-22 Motor Voltage**.
- Parameter **1-23 Motor Frequency**.
- Parameter **1-24 Motor Current**.

- Parameter **1-25 Motor Nominal Speed**.

When running in flux control principle, or for optimum performance in VVC+ mode, extra motor data is required to set up the following parameters. Find the data in the motor datasheet (this data is typically not available on the motor nameplate). Run a complete automatic motor adaptation (AMA) using parameter **1-29 Automatic Motor Adaptation (AMA) [1] Enable Complete AMA** or enter the parameters manually. Parameter **1-36 Iron Loss Resistance (Rfe)** is always entered manually.

- Parameter **1-30 Stator Resistance (Rs)**.
- Parameter **1-31 Rotor Resistance (Rr)**.
- Parameter **1-33 Stator Leakage Reactance (X1)**.
- Parameter **1-34 Rotor Leakage Reactance (X2)**.
- Parameter **1-35 Main Reactance (Xh)**.
- Parameter **1-36 Iron Loss Resistance (Rfe)**.

Application-specific adjustment when running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

5.3.2.2 PM Motor Setup

This section describes how to set up a PM motor. Danfoss offers 2 types of PM motors: [1] Non-salient PM and [3] Salient PM. The following example covers a non-salient PM motor.

5.3.2.3 Programming of PM Motors

5.3.2.3.1 Initial Programming Steps

1. To activate permanent magnet motor operation, select **[1] PM, non-salient SPM** in parameter **1-10 Motor Construction**.

5.3.2.3.2 Programming Motor Data

After selecting a permanent magnet motor, the permanent magnet motor-related parameters in parameter groups **1-2* Motor Data**, **1-3* Adv. Motor Data**, and **1-4* Adv. Motor Data II** are active. The necessary data is on the motor nameplate and on the motor datasheet.

1. Set parameter **1-24 Motor Current**.
2. Set parameter **1-25 Motor Nominal Speed**.
3. Set parameter **1-26 Motor Cont. Rated Torque**.
4. Set parameter **1-39 Motor Poles**.
5. Run a complete AMA by setting parameter **1-29 Automatic Motor Adaptation (AMA)** to **[1] Enable complete AMA**.
6. If a complete AMA is NOT performed, configure the following parameters manually:
 - a. Parameter **1-30 Stator Resistance (Rs)**: Enter the line-to-common stator winding resistance (Rs). If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
 - b. Parameter **1-37 d-axis Inductance (Ld)**: Enter the line-to-common direct axis inductance of the permanent magnet motor. If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
 - c. Parameter **1-40 Back EMF at 1000 RPM**: Enter the line-to-line back EMF of the permanent magnet motor at 1000 RPM (RMS value). Back EMF is the voltage generated by a permanent magnet motor when no drive is connected and the shaft is turned externally. It is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is, for example, 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows: Back EMF = (Voltage/RPM)x1000 = (320/1800)x1000 = 178.
7. For IPM motors, configure the inductance values in the following parameters:
 - a. Parameter **1-38 q-axis Inductance (Lq)**.

- b. Parameter **1-44 d-axis Inductance Sat. (LdSat)**.
- c. Parameter **1-45 q-axis Inductance Sat (LqSat)**.
- d. Parameter **1-49 q-axis Inductance Sat. Point**.



NOTE: IPM motors may be missing some inductance values on the product label or in the datasheets. Perform an AMA to get the valid values.

5.3.2.3.3 Testing Motor Operation

1. Start the motor at low speed (100–200 RPM). If the motor does not turn, check the installation, general programming, and motor data.
2. Check if the start function in parameter **1-70 Start Mode** fits the application requirements.

5.3.2.3.4 Rotor Detection

This function is the recommended selection for applications where the motor starts from standstill, for example, pumps or conveyors. On some motors, a sound is heard when the drive performs the rotor detection. This does not harm the motor.

5.3.2.3.5 Parking

This function is the recommended selection for applications where the motor is rotating at slow speed, for example, windmilling in fan applications. Parameter **2-06 Parking Current** and parameter **2-07 Parking Time** can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

5.3.2.3.6 Application-specific Adjustments when Running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

Start the motor at nominal speed. If the application does not run well, check the VVC+ PM settings. See recommendations for various applications in [Table 14](#).

Table 14: Recommendations for Various Applications

Application	Settings
Low-inertia applications $I_{Load}/I_{Motor} < 5$	Increase parameter 1-17 Voltage Filter Time Const. by factor 5–10. Reduce parameter 1-14 Damping Gain . Reduce parameter 1-66 Min. Current at Low Speed (<100%).
Low-inertia applications $50 > I_{Load}/I_{Motor} > 5$	Keep the default values.
High-inertia applications $I_{Load}/I_{Motor} > 50$	Increase parameter 1-14 Damping Gain , parameter 1-15 Low Speed Filter Time Const. , and parameter 1-16 High Speed Filter Time Const.
High load at low speed <30% (rated speed)	Increase parameter 1-17 Voltage filter time const. Increase parameter 1-66 Min. Current at Low Speed to adjust the starting torque. 100% current provides nominal torque as starting torque. This parameter is independent of parameter 30-20 High Starting Torque Time [s] and parameter 30-21 High Starting Torque Current [%] . Working at a current level higher than 100% for a prolonged time can cause the motor to overheat.

If the motor starts oscillating at a certain speed, increase parameter **1-14 Damping Gain**. Increase the value in small steps. Depending on the motor, this parameter can be set to 10–100% higher than the default value.

5.3.2.4 SynRM and PMaSynRM Motor Setup

This section describes how to set up a synchronous reluctance motor and a PMaSynRM motor.

5.3.2.5 Programming of SynRM and PMaSynRM Motors

5.3.2.5.1 Initial Programming

1. To activate SynRM and PMaSynRM motor operation, select **[3] SynRM** or **[6] PMaSynRM** in parameter **1-10 Motor Construction**.

5.3.2.5.2 Programming Motor Data

After selecting a SynRM or PMaSynRM motor, the motor-related parameters in parameter groups **1-2* Motor Data**, **1-3* Adv. Motor Data**, and **1-4* Adv. Motor Data II** are active. The necessary data is on the motor nameplate and on the motor datasheet.

1. Set parameter **1-24 Motor Current**.
2. Set parameter **1-25 Motor Nominal Speed**.
3. Set parameter **1-26 Motor Cont. Rated Torque**.
4. Set parameter **1-39 Motor Poles**.
5. For PMaSynRM motors, set parameter **1-40 Back EMF at 1000 RPM**.
6. Run a complete AMA by setting parameter **1-29 Automatic Motor Adaptation (AMA)** to **[1] Enable complete AMA**.
7. If a complete AMA is NOT performed, configure the following parameters manually:
 - a. Parameter **1-30 Stator Resistance (Rs)**: Enter the line-to-common stator winding resistance (Rs). If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
 - b. Parameter **1-37 d-axis Inductance (Ld)**: Enter the line-to-common direct axis inductance of the PM motor. If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
 - c. Parameter **1-38 q-axis Inductance (Lq)**: Enter the line-to-common quadrature axis inductance of the motor. If only line-to-line data is available, divide the line-to-line value by 2 to get the line-to-common value.
 - d. Parameter **1-44 d-axis Inductance Sat. (LdSat)**: Enter the line-to-common saturated value of the d-axis inductance. This is the value at a current higher than the nominal current where the inductance is fully saturated.
 - e. Parameter **1-45 q-axis Inductance Sat (LqSat)**: Enter the line-to-common saturated value of the q-axis inductance. This is the value at a current higher than the nominal current where the inductance is fully saturated.
 - f. Parameter **1-48 Inductance Sat. Point**: Enter the percentage of nominal current where the d-axis inductance is half-saturated, meaning that it has the average value of the non-saturated and saturated values.



NOTE: Motors may be missing some inductance values on the nameplate or in the datasheets. Perform AMA to get the valid values.

5.3.2.5.3 Testing Motor Operation

1. Start the motor at low speed (100–200 RPM). If the motor does not turn, check the installation, general programming, and motor data.
2. Check if the start function in parameter **1-70 Start Mode** fits the application requirements.

5.3.2.5.4 Rotor Detection

This function is the recommended selection for applications where the motor starts from standstill, for example, pumps or conveyors. On some motors, a sound is heard when the drive performs the rotor detection. This does not harm the motor.

5.3.2.5.5 Parking

This function is the recommended selection for applications where the motor is rotating at slow speed, for example, windmilling in fan applications. Parameter **2-06 Parking Current** and parameter **2-07 Parking Time** can be adjusted. Increase the factory setting of these parameters for applications with high inertia.

5.3.2.5.6 Application-specific Adjustment when Running VVC+

VVC+ is the most robust control mode. In most situations, it provides optimum performance without further adjustments. Run a complete AMA for best performance.

Start the motor at nominal speed. If the application does not run well, check the VVC+ SynRM and PMaSynRM settings. See recommendations for various applications in [Table 15](#).

Table 15: Recommendations for Various Applications

Application	Settings
Low-inertia applications $I_{Load}/I_{Motor} < 5$	Increase parameter 1-17 Voltage Filter Time Const. by factor 5–10. Reduce parameter 1-14 Damping Gain . Reduce parameter 1-66 Min. Current at Low Speed (<100%).
Low-inertia applications $50 > I_{Load}/I_{Motor} > 5$	Keep the default values.
High-inertia applications $I_{Load}/I_{Motor} > 50$	Increase parameter 1-14 Damping Gain , parameter 1-15 Low Speed Filter Time Const. , and parameter 1-16 High Speed Filter Time Const.
High load at low speed <30% (rated speed)	Increase parameter 1-17 Voltage filter time const. Increase parameter 1-66 Min. Current at Low Speed to adjust the starting torque. 100% current provides nominal torque as starting torque. This parameter is independent of parameter 30-20 High Starting Torque Time [s] and parameter 30-21 High Starting Torque Current [%] . Working at a current level higher than 100% for a prolonged time can cause the motor to overheat.

If the motor starts oscillating at a certain speed, increase parameter **1-14 Damping Gain**. Increase the value in small steps. Depending on the motor, this parameter can be set to 10–100% higher than the default value.

5.3.3 1-1* Motor Selection

1-10 Motor Construction

Default value:	[0] Asynschron	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

Select the motor design type.

Option	Name	Description
[0]*	Asynschron	Use for ASM/IM motors.
[1]	PM, non salient SPM	Use for SPM motors, surface-mounted magnet. PM motors are divided into 2 groups, with either surface-mounted (SPM)/non-salient magnets or interior-mounted (IPM)/ salient magnets.

Option	Name	Description
[2]	PM, salient IPM	Use for IPM motors, interior-mounted magnet. PM motors are divided into 2 groups, with either surface-mounted (SPM)/non-salient magnets or interior-mounted (IPM)/ salient magnets.
[5]	SynRM	Use for SynRM, synchronous reluctance motors.
[6]	PMaSynRM	Use for PMaSynRM, Permanent Magnet assisted synchronous reluctance motors.

5.3.4 1-1* VVC+ for Synchronous Motors

The default control parameters for VVC+ synchronous motors are optimized for applications where inertia load in the range of $50 > J_l/J_m$. J_l is load inertia from the application and J_m is machine inertia. For low-inertia applications ($J_l/J_m < 5$), increase parameter **1-17 Voltage Filter Time Const.**, parameter **1-16 High Speed Filter Time Const.**, and parameter **1-14 Damping Gain** to improve performance and stability.

For high-inertia at low speed (<30% of rated speed), increase parameter **1-17 Voltage Filter Time Const.** due to non-linearity in the inverter at low speed.

1-14 Damping Gain

Default value:	120%	Parameter type:	Range, 0 - 250%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

The damping gain stabilizes the PM machine to run smoothly and with stability. The value of damping gain controls the dynamic performance of the PM machine. High damping gain gives high dynamic performance and low damping gain gives low dynamic performance. The dynamic performance is related to the machine data and load type. If the damping gain is too high or low, the control becomes unstable.

1-15 Low Speed Filter Time Const.

Default value:	Size related	Parameter type:	Range, 0.01 - 20 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The time constant is used below 10% rated speed. Obtain quick control through a short dampening time constant. However, if this value is too short, the control becomes unstable.

1-16 High Speed Filter Time Const.

Default value:	Size related	Parameter type:	Range, 0.01 - 20 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The time constant is used above 10% rated speed. Obtain quick control through a short dampening time constant. However, if this value is too short, the control becomes unstable.

1-17 Voltage Filter Time Const.

Default value:	Size related	Parameter type:	Range, 0.001 - 2 s
Setup:	All setups	Conversion index:	-3

Data type: Uint16 **Change during operation:** True

Reduces the influence of high frequency ripple and system resonance in the calculation of supply voltage. Without this filter, the ripples in the currents can distort the calculated voltage and affect the stability of the system.

5.3.5 1-2* Motor Data

This parameter group contains input data from the nameplate on the connected motor.

NOTE: Changing the value of these parameters affects the setting of other parameters.

NOTE: The following parameters have no effect when parameter *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*, *[2] PM, salient IPM*, *[5] Sync. Reluctance*:

- Parameter *1-20 Motor Power [kW]*
- Parameter *1-21 Motor Power [HP]*
- Parameter *1-22 Motor Voltage*
- Parameter *1-23 Motor Frequency*

1-20 Motor Power [kW]

Default value:	Size related	Parameter type:	0.09 - 2000.00 kW
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	False

NOTE: This parameter cannot be adjusted while the motor is running.

NOTE: Changing this parameter will affect the settings of other parameters.

Enter the nominal motor power in kW according to the motor nameplate data. The default value corresponds to the nominal rated output of the drive. This parameter is visible in the LCP if parameter *0-03 Regional Settings* is set to *[0] International*.

1-21 Motor Power [HP]

Default value:	Size related	Parameter type:	Range, 0.09 - 500.00 hp
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	False

NOTE: This parameter cannot be adjusted while the motor is running.

NOTE: Changing this parameter will affect the settings of other parameters.

Enter the nominal motor power in hp according to the motor nameplate data. The default value corresponds to the nominal rated output of the drive. This parameter is visible in the LCP if parameter *0-03 Regional Settings* is set to *[1] North America*.

1-22 Motor Voltage

Default value:	Size related	Parameter type:	Range, 10 - 1000 V
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False



NOTE: Setting this parameter sets the following parameters to their default settings:

- Parameter *1-15 Low Speed Filter Time Const.*
- Parameter *1-16 High Speed Filter Time Const.*
- Parameter *1-17 Voltage Filter Time Const.*
- Parameter *1-24 motor Current*
- Parameter *1-30 Stator Resistance (Rs)*
- Parameter *1-31 Rotor Resistance (Rr)*
- Parameter *1-33 Stator Leakage Reactance (X1)*
- Parameter *1-34 Rotor Leakage Reactance (X2)*
- Parameter *1-35 Main Reactance (Xh)*
- Parameter *1-36 Iron Loss Resistance (Rfe)*
- Parameter *4-18 Current Limit*
- Parameter *14-31 Current Lim Ctrl, Integration Time*
- Parameter *14-43 Motor Cosphi*
- Parameter *16-36 Inv. Nom. Current*
- Parameter *16-37 Inv. Max. Current*
- Parameter *45-33 Alarm High*
- Parameter *45-62 Load Threshold*

Enter the nominal motor voltage according to the motor nameplate data. The default value corresponds to the nominal rated output of the unit.

1-23 Motor Frequency

Default value:	Size related	Parameter type:	Range, 5 - 1000 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Select the motor frequency value from the motor nameplate data. For 87 Hz operation with 230/400 V motors, set the nameplate data for 230 V/50 Hz. Adapt parameter *4-13 Motor Speed High Limit [RPM]* and parameter *3-03 Maximum Reference* to the 87 Hz application.

1-24 Motor Current

Default value:	Size related	Parameter type:	Range, 0.10 - 10000.00 A
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Setting this parameter sets the following parameters to their default settings:

- Parameter 1-15 Low Speed Filter Time Const.
- Parameter 1-16 High Speed Filter Time Const.
- Parameter 1-17 Voltage Filter Time Const.
- Parameter 1-30 Stator Resistance (R_s)
- Parameter 1-31 Rotor Resistance (R_r)
- Parameter 1-33 Stator Leakage Reactance (X_1)
- Parameter 1-34 Rotor Leakage Reactance (X_2)
- Parameter 1-35 Main Reactance (X_h)
- Parameter 1-36 Iron Loss Resistance (R_{fe})
- Parameter 4-18 Current Limit
- Parameter 14-31 Current Lim Ctrl, Integration Time
- Parameter 14-43 Motor Cosphi
- Parameter 45-33 Alarm High
- Parameter 45-62 Load Threshold

Enter the nominal motor current value from the motor nameplate data. The data is used for calculating torque, motor overload protection, and so on.

1-25 Motor Nominal Speed

Default value:	Size related	Parameter type:	Range, 100 - 60000 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Changing this parameter will affect the settings of other parameters.

Enter the nominal motor speed value from the motor nameplate data. The data is used for calculating motor compensations.

$$n_m, n = n_s - n_{slip}$$

1-26 Motor Cont. Rated Torque

Default value:	Size related	Parameter type:	Range, 0.1 - 10000.0 Nm
Setup:	All setups	Conversion index:	-1
Data type:	Uint32	Change during operation:	False



NOTE: Changing this parameter sets certain other parameters to their default settings.

Enter the value from the motor nameplate data. The default value corresponds to the nominal rated output. This parameter is available when parameter **1-10 Motor Construction** is set to **[1] PM, non-salient SPM**, **[2] PM, salient IPM**, **[5] SynRM**, and **[6] PMA SynRM**.

1-28 Motor Rotation Check

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

WARNING



HIGH VOLTAGE

Drives contain high voltage when connected to AI mains input, DC supply, or load sharing. Disconnecting motor cables while mains power is turned on can result in death or serious injury.

- Remove mains power before disconnecting motor phase cables.



NOTE: Once the motor rotation check is enabled, the display shows: *Note! Motor may run in wrong direction*. Pressing [OK], [Back], or [Cancel] dismisses the message and shows a new message: *Press [Hand On] to start the motor. Press [Cancel] to abort*. Pressing [Hand On] starts the motor at 5 Hz in forward direction and the display shows: *Motor is running*. Check if the motor rotation direction is correct. Press [Off] to stop the motor. Pressing [Off] stops the motor and resets parameter **1-28 Motor Rotation Check**. If motor rotation direction is incorrect, interchange 2 motor phase cables.

Following installation and connection of the motor, this function allows the correct motor rotation direction to be verified. Enabling this function overrides any bus commands or digital inputs, except external interlock and STO (if Included).

Option	Name	Description
[0]*	Off	Motor rotation check is not active.
[1]	Enabled	Motor rotation check is enabled.

1-29 Automatic Motor Adaptation (AMA)

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

The AMA function optimizes dynamic motor performance by automatically optimizing the advanced motor parameters (parameter **1-30 Stator Resistance (Rs)** to parameter **1-35 Main Reactance (Xh)**) at motor standstill. Activate the AMA function by pressing [Hand On] after selecting **[1] Enable Complete AMA** or **[2] Enable Reduced AMA**. See also the section *Automatic Motor Adaptation* in the design guide. After a normal sequence, the display reads: *Press [OK] to finish AMA*. After pressing [OK], the drive is ready for operation.



NOTE: Ensure that a value is set in parameter **14-43 Motor Cosphi** before running AMA II.

Option	Name	Description
[0]*	Off	
[1]	Enable complete AMA	Performs • AMA of the stator resistance R_s • The rotor resistance R_r • The stator leakage reactance X_1 • The rotor leakage reactance X_2, and • The main reactance X_h Do not select this option if an LC filter is used between the drive and the motor. For best performance, it is recommended to obtain the advanced motor data from the motor manufacturer to enter into parameter 1-31 Rotor Resistance (R_r) through parameter 1-36 Iron Loss Resistance (R_{fe}). Complete AMA cannot be performed on permanent magnet motors.
[2]	Enable Reduced AMA	Performs a reduced AMA of the stator resistance R_s in the system only. This option is available for standard asynchronous motors and non-salient PM motors. Select this option if an LC filter is installed between the drive and the motor.
[3]	Enable reduced AMA II	Performs AMA of the stator resistance R_s, the rotor resistance R_r, the stator leakage reactance X_1, the rotor leakage reactance X_{21}, and the main reactance X_h.
[4]	Enable reduced AMA II	Performs a reduced AMA of the stator resistance R_s in the system only. Select this option if an LC filter is used between the drive and the motor. The AMA II is a variant of AMA, based on the principles of the torque calibration. It is recommended for special motors (for example S3) and high-power motors.


NOTE:

- For the best adaptation of the drive, run AMA on a cold motor.
- AMA cannot be performed while the motor is running.
- AMA cannot run with a sine-wave filter connected.



NOTE: It is important to set parameter group **1-2* Motor Data** correctly, since these form part of the AMA algorithm. Perform an AMA to achieve optimum dynamic motor performance. It may take up to 10 minutes, depending on the power rating of the motor.



NOTE: Avoid generating external torque during AMA.



NOTE: If 1 of the settings in parameter group **1-2* Motor Data** is changed, parameter **1-30 Stator Resistance (R_s)** to parameter **1-39 Motor Poles** return to their default settings.



NOTE: AMA works problem-free on 1 motor size down, typically works on 2 motor sizes down, rarely works on 3 sizes down, and never works on 4 sizes down. Keep in mind that the accuracy of the measured motor data is poorer when operating on motors smaller than the nominal drive size.

5.3.6 1-3* Adv. Motor Data

Parameters for advanced motor data. Ensure that the motor data in parameter **1-30 Stator Resistance (R_s)** to parameter **1-39 Motor Poles** matches the motor. The default settings are based on standard motor values. If the motor parameters are not set correctly, a malfunction of the drive system may occur. If the motor data is unknown, running an AMA (automatic motor adaptation) is recommended. See parameter **1-29 Automatic Motor Adaptation (AMA)**.

Parameter groups **1-3* Adv. Motor Data** and **1-4* Adv. Motor Data II** cannot be adjusted while the motor is running.



NOTE: A simple check of the $X_1 + X_h$ sum value is to divide the line-to-line motor voltage by the $\sqrt{3}$ and divide this value by the motor no load current. $[V_{L-L}/\sqrt{3}]/I_{NL} = X_1 + X_h$. These values are important to magnetize the motor properly. For high-pole motors, it is highly recommended to perform this check.

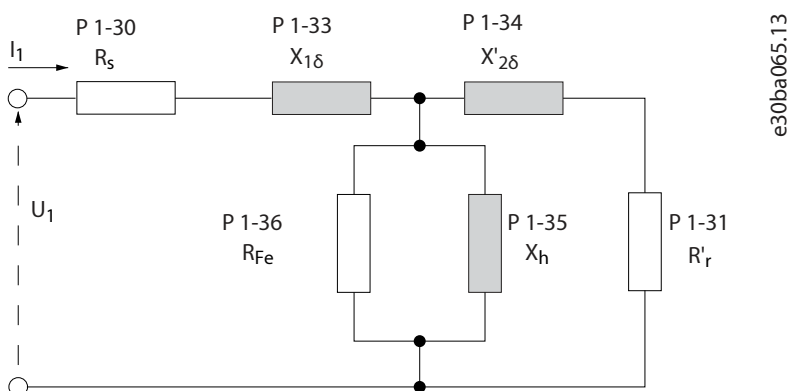


Figure 29: Motor Equivalent Diagram for an Asynchronous Motor

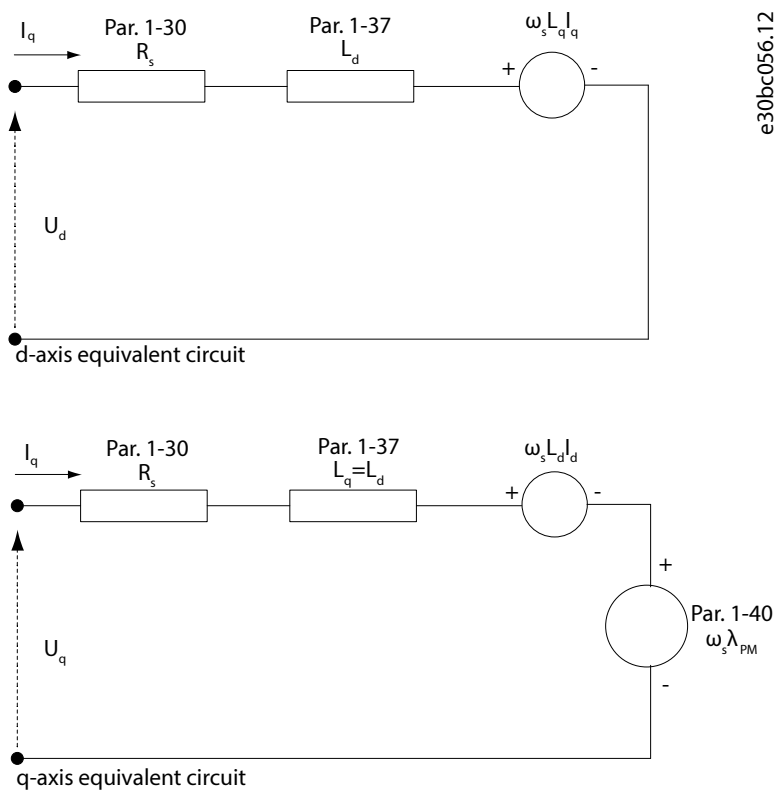


Figure 30: Motor Equivalent Circuit Diagram for a PM Non-salient Motor

1-30 Stator Resistance (Rs)

Default value:	Size related	Parameter type:	Range, 0.0140 - 140.0000 Ohm
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	False

Set the line-to-common stator resistance value. Enter the value from a motor datasheet or perform an AMA on a cold motor.

NOTE: This parameter cannot be adjusted while the motor is running.

NOTE: The parameter value is updated after each torque calibration if option [3] *1st start with store* or option [4] *Every start with store* is selected in parameter 1-47 *Torque Calibration*.

1-31 Rotor Resistance (Rr)

Default value:	Size related	Parameter type:	Range, 0.0100 - 100.0000 Ohm
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	False

NOTE: Parameter 1-31 *Rotor Resistance (Rr)* has no effect when parameter 1-10 *Motor Construction* is set to [1] *PM, non-salient SPM*, [2] *PM, salient IPM*, [5] *SynRM*, and [6] *PMSynRM*.

Set the rotor resistance value R_r to improve shaft performance using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor. All compensations are reset to 100%.

- Enter the R_r value manually. Obtain the value from the motor supplier.
- Use the R_r default setting. The drive establishes the setting based on the motor nameplate data.

1-33 Stator Leakage Reactance (X1)

Default value:	Size related	Parameter type:	Range, 0.0400 - 400.0000 Ohm
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	False



NOTE: This parameter is only relevant for induction motors.

Set the stator leakage reactance of the motor using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor.
- Enter the X_1 value manually. Obtain the value from the motor supplier.
- Use the X_1 default setting. The drive establishes the setting based on the motor nameplate data.



NOTE: The parameter value is updated after each torque calibration if option [3] *1st start with store* or option [4] *Every start with store* is selected in parameter 1-47 *Torque Calibration*.

1-34 Rotor Leakage Reactance (X2)

Default value:	Size related	Parameter type:	Range, 0.0400 - 400.0000 Ohm
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	False



NOTE: This parameter is only relevant for induction motors.

Set the rotor leakage reactance of the motor using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor.
- Enter the X_2 value manually. Obtain the value from the motor supplier.
- Use the X_2 default setting. The drive establishes the setting based on the motor nameplate data.



NOTE: The parameter value is updated after each torque calibration if option [3] *1st start with store* or option [4] *Every start with store* is selected in parameter 1-47 *Torque Calibration*.

1-35 Main Reactance (Xh)

Default value:	Size related	Parameter type:	Range, 1.0000 - 10000.0000 [Ohm]
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Parameter *1-35 Main Reactance (Xh)* has no effect when parameter *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*.

Set the main reactance of the motor using 1 of these methods:

- Run an AMA on a cold motor. The drive measures the value from the motor.
- Enter the X_h value manually. Obtain the value from the motor supplier.
- Use the X_h default setting. The drive establishes the setting based on the motor nameplate data.



NOTE: The parameter value is updated after each torque calibration if option *[3] 1st start with store* or option *[4] Every start with store* is selected in parameter *1-47 Torque Calibration*.

1-36 Iron Loss Resistance (Rfe)

Default value:	Size related	Parameter type:	Range, 0 - 10000.000 Ohm
Setup:	All setups	Conversion index:	-3
Data type:	Uint32	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the equivalent iron loss resistance (R_{Fe}) value to compensate for iron loss in the motor. The R_{Fe} value cannot be found by performing an AMA. The R_{Fe} value is especially important in torque control applications. If R_{Fe} is unknown, leave parameter *1-36 Iron Loss Resistance (Rfe)* on default setting.

1-37 d-axis Inductance (Ld)

Default value:	Size related	Parameter type:	Range, 0.001 - 1000.000 mH
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False



NOTE: This parameter is only active parameter *1-10 Motor Construction* is set to *[1] PM, non-salient SPM*.

Enter line-to-common direct axis inductance of the PM motor. Obtain the value from the permanent magnet motor datasheet.

For induction motors, stator resistance and d-axis inductance values are normally described technical specifications as between line and common (starpoint). For PM motors, they are typically described in technical specifications as between line-to-line. PM motors are typically built for star connection.

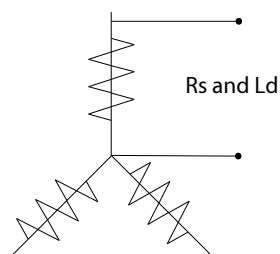
Table 16: Parameters Related to PM Motors

Parameter	Function
Parameter 1-30 Stator Resistance (R_s) (line to common).	This parameter gives stator winding resistance (R_s) similar to asynchronous motor stator resistance. The stator resistance is defined for line-to-common measurement. For line-to-line data, where stator resistance is measured between any 2 lines, divide by 2.
Parameter 1-37 d-axis Inductance (L_d) (line to common).	This parameter gives direct axis inductance of the PM motor. The d-axis inductance is defined for phase-to-common measurement. For line-to-line data, where stator resistance is measured between any 2 lines, divide by 2.
Parameter 1-40 Back EMF at 1000 RPM RMS (line to line value).	This parameter gives back EMF across stator terminal of PM motor at 1000 RPM mechanical speed specifically. It is defined between line-to-line and expressed in RMS value.

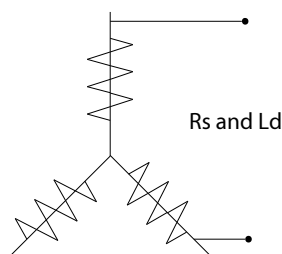


NOTE: Motor manufacturers provide values for stator resistance (parameter **1-30 Stator Resistance (R_s)**) and d-axis inductance (parameter **1-37 d-axis Inductance (L_d)**) in technical specifications as between line and common (starpoint) or line between line. There is no general standard. The different setups of stator winding resistance and induction are shown in the illustration *Stator Winding Setups*. Danfoss AC drives always require the line-to-common value. The back EMF of a PM motor is defined as induced EMF developed across any of 2 phases of stator winding of a free-running motor. Danfoss AC drives always require the line-to-line RMS value measured at 1000 RPM, mechanical speed of rotation, see [Figure 32](#).

Line to common (starpoint)



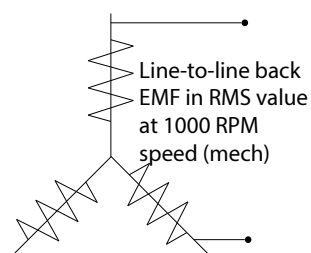
Line-to-line values



e30bc008.12

Figure 31: Stator Winding Setups

Permanent magnet motors



e30bc009.11

Figure 32: Machine Parameter Definitions of Back EMF of PM Motors

1-38 q-axis Inductance (Lq)

Default value:	Size related	Parameter type:	Range, 0.001 - 1000 mH
Setup:	All setups	Conversion index:	-6
Data type:	Int32	Change during operation:	False

Set the value of the q-axis inductance. See the motor datasheet.

1-39 Motor Poles

Default value:	Size related	Parameter type:	Range, 2 - 255
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the number of motor poles. The number of motor poles is always an even number as it refers to the total number of poles, not pairs of poles.

Table 17: Pole Number for Normal Speed Ranges

Poles	~n _n @50 Hz	~n _n @60 Hz
2	2700–2880	3520–3460
4	1350–1450	1625–1730
6	700–960	840–1153

The table shows the pole number for normal speed ranges of various motor types. Define motors designed for other frequencies separately. The motor pole value is always an even number because it refers to the total pole number, not pairs of poles. The drive creates the initial setting of parameter **1-39 Motor Poles** based on parameter **1-23 Motor Frequency** and parameter **1-25 Motor Nominal Speed**.

1-40 Back EMF at 1000 RPM

Default value:	Size related	Parameter type:	Range, 1 - 9000 V
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Conversion index:	False



NOTE: This parameter is only active when parameter **1-10 Motor Construction** is set to options that enable permanent magnet motors.

Set the nominal back EMF for the motor when running at 1000 RPM. Back EMF is the voltage generated by a permanent magnet motor when no drive is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows:

$$\text{BackEMF} = (\text{Voltage} \div \text{RPM}) \times 1000$$

In an example where the voltage is 320 V and RPM is 1800, the back EMF at 1000 RPM is:

$$(320 \div 1800) \times 1000 = 178$$

1-44 d-axis Inductance Sat. (LdSat)

Default value:	Size related	Parameter type:	Range, 0.001 - 1000 mH
Setup:	All setups	Conversion index:	-6
Data type:	Int32	Change during operation:	False

This parameter corresponds to the inductance saturation of Ld. Ideally, this parameter has the same value as parameter **1-37 d-axis Inductance (Ld)**. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value.

1-45 q-axis Inductance Sat. (LqSat)

Default value:	Size related	Parameter type:	Range, 0.001 - 1000 mH
Setup:	All setups	Conversion index:	-6
Data type:	Int32	Change during operation:	False

This parameter corresponds to the inductance saturation of Lq. Ideally, this parameter has the same value as parameter **1-38 q-axis Inductance (Lq)**. If the motor supplier provides an induction curve, enter the induction value at 200% of the nominal value.

1-46 Position Detection Gain

Default value:	120%	Parameter type:	Range, 20 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Adjusts the amplitude of the test pulse during position detection at start. Adjust this parameter to improve the position measurement.

1-47 Torque Calibration

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	-
Data type:	Uint8	Change during operation:	True

Use this parameter to optimize the torque estimate in the full speed range. The estimated torque is based on the shaft power, $P_{\text{shaft}} = P_m - R_s \times I^2$. Make sure that the R_s value is correct. The R_s value in this formula is equal to the power loss in the motor, the cable, and the drive. When this parameter is active, the drive calculates the R_s value during power-up, ensuring the optimal torque estimate and optimal performance. Use this feature in cases when it is not possible to adjust parameter **1-30 Stator Resistance (Rs)** on each drive to compensate for the cable length, drive losses, and the temperature deviation on the motor.

Option	Name	Description
[0]*	Off	
[1]	1st start after pwr-up	Calibrates at the 1st start-up after power-up and keeps this value until reset by a power cycle.
[2]	Every start	Calibrates at every start-up, compensating for a possible change in motor temperature since last start-up. The value is reset after a power cycle.

Option	Name	Description
[3]	1st start with store	The drive calibrates the torque at the 1st start-up after power-up. This option is used to update motor parameters: - Parameter 1-30 Stator Resistance (Rs). - Parameter 1-33 Stator Leakage Reactance (X1). - Parameter 1-34 Rotor Leakage Reactance (X2). - Parameter 1-37 d-axis Inductance (Ld).
[4]	Every start with store	The drive calibrates the torque at every start-up, compensating for a possible change in motor temperature since last start-up. This option is used to update motor parameters: - Parameter 1-30 Stator Resistance (Rs). - Parameter 1-33 Stator Leakage Reactance (X1). - Parameter 1-34 Rotor Leakage Reactance (X2). - Parameter 1-37 d-axis Inductance (Ld).

1-48 d-axis Inductance Sat. Point

Default value:	Size related	Parameter type:	Range, 1 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	False



NOTE: Run an AMA to set the value of this parameter. Edit the value manually only when the application requires a value other than the one determined by AMA.

Select the d-axis inductance saturation point. The drive uses this value to optimize the performance of SynRM motors. Select the value that matches the point where the inductance equals the mean value of parameter **1-37 d-axis Inductance (Ld)** and parameter **1-44 d-axis Inductance Sat. (LdSat)**, as percentage of nominal current.

1-49 q-axis Inductance Sat. Point

Default value:	Size related	Parameter type:	Range, 1 - 500%
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	False



NOTE: Run an AMA to set the value of this parameter. Edit the value manually only when the application requires a value other than determined by AMA.

Enter the q-axis inductance saturation point. The drive uses this value to optimize the performance of IPM motors. Select the value that matches the point where the inductance equals the average value of parameter **1-38 q-axis Inductance (Lq)** and parameter **1-45 q-axis Inductance Sat. (LqSat)**, as a percentage of nominal current.

5.3.7 1-5* Load Indep. Setting

1-50 Motor Magnetization at Zero Speed

Default value:	100%	Parameter type:	Range, 0 - 300%
Setup:	All setups	Conversion index:	0

Data type: Uint16 Change during operation: True



NOTE: Parameter *1-50 Motor Magnetization at Zero Speed* has no effect when parameter *1-10 Motor Construction* = [1] PM, nonsalient SPM.

Use this parameter along with parameter *1-51 Min Speed Normal Magnetizing [RPM]* to obtain a different thermal load on the motor when running at low speed. Enter a value which is a percentage of the rated magnetizing current. If the setting is too low, the torque on the motor shaft may be reduced.

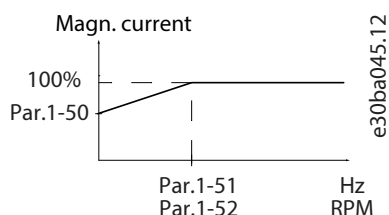


Figure 33: Motor Magnetization

1-51 Min Speed Normal Magnetising [RPM]

Default value:	Size related	Parameter type:	Range, 10 - 300 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True



NOTE: Parameter *1-51 Min Speed Normal Magnetising [RPM]* has no effect when parameter *1-10 Motor Construction* = [1] PM, non-salient SPM.

Set the required speed for normal magnetizing current. If the speed is set lower than the motor slip speed, parameter *1-50 Motor Magnetisation at Zero Speed* and parameter *1-51 Min Speed Normal Magnetising [RPM]* are of no significance. Use this parameter along with parameter *1-50 Motor Magnetisation at Zero Speed*.

1-52 Min Speed Normal Magnetising [Hz]

Default value:	Size related	Parameter type:	Range, 0.3 - 10.0 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: Parameter *1-52 Min Speed Normal Magnetising [Hz]* has no effect when parameter *1-10 Motor Construction* = [1] PM, non-salient SPM.

Set the required frequency for normal magnetizing current. If the frequency is set lower than the motor slip frequency, parameter *1-50 Motor Magnetisation at Zero Speed* is inactive. Use this parameter along with parameter *1-50 Motor Magnetisation at Zero Speed*.

1-53 Model Shift Frequency

Default value:	Size related	Parameter type:	Range, 4 - 45 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Flux model shift: Enter the frequency value for shifting between 2 models for determining motor speed. Select the value based on settings in parameter **1-00 Configuration Mode** and parameter **1-01 Motor Control Principle**. There are the following options:

- Shift between variable current mode and flux model 2.
- No shift between models at low speed if parameter **40-50 Flux Sensorless Model Shift** is set to option **[0] Off**.

Variable current - flux model - sensorless: This model is used when parameter **1-00 Configuration Mode** is set to **[0] Speed open loop** and parameter **1-01 Motor Control Principle** is set to **[2] Flux sensorless**. In speed open loop in flux mode, the speed is determined from the current measurement. Below $f_{norm} \times 0.1$, the drive runs on a variable current model. Above $f_{norm} \times 0.125$ the drive runs on a flux model.

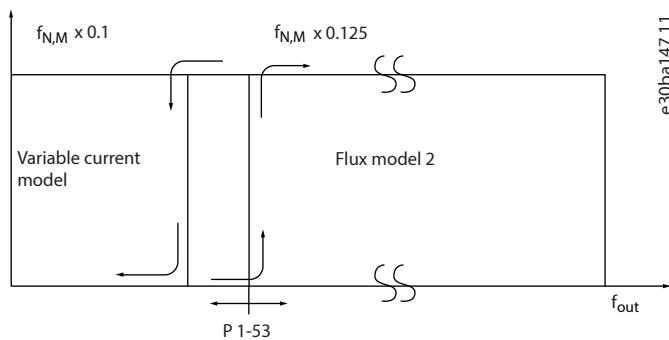


Figure 34: Parameter 1-00 Configuration Mode = [0] Speed Open Loop, Parameter 1-01 Motor Control Principle = [2] Flux Sensorless

1-54 Voltage Reduction in Fieldweakening

Default value:	0 V	Parameter type:	Range, -50 - 100 V
Setup:	All setups	Conversion index:	0
Data type:	Int8	Change during operation:	True

The value of this parameter reduces the maximum voltage available for the flux of the motor in field weakening, providing more voltage for torque. Increasing the value increases the risk of stalling at high speed. When reducing the voltage below 0, the output voltage is increased and at some point the current controller is forced into "Voltage Limit".

1-55 U/f Characteristic - U

Default value:	Size related	Parameter type:	Array [6]
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	True

Enter the voltage at each frequency point to manually form a U/f characteristic matching the motor. The frequency points are defined in parameter **1-56 U/f Characteristic - F**. This parameter is an array parameter [0-5] and is only accessible when parameter **1-01 Motor Control Principle** is set to **[0] U/f**.

1-56 U/f Characteristic - F

Default value:	Size related	Parameter type:	Array [6]
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	True

Enter the frequency points to form a U/f characteristic manually matching the motor. The voltage at each point is defined in parameter **1-55 U/f Characteristic - U**. This parameter is an array parameter [0–5] and is only accessible when parameter **1-01 Motor Control Principle** is set to **[0] U/f**.

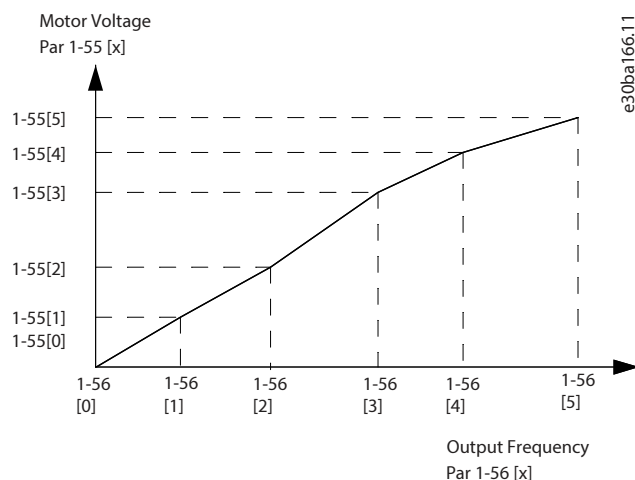


Figure 35: U/f Characteristic

1-58 Flying Start Test Pulses Current

Default value:	Size related	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False



NOTE: This parameter is only available in VVC+.



NOTE: This parameter is active when parameter **1-73 Flying Start** is enabled.

Sets the current level for the flying start test pulses that are used to detect the motor direction. 100% means $I_{m,n}$. Adjust the value to be high enough to avoid noise influence, but low enough to avoid affecting the accuracy (current must be able to drop to 0 before the next pulse). Reduce the value to reduce the generated torque. Default is 30% for asynchronous motors. For permanent magnet motors, the default may vary, but a general setting of 20% is recommended. For adjusting permanent magnet motors, the value tunes for back EMF and d-axis inductance of the motor.

1-59 Flying Start Test Pulses

Default value:	Size related	Parameter type:	Range, 0 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter is active when parameter **1-73 Flying Start** is enabled. The value range and function depend on parameter **1-10 Motor Construction**: **[0] Asynchron**: [0-500%] Control the percentage of the frequency for the pulses used to detect the motor direction. Increasing this value reduces the generated torque. In this mode, 100% means 2 times the slip frequency. **[1] PM non salient** and **[2] PM, salient IPM**: [0-10%] This parameter defines the motor speed (in % of nominal motor speed) below which the parking function (see parameter **2-06 Parking Current** and parameter **2-07 Parking Time**) becomes active. This parameter is only active when parameter **1-70 Start Mode** is set to **[1] Parking** and only after starting the motor.

5.3.8 1-6* Load Depend. Setting

1-60 Low Speed Load Compensation

Default value:	100%	Parameter type:	Range, 0 - 300%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True



NOTE: Parameter *1-60 Low Speed Load Compensation* only has effect when parameter *1-10 Motor Construction* = [0] *Asynchron*.

Enter the % value to compensate voltage in relation to load when the motor is running at low speed and obtain the optimum U/f characteristic. The motor size determines the frequency range within which this parameter is active.

Motor size [kW]	Changeover [Hz]
0.25–7.5	<10
11–45	<5
55–550	<3–4

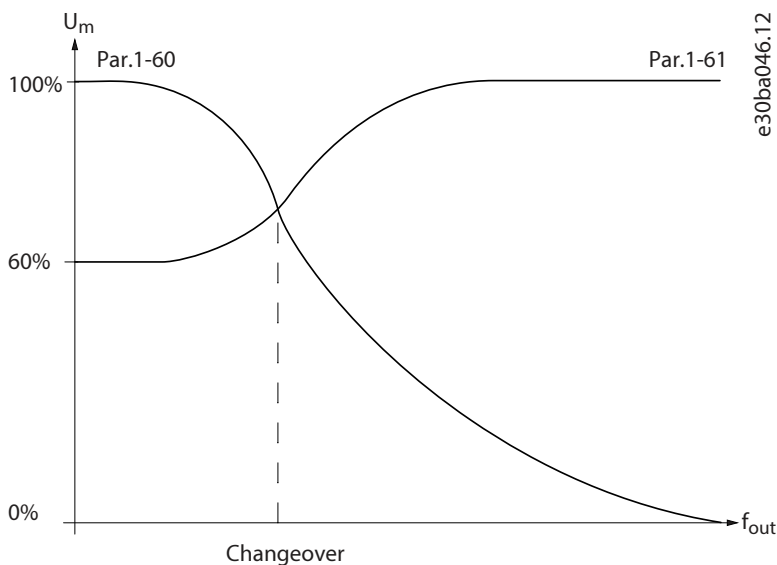


Figure 36: Low-speed Load Compensation

1-61 High Speed Load Compensation

Default value:	100%	Parameter type:	Range, 0 - 300%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True



NOTE: Parameter *1-61 High Speed Load Compensation* only has effect when parameter *1-10 Motor Construction* = [0] *Asynchron*.

Enter the % value to compensate voltage in relation to load when the motor is running at high speed and obtain the optimum U/f characteristic. The motor size determines the frequency range within which this parameter is active.

Motor size	Changeover
0.25–7.5 kW	>10 Hz
11–45 kW	>5 Hz
55–maximum powerHz size kW	>3–4

1-62 Slip Compensation

Default value:	0%	Parameter type:	Range, -500 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True



NOTE: Parameter *1-62 Slip Compensation* only has effect when parameter *1-10 Motor Construction* = [0] *Asynchron*.

Enter the % value for slip compensation to compensate for tolerances in the value of $n_{M,N}$. Slip compensation is calculated automatically, that is on the basis of the nominal motor speed $n_{M,N}$. Slip compensation is calculated automatically based on the rated motor speed $n_{M,N}$.

1-63 Slip Compensation Time Constant

Default value:	Size related	Parameter type:	Range, 0.05 - 5 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True



NOTE: Parameter *1-63 Slip Compensation Time Constant* only has effect when parameter *1-10 Motor Construction* = [0] *Asynchron*.

Enter the slip compensation reaction speed. A high value results in slow reaction, and a low value results in quick reaction. If low-frequency resonance problems arise, use a longer time setting.

1-64 Resonance Damping

Default value:	Size related	Parameter type:	Range, 0 - 500%
Setup:	All setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True



NOTE: Parameter *1-64 Resonance Damping* only has effect when parameter *1-10 Motor Construction* = [0] *Asynchron*.

Enter the resonance damping value. Set parameter *1-64 Resonance Damping* and parameter *1-65 Resonance Damping Time Constant* to help eliminate high-frequency resonance problems. To reduce resonance oscillation, increase the value of parameter *1-64 Resonance Damping*.

1-65 Resonance Damping Time Constant

Default value:	5 ms	Parameter type:	Range, 1 - 50 ms
Setup:	All setups	Conversion index:	-3
Data type:	Uint8	Change during operation:	True



NOTE: Parameter *1-65 Resonance Damping Time Constant* only has effect when parameter *1-10 Motor Construction* = [0] *Asynchron*.

Set parameter *1-64 Resonance Damping* and parameter *1-65 Resonance Damping Time Constant* to help eliminate high-frequency resonance problems. Enter the time constant that provides the best dampening.

1-66 Min. Current at Low Speed

Default value:	Size related	Parameter type:	Range, 1 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True



NOTE: If parameter *40-50 Flux Sensorless Model Shift* is set to [0] *Off*, this parameter is ignored.

Enter the minimum motor current at low speed, see parameter *1-53 Model Shift Frequency*. Increasing this current improves motor torque at low speed. Parameter *1-66 Min. Current at Low Speed* is enabled when parameter *1-00 Configuration Mode* is set to [0] *Speed open loop* only. The drive runs with constant current through motor for speeds below 10 Hz. For speeds above 10 Hz, the motor flux model in the drive controls the motor. Parameter *4-16 Torque Limit Motor Mode* and/or parameter *4-17 Torque Limit Generator Mode* automatically adjust parameter *1-66 Min. Current at Low Speed*. The parameter with the highest value adjusts parameter *1-66 Min. Current at Low Speed*. The current setting in parameter *1-66 Min. Current at Low Speed* is composed of the torque generating current and the magnetizing current. **Example:** Set parameter *4-16 Torque Limit Motor Mode* to 100% and set parameter *4-17 Torque Limit Generator Mode* to 60%. Parameter *1-66 Min. Current at Low Speed* automatically adjusts to about 127%, depending on the motor size.

1-67 Load Type

Default setting:	[0] Passive load	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Passive load	For conveyors, fans, and pump applications.
[1]	Active load	For hoisting applications. This option allows the drive to ramp up at 0 RPM. When [1] <i>Active Load</i> is selected, set parameter <i>1-66 Min. Current at Low Speed</i> to a level which corresponds to maximum torque.

1-68 Motor Inertia

Default value:	0 kgm	Parameter type:	Range, 0.0000 - 10000.0000 kgm ²
Setup:	All setups	Conversion index:	–4
Data type:	Uint32	Change during operation:	False

Enter the motor inertia to obtain an improved torque readout and therefore a better estimate of the mechanical torque on the shaft. Available in flux control principle only.

1-69 System Inertia

Default value:	Size related	Parameter type:	Range, 0000 - 10000.0000 kgm ²
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

The system inertia and parameter **7-08 Speed PID Feed Forward Factor** is used to calculate acceleration feed forward for the speed PID controller. Automatic measurement of system inertia and setting of this parameter is activated by setting the parameter to 0. System inertia is calculated after the 1st running cycle with sufficient data and the parameter is automatically set after stop. The function is only active when parameter **1-01 Motor Control Principle** is set to **[2] Flux Sensorless**. Accelerate to at least model shift frequency (parameter **1-53 Model Shift Frequency**) + 10 Hz and decelerate to produce a result. Measurement is possible in both speed, position, or synchronization mode.

5.3.9 1-7* Start Adjustments

1-70 Start Mode

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the start-up mode. This is done to initialize the VVC+ control core for previously free-running motor. Both selections estimate the speed and angle. Active for PM and SynRM motors in VVC+ only.

Option	Name	Description
[0]	Rotor detection	Estimates the electrical angle of the rotor and uses this as a starting point. Standard selection for automation applications.
[1]	Parking	The parking function applies DC current across the stator winding and rotates the rotor to electrical 0 position (typically selected for HVAC applications). Parking current and time are configured in parameter 2-06 Parking Current and parameter 2-07 Parking Time .
[2]	Rotor det. w/parking	Combining rotor detection with the parking function.
[4]	Rotor detection II	Estimates the electrical angle of the rotor by sending out test pulses. If the motor is restarted in less than 1.0 s, this function does a 2nd measurement. If movement is detected, the start will be delayed for maximum 10 s.

1-71 Start Delay

Default value:	00 s	Parameter type:	Range, 0 - 300 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Enter the time delay between the start command and the time when the drive supplies the power to the motor. This parameter refers to the start function selected in parameter **1-72 Start Function**. Enter the time delay required before commencing acceleration.

1-72 Start Function

Default value:	[2] Coast	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the start function during start delay. This parameter is linked to parameter **1-71 Start Delay**.

Option	Name	Description
[0]	DC hold/motor preheat	Energize the motor with a DC hold current (parameter 2-00 DC Hold Current) during the start delay time.
[2]*	Coast	Motor coasted during the start delay time (inverter off).

1-73 Flying Start

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False



NOTE: This function is not recommended for hoisting applications. For power levels above 55 kW, flux mode must be used to achieve the best performance.



NOTE: To obtain the best flying start performance, the advanced motor data, parameter **1-30 Stator Resistance (Rs)** to parameter **1-35 Main Reactance (Xh)**, must be correct.

This function makes it possible to catch a freely spinning motor, for example, coasted because of mains dropout. When parameter **1-73 Flying Start** is enabled, parameter **1-71 Start Delay** has no function. Search direction for flying start is linked to the setting in parameter **4-10 Motor Speed Direction**. **[0] Clockwise:** Flying start searches in clockwise direction. If not successful, a DC brake is carried out. **[2] Both Directions:** The flying start first searches in the direction determined by the last reference (direction). If the speed is not found, flying start searches in the other direction. If not successful, a DC brake activates in the time set in parameter **2-02 DC Braking Time**. Start then takes place from 0 Hz.

Option	Name	Description
[0]	Disabled	No function.
[1]	Enabled	Enable after coast.
[2]	Enabled always	Enable at every start.
[3]	Enabled ref. dir.	Enable after coast, search in reference direction only.
[4]	Enab. always ref. dir.	Enable at every start, search in reference direction only.
[11]	v2 Enabled	Enable flying start version 2, after coast.
[12]	v2 Enabled Always	Enable flying start version 2, at every start.
[13]	v2 Enabled Ref. Dir.	Enable flying start version 2, after coast, search in reference direction only.
[14]	v2 Enab. Alw. Ref. Dir.	Enable flying start version 2, OK at every start, search in reference direction only.

The flying-start function used for PM motors is based on an initial parameter speed estimation. The speed is always estimated as the 1st thing after an active start signal is given. Based on the setting of **1-70 Start Mode**, the following happens:

Parameter **1-70 Start Mode = [0] Rotor Detection**: If the speed estimate appears as greater than 0 Hz, the drive catches the motor at that speed and resumes normal operation. Otherwise, the drive estimates the rotor position and starts normal operation from there.

Parameter **1-70 Start Mode = [1] Parking**: A speed estimate lower than the setting in parameter **1-59 Flying Start Test Pulses Frequency** engages the parking function (see parameter **2-06 Parking Current** and parameter **2-07 Parking Time**). Otherwise, the drive catches the motor at that speed and resumes normal operation. Refer to the description of parameter **1-70 Start Mode** for recommended settings.

Current limitations of the flying-start principle used for PM motors:

- The speed range is up to 100% nominal speed or the field weakening speed (whichever is lowest).
- PMSM with high back EMF (>300 VLL(rms)) and high-winding inductance (>10 mH) needs more time for reducing short-circuit current to 0 and may be susceptible to error in estimation.
- Current testing limited to a speed range up to 300 Hz. For certain units, the limit is 250 Hz; all 200–240 V units up to and including 2.2 kW (3.0 hp) and all 380–480 V units up to and including 4 kW (5.0 hp).
- Current testing limited to a machine power size up to 22 kW (30 hp).
- Prepared for salient-pole machine (IPMSM) but not yet verified on those types of machines.
- For high-inertia applications (that is, where the load inertia is more than 30 times larger than the motor inertia), use a brake resistor to avoid overvoltage trip during high-speed engagement of the flying-start function.

1-77 Compressor Start Max Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 Motor Speed High Limit [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint 16	Change during operation:	True



NOTE: Parameter **1-77 Compressor Start Max Speed [RPM]** has no effect when parameter **1-10 Motor Construction = [1] PM, non-salient SPM**.

The parameter enables high starting torque. This is a function where the current limit and torque limit are ignored during start of the motor. The time from the start signal is given, until the speed exceeds the speed set in this parameter, becomes a start-zone where the current limit and motoric torque limit is set to what is maximally possible for the drive/motor combination. This parameter is normally set to the same value as parameter **4-11 Motor Speed Low Limit [RPM]**. When set to 0, the function is inactive. In this starting-zone, parameter **3-82 Starting Ramp Up Time** is active to ensure extra acceleration during the start and to minimize the time where the motor is operated under the minimum speed for the application. The time without protection from the current limit and torque limit must not exceed the value set in parameter **1-79 Compressor Start Max Time to Trip**. If the value in parameter **1-79 Compressor Start Max Time to Trip** is exceeded, the drive trips with *alarm 18, Start failed*. When this function is activated to get a fast start, parameter **1-86 Trip Speed Low [RPM]** is also activated to protect the application from running below minimum motor speed, for example when in current limit. This function allows high starting torque and use of a fast starting ramp. To ensure the build-up of a high torque during the start, enter appropriate values for start delay/start speed/start current.

1-78 Compressor Start Max Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-14 Motor Speed High Limit [Hz]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: Parameter *1-78 Compressor Start Max Speed [Hz]* has no effect when parameter *1-10 Motor Construction* = [1] PM, non-salient SPM.

The parameter enables high starting torque. This is a function where the current limit and torque limit are ignored during start of the motor. The time, from the start signal is given until the speed exceeds the speed set in this parameter, becomes a start-zone where the current limit and motoric torque limit is set to what is maximally possible for the drive/motor combination. This parameter is normally set to the same value as parameter *4-11 Motor Speed Low Limit [RPM]*. When set to 0, the function is inactive. In this starting-zone, parameter *3-82 Starting Ramp Up Time* is active instead of parameter *3-41 Ramp 1 Ramp Up Time* to ensure extra acceleration during the start, and to minimize the time where the motor is operated under the minimum speed for the application. The time without protection from the current limit and torque limit must not exceed the value set in parameter *1-79 Compressor Start Max Time to Trip*. If the value in parameter *1-79 Compressor Start Max Time to Trip* is exceeded, the drive trips with *alarm 18, Start failed*. When this function is activated to get a fast start, parameter *1-86 Trip Speed Low [RPM]* is also activated to protect the application from running below minimum motor speed, for example when in current limit. This function allows high starting torque and use of a fast starting ramp. To ensure the build-up of a high torque during the start, enter appropriate values for start delay/start speed/start current.

1-79 Compressor Start Max Time to Trip

Default value:	0 s	Parameter type:	Range, 0 - 3600.0 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: Parameter *1-79 Compressor Start Max Time to Trip* has no effect when parameter *1-10 Motor Construction* = [1] PM, non-salient SPM.

The time from the start signal is given until the speed exceeds the speed set in parameter *1-77 Compressor Start Max Speed [RPM]* must not exceed the time set in the parameter. If the time set is exceeded, the drive trips with *alarm 18, Start failed*. Any time set in parameter *1-71 Start Delay* for use of a start function must be executed within the time limit.

5.3.10 1-8* Stop Adjustments

1-80 Function at Stop

Default value:	[0] Coast	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the drive function after a stop command or after the speed is ramped down to the settings in parameter *1-81 Min Speed for Function at Stop [RPM]*. Available selections depend on parameter *1-10 Motor Construction*:

- [0] Asynchronous:
 - [0] Coast
 - [1] DC hold
 - [2] Motor check, warning
 - [6] Motor check, alarm
- [1] PM non-salient:
 - [0] Coast

Option	Name	Description
[0]*	Coast	Leaves motor in free mode. The motor is disconnected from the drive.
[1]	DC hold/motor preheat	Energizes the motor with a DC hold current (see parameter 2-00 DC Hold Current).
[2]	Motor check, warning	The drive issues a warning if 1 or more motor phases are missing.
[6]	Motor check, alarm	The drive issues an alarm if 1 or more motor phases are missing.

1-81 Min Speed for Function at Stop [RPM]

Default value:	Size related	Parameter type:	Range, 0 - 600 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Set the speed at which to activate parameter **1-80 Function at Stop**.

1-82 Min Speed for Function at Stop [Hz]

Default:	Size related	Parameter type:	Range, 0 - 20.0 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the output frequency at which to activate parameter **1-80 Function at Stop**.

Advanced minimum speed monitoring for submersible pumps

Some pumps are sensitive to operating at low speed. Insufficient cooling or lubrication at low speed are typical reasons.

Under overload conditions, the drive protects itself using its integral protection features, which include lowering the speed. For example, the current limit controller can lower the speed. Sometimes, the speed may go lower than the speed specified in parameter **4-11 Motor Speed Low Limit [RPM]** and parameter **4-12 Motor Speed Low Limit [Hz]**.

If the speed drops below a certain value, the advanced minimum-speed monitoring feature trips the drive. If the pump does not reach the speed specified in parameter **1-86 Trip Speed Low [RPM]** within the time specified in parameter **1-79 Pump Start Max Time to Trip** (ramping takes too long), the drive trips. Timers for parameter **1-71 Start Delay** and parameter **1-79 Pump Start Max Time to Trip** start at the same time when the start command is issued. For instance, this means that if the value in parameter **1-71 Start Delay** is more than or equal to the value in parameter **1-79 Pump Start Max Time to Trip**, the drive never starts.

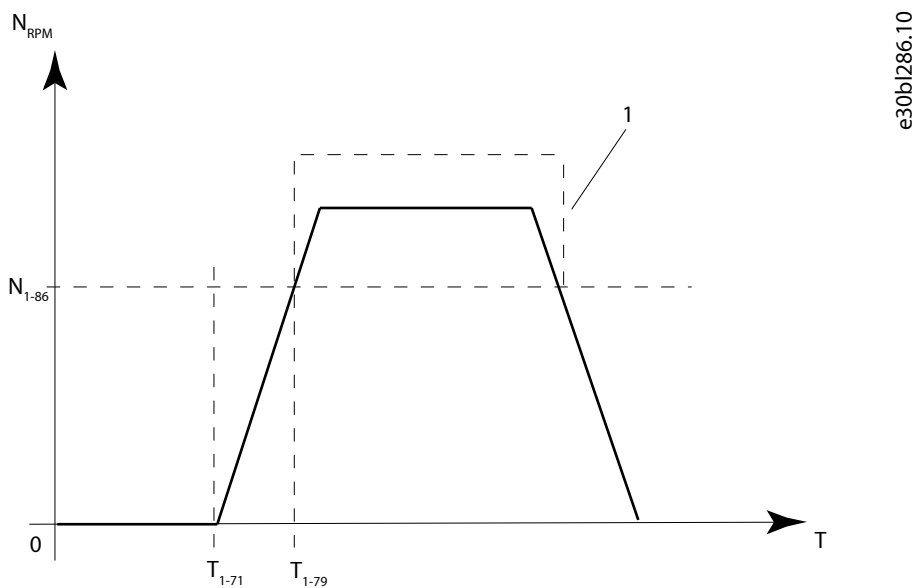


Figure 37: Advanced Minimum Speed Monitoring

T_{1-71}	Parameter 1-71 Start Delay	T_{1-79}	Parameter 1-79 Pump Start Max to Trip . This time includes the time in T_{1-71} .
N_{1-86}	Parameter 1-86 Trip Speed Low [RPM] . If the speed drops below this value during normal operation, the drive trips.	1	Normal operation.

1-86 Trip Speed Low [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 Motor Speed High Limit [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is only available if parameter **0-02 Motor Speed Unit** is set to **[11] RPM**.

Enter the low limit for the motor speed at which the drive trips. If the value is 0, the function is not active. If the speed at any time after the start (or during a stop) drops below the value in the parameter, the drive trips with *alarm 49, Speed Limit*.

1-87 Trip Speed Low [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-14 Motor Speed High Limit [Hz]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is only available if parameter **0-02 Motor Speed Unit** is set to **[1] Hz**.

Enter the low limit for the motor speed at which the drive trips. If the value is 0, the function is not active. If the speed at any time after the start (or during a stop) drops below the value in the parameter, the drive trips with *alarm 49, Speed Limit*.

5.3.11 1-9* Motor Temperature

1-90 Motor Thermal Protection

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Motor thermal protection can be implemented using a range of techniques:

- Via a PTC sensor in the motor windings connected to 1 of the analog or digital inputs (parameter **1-93 Thermistor Resource**). See [5.3.11.1.1 PTC Thermistor Connection](#).
- Via calculation (ETR = Electronic Thermal Relay) of the thermal load, based on the actual load and time. The calculated thermal load is compared with the rated motor current $I_{M,N}$ and the rated motor frequency $f_{M,N}$. See [5.3.11.1.2 ETR](#) and [5.3.11.1.3 ATEX ETR](#).
- Via a mechanical thermal switch (Klixon type). See [5.3.11.1.4 Klixon](#).

For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.

Option	Name	Description
[0]	No protection	Continuously overloaded motor when no warning or trip of the drive is required.
[1]	Thermistor warning	Activates a warning when the connected thermistor in the motor reacts if there is a motor overtemperature.
[2]	Thermistor trip	Stops (trips) the drive when connected thermistor in the motor reacts if there is a motor overtemperature.
[3]	ETR warning 1	Calculates the load when setup 1 is active and activates a warning on the display when the motor is overloaded. Program a warning signal via 1 of the digital outputs.
[4]	ETR trip 1	Calculates the load when setup 1 is active and stops (trips) the drive when the motor is overloaded. Program a warning signal via 1 of the digital outputs. The signal appears in the event of a warning and if the drive trips (thermal warning).
[5]	ETR warning 2	Same as [3] ETR warning 1 , but for setup 2.
[6]	ETR trip 2	Same as [4] ETR trip 1 but for setup 2.
[7]	ETR warning 3	Same as [3] ETR warning 1 but for setup 3.
[8]	ETR trip 3	Same as [4] ETR trip 1 but for setup 3.
[9]	ETR warning 4	Same as [3] ETR warning 1 but for setup 4.
[10]	ETR trip 4	Same as [4] ETR trip 1 but for setup 4.
[20]	ATEX ETR	Activates the thermal monitoring function for Ex-e motors for ATEX. Enables parameter 1-94 ATEX ETR cur.lim. speed reduction , parameter 1-98 ATEX ETR interpol. points freq. , and parameter 1-99 ATEX ETR interpol points current .
[21]	Advanced ETR	

1-91 Motor External Fan

Default value:	[0] No	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True
Option	Name	Description	
[0]*	No	No external fan is required, that is the motor is derated at low speed.	
[1]	Yes	Applies an external motor fan (external ventilation), so no derating of the motor is required at low speed. The upper curve in the illustration below ($f_{out} = 1 \times f_{M,N}$) is followed if the motor current is lower than nominal motor current (see parameter 1-24 Motor Current). If the motor current exceeds nominal current, the operation time still decreases as if no fan was installed.	

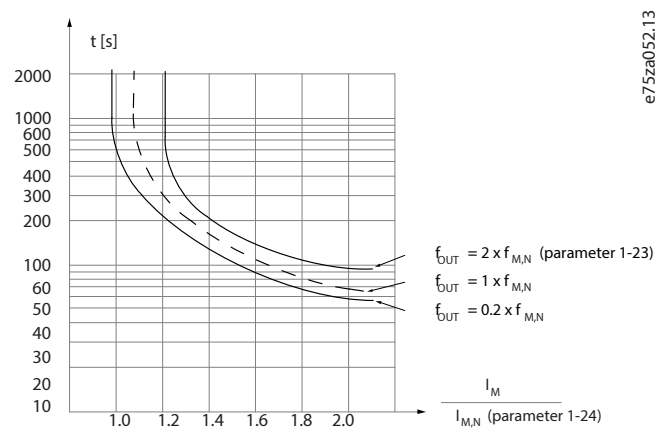


Figure 38: ETR Profile

1-93 Thermistor Resource

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

NOTE: This parameter cannot be adjusted while the motor is running.

NOTE: Set digital input to **[0] PNP - Active at 24 V** in parameter **5-00 Digital I/O Mode**.

NOTE: When using VLT® PTC Thermistor Card MCB 112 always select **[0] None**.

Select the input to which the thermistor (PTC sensor) should be connected. An analog input option **[1] Analog Input 53** or **[2] Analog Input 54** cannot be selected if the analog input is already in use as a reference source (selected in parameter **3-15 Reference Resource 1**, parameter **3-16 Reference Resource 2**, or parameter **3-17 Reference Resource 3**).

Option	Name	Description
[0]*	None	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Digital input 18	
[4]	Digital input 19	
[5]	Digital input 32	
[6]	Digital input 33	

1-94 ATEX ETR Cur. Lim. Speed Reduction

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	2 setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Only visible if parameter **1-90 Motor Thermal Protection** is set to **[20] ATEX ETR**.

1-95 Thermistor Sensor Type

Default value:	[0] KTY Sensor 1	Parameter type:	Option
Setup:	All setups	Conversion index:	-
Data type:	Uint8	Change during operation:	True

Select the used type of thermistor sensor.

Option	Name	Description
[0]*	KTY sensor 1	1 kΩ at 100 °C (212 °F).
[1]	KTY sensor 2	1 kΩ at 25 °C (77 °F).
[2]	KTY sensor 3	2 kΩ at 25 °C (77 °F).
[3]	Pt1000	1 kΩ at 0 °C (32 °F).
[4]	Ni1000 (6178 ppm/K)	1 kΩ at 0 °C (32 °F).
[5]	Ni1000-LG (TC5)	Examples: - Siemens LG-Ni1000 - Tasseron RTD Ni1000-TC5 1000 Ohm

1-96 Thermistor Sensor Resource

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	-
Data type:	Uint8	Change during operation:	True

Select analog input terminal 54 to be used for connection of KTY/Pt1000/Ni1000 thermistor sensor. Terminal 54 cannot be selected as thermistor source if otherwise used as reference (see parameter **3-15 Reference Resource 1** to parameter **3-17 Reference Resource 3**).



NOTE: Connection of thermistor sensor between terminals 54 and 55 (GND).

Option	Name	Description
[0]*	None	
[2]	Analog input 54	

1-97 Thermistor Threshold Level

Default value:	80 °C	Parameter type:	Range, -40...220 °C
Setup:	1 setup	Conversion index:	100
Data type:	Int16	Change during operation:	True

Select the thermistor sensor threshold level for motor thermal protection.

1-98 ATEX ETR Interpol. Points Freq.

Default value:	Size related	Parameter type:	Array [4]
Setup:	1 setup	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Only visible if parameter **1-90 Motor Thermal Protection** is set to **[20] ATEX ETR**.

Enter the 4 frequency points [Hz] from the motor nameplate into this array.



NOTE: All frequency/current limit points from the motor nameplate or motor datasheet must be programmed.

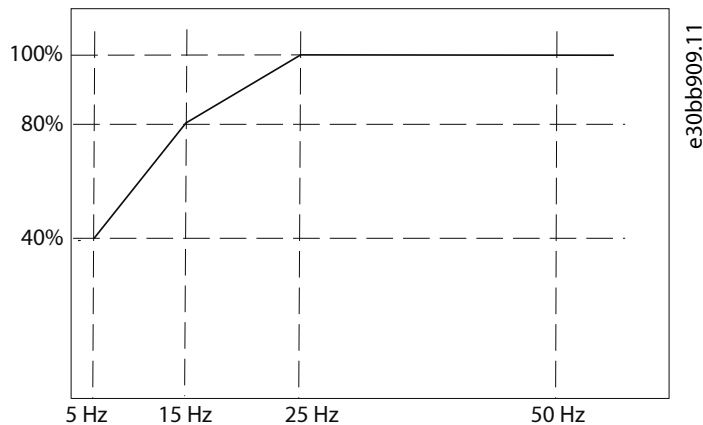


Figure 39: Example of ATEX ETR Thermal Limitation Curve

1-99 ATEX ETR Interpol. Points Current

Default value:	Size related	Parameter type:	Array [4]
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Definition of the thermal limitation curve. For example, see parameter **1-98 ATEX ETR Interpol. Points Freq.**

5.3.11.1 Connections Related to Motor Temperature Control

5.3.11.1.1 PTC Thermistor Connection

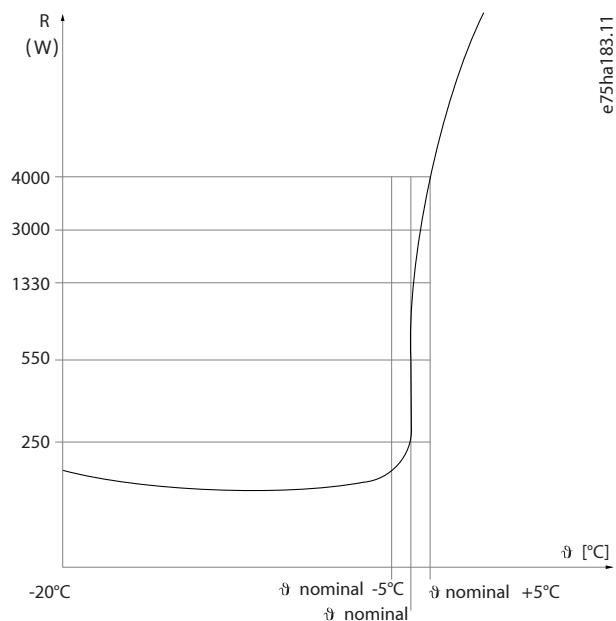


Figure 40: PTC Profile

Using a digital input and 10 V as supply: Example: The drive trips when the motor temperature is too high.

Parameter setup:

- Set parameter **1-90 Motor Thermal Protection** to **[2] Thermistor Trip**.
- Set parameter **1-93 Thermistor Source** to **[6] Digital Input**.

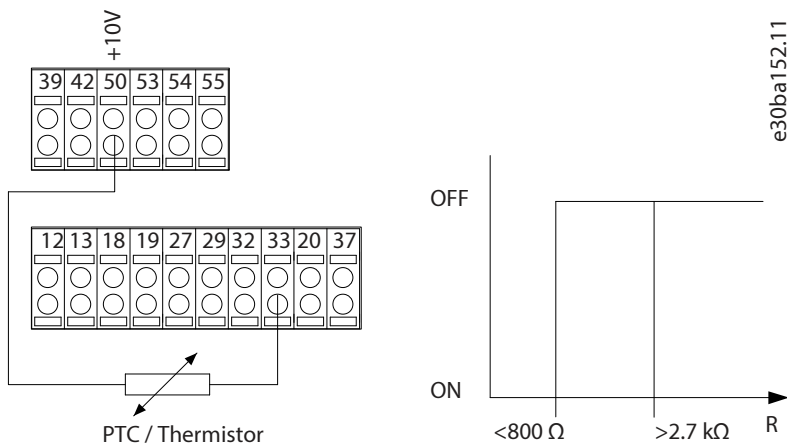


Figure 41: PTC Thermistor Connection - Digital Input

Using an analog input and 10 V as supply: Example: The drive trips when the motor temperature is too high.

Parameter setup:

- Set parameter **1-90 Motor Thermal Protection** to **[2] Thermistor Trip**.
- Set parameter **1-93 Thermistor Source** to **[2] Analog Input 54**.

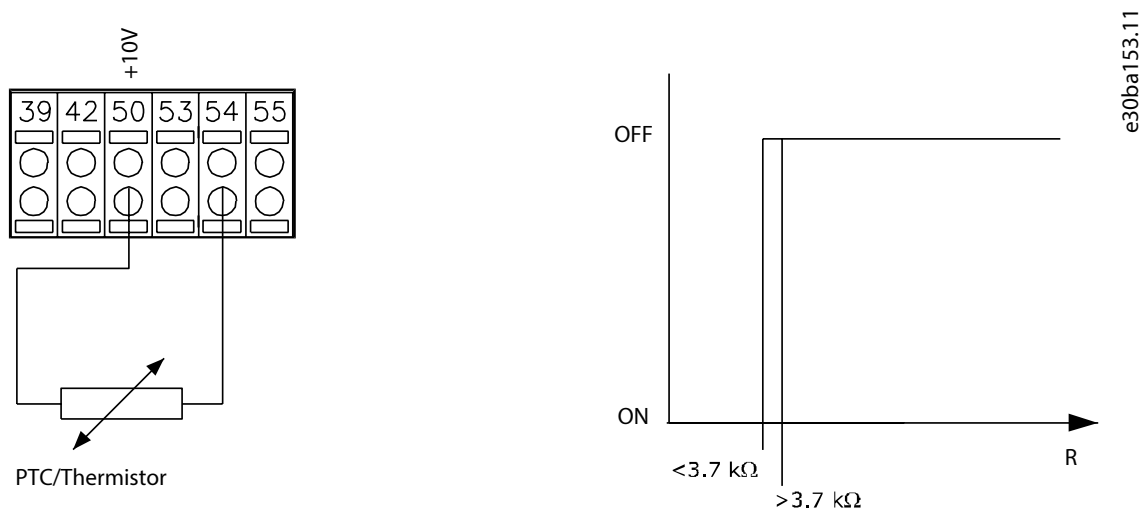


Figure 42: PTC Thermistor Connection - Analog Input

Table 18: Threshold Cutout Values

Input digital/analog	Supply voltage	Threshold cutout values
Digital	10 V	$<800 \Omega \Rightarrow 2.7 \text{ k}\Omega$
Analog	10 V	$<3.0 \text{ k}\Omega \Rightarrow 3.0 \text{ k}\Omega$



NOTE: Check that the selected supply voltage follows the specification of the used thermistor element.

5.3.11.1.2 ETR

The calculations estimate the need for a lower load at lower speed due to less cooling from the fan incorporated in the motor.

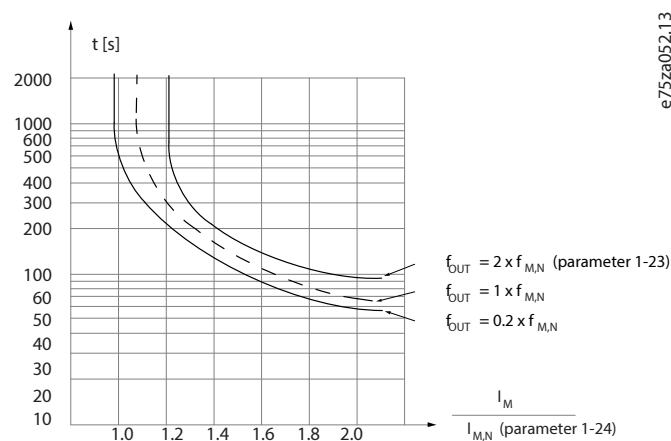


Figure 43: ETR Profile

5.3.11.1.3 ATEX ETR

The VLT® PTC Thermistor Card MCB 112 offers ATEX-approved monitoring of motor temperature. Alternatively, an external ATEX-approved PTC protection device can be used.



NOTE: Only use ATEX Ex-e-approved motors for this function. See motor nameplate, approval certificate, datasheet, or contact motor supplier.

When controlling an Ex-e motor with increased safety, it is important to ensure certain limitations. The parameters that must be programmed are presented in [Table 19](#).

Table 19: Parameters

Function	Setting
Parameter 1-90 Motor Thermal Protection	[20] ATEX ETR
Parameter 1-94 ATEX ETR cur.lim. speed reduction	20%
Parameter 1-98 ATEX ETR interpol. points freq.	Motor nameplate.
Parameter 1-99 ATEX ETR interpol points current	
Parameter 1-23 Motor Frequency	Enter the same value as for parameter 4-19 Max Output Frequency.
Parameter 4-19 Max Output Frequency	Motor nameplate, possibly reduced for long motor cables, sine-wave filter, or reduced supply voltage.
Parameter 4-18 Current Limit	Forced to 150% by 1-90 [20]
Parameter 5-15 Terminal 33 Digital Input	[80] PTC Card 1
Parameter 5-19 Terminal 37 Safe Stop	[4] PTC 1 Alarm
Parameter 14-01 Switching Frequency	Check that the default value fulfills the requirement from the motor nameplate. If not, use a sine-wave filter.
Parameter 14-26 Trip Delay at Inverter Fault	0



NOTE: Compare the minimum switching frequency requirement stated by the motor manufacturer to the minimum switching frequency of the drive, the default value in parameter 14-01 *Switching Frequency*. If the drive does not meet this requirement, use a sine-wave filter.

5.3.11.1.4 Klixon

The Klixon type thermal circuit breaker uses a KLIXON® metal dish. At a predetermined overload, the heat caused by the current through the disc causes a trip.

Using a digital input and 24 V as supply:

Example: The drive trips when the motor temperature is too high.

Parameter setup:

- Set parameter 1-90 Motor Thermal Protection to [2] Thermistor Trip.
- Set parameter 1-93 Thermistor Source to [6] Digital Input.

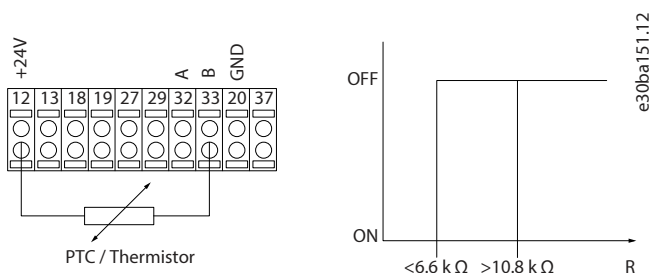


Figure 44: Thermistor Connection

5.4 Parameter Group 2-** Brakes

5.4.1 2-0* DC Brakes

Use the parameters in this group for configuring the DC brake and DC hold functions.

2-00 DC Hold/Preheat

Default value:	50%	Parameter type:	Range, 0 - 160%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True



NOTE: The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor. In VVC+ control core, low values (<20%) of DC hold may result in wrong currents with larger motor sizes (>90 kW) and should be avoided. In cases when low DC hold currents with larger motors are required, select Flux control core to ensure the right currents.

Enter a value for holding current as a percentage of the rated motor current $I_{M,N}$ set in parameter **1-24 Motor Current**. 100% DC hold current corresponds to $I_{M,N}$. This parameter holds the motor function (holding torque) or preheats the motor. This parameter is active if **DC hold** is selected in parameter **1-72 Start Function** or parameter **1-80 Function at Stop**.

2-01 DC Brake Current

Default value:	50%	Parameter type:	Range, 0 - 1000%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True



NOTE: The maximum value depends on the rated motor current. Avoid 100% current for too long. It may damage the motor.

Enter a value for current as a percentage of the rated motor current $I_{M,N}$, see parameter **1-24 Motor Current**. 100% DC brake current corresponds to $I_{M,N}$. DC brake current is applied on a stop command, when the speed is lower than the limit set in parameter **2-03 DC Brake Cut In Speed [RPM]**; when the DC brake inverse function is active, or via the serial communication port. The braking current is active during the time period set in parameter **2-02 DC Braking Time**.

2-02 DC Braking Time

Default value:	10 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the duration of the DC brake current set in parameter **2-01 DC Brake Current**, once activated.

2-03 DC Brake Cut In Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Set the DC brake cut-in speed for activation of the DC brake current set in parameter **2-01 DC Brake Current**, upon a stop command.

2-06 Parking Current

Default value:	50%	Parameter type:	Range, 0 - 1000%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set current as percentage of rated motor current, parameter **1-24 Motor Current**. Is used when enabled in parameter **1-70 Start Mode**.

2-07 Parking Time

Default value:	3 s	Parameter type:	Range, 0.1 - 60 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the duration of the parking current set in parameter **2-06 Parking Current**, once activated.

5.4.2 2-1* Brake Energy Funct.

This parameter group contains dynamic brake parameters. The parameters in this group are only valid for drives with brake chopper.

2-10 Brake Function

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	Off	No brake resistor installed.
[1]	Resistor brake	A brake resistor is incorporated in the system for dissipation of surplus brake energy as heat. Connecting a brake resistor allows a higher DC-link voltage during braking (generating operation). The resistor brake function is only active in drives with an integral dynamic brake.
[2]	AC brake	Improves braking without using a brake resistor. This parameter controls an overmagnetization of the motor when running with a generative load. This function can improve the OVC function. Increasing the electrical losses in the motor allows the OVC function to increase the braking torque without exceeding the overvoltage limit.



NOTE: The AC brake is not as efficient as dynamic braking with resistor. AC brake is for VVC+ mode in both open and closed loop.

2-11 Brake Resistor (ohm)

Default value:	Size related	Parameter type:	Range, 5 - 65535 Ohm
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the brake resistor value in Ω . This value is used for monitoring the power to the brake resistor in parameter **2-13 Brake Power Monitoring**. This parameter is only active in drives with an integral dynamic brake. Use this parameter for values without decimals. For a selection with 2 decimals, use parameter **30-81 Brake Resistor (ohm)**.

2-12 Brake Power Limit (kW)

Default value:	Size related	Parameter type:	Range, 0.001 - 2000.000 kW
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Parameter **2-12 Brake Power Limit (kW)** is the expected average power dissipated in the brake resistor over a period of 120 s. It is used as the monitoring limit for parameter **16-33 Brake Energy Average** and thereby specifies when a warning/alarm is to be given. To calculate parameter **2-12 Brake Power Limit (kW)**, the following formula can be used. $P_{br,avg}$ is the average power dissipated in the brake resistor. R_{br} is the resistance of the brake resistor. t_{br} is the active braking time within the 120 s period, T_{br} . U_{br} is the DC voltage where the brake resistor is active. This depends on the unit as follows:

$$P_{br,avg}[W] = \frac{U_{br}^2[V] \times t_{br}[s]}{R_{br}[\Omega] \times T_{br}[s]}$$

- T2 units: 390 V
- T4 units: 778 V
- T5 units: 810 V
- T6 units: 943 V/1099 V for D–F enclosures
- T7 units: 1099 V



NOTE: If R_{br} is not known, or if T_{br} is different from 120 s, the practical approach is to run the brake application, read parameter **16-33 Brake Energy Average** and then enter this + 20% in parameter **2-12 Brake Power Limit (kW)**.

2-13 Brake Power Monitoring

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is only active in drives with a brake. This parameter enables monitoring of the power to the brake resistor. The power is calculated based on the resistance (parameter **2-11 Brake Resistor (ohm)**), the DC-link voltage, and the resistor duty time. If power monitoring is set to **[0] Off** or **[1] Warning**, the brake function remains active, even if the monitoring limit is exceeded. This may lead to thermal overload of the resistor. It is also possible to generate a warning via a relay/digital output. The measuring accuracy of the power monitoring depends on the accuracy of the resistance of the resistor (better than $\pm 20\%$).

Option	Name	Description
[0]*	Off	No brake power monitoring required.
[1]	Warning 120s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (parameter 2-12 Brake Power Limit (kW)). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[2]	Trip 120s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[3]	Warning & Trip 120s	Activates both of the above, including warning and alarm.

Option	Name	Description
[4]	Warning 30s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (parameter 2-12 Brake Power Limit (kW)). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[5]	Trip 30s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[6]	Warning & trip 30s	Activates both of the above, including warning and alarm.
[7]	Warning 60s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (parameter 2-12 Brake Power Limit (kW)). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[8]	Trip 60s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[9]	Warning & trip 60s	Activates both of the above, including warning and alarm.
[10]	Warning 300s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (parameter 2-12 Brake Power Limit (kW)). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[11]	Trip 300s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[12]	Warning & trip 300s	Activates both of the above, including warning and alarm.
[13]	Warning 600s	Activates a warning on the display when the power transmitted during the duty time exceeds 100% of the monitoring limit (parameter 2-12 Brake Power Limit (kW)). The warning disappears when the transmitted power drops below 80% of the monitoring limit.
[14]	Trip 600s	Trips the drive and shows an alarm when the calculated power exceeds 100% of the monitoring limit.
[15]	Warning & trip 600s	Activates both of the above, including warning and alarm.

2-15 Brake Check

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Parameter **2-15 Brake Check** is only active in drives with an integral dynamic brake. Select type of test and monitoring function to check the connection to the brake resistor, or whether a brake resistor is present, and then show a warning or an alarm in the event of a fault.



NOTE: The brake resistor disconnection function is tested during power-up. However, the brake IGBT test is performed when there is no braking. A warning or trip disconnects the brake function.

The testing sequence is as follows:

- 1: The DC-link ripple amplitude is measured for 300 ms without braking.
- 2: The DC-link ripple amplitude is measured for 300 ms with the brake turned on.
 - If the DC-link ripple amplitude while braking is lower than the DC-link ripple amplitude before braking +1%: *Brake check has failed by returning a warning or alarm.*
 - If the DC-link ripple amplitude while braking is higher than the DC-link ripple amplitude before braking +1%: *Brake check is OK.*



NOTE: Remove a warning arising with *[0] Off* or *[1] Warning* by cycling the mains supply. The fault must be corrected first. For *[0] Off* or *[1] Warning*, the drive keeps running even if a fault is located.

Option	Name	Description
[0]*	Off	Monitors brake resistor and brake IGBT for a short circuit during operation. If a short circuit occurs, <i>Warning 25 Brake resistor shortcircuited</i> appears.
[1]	Warning	Monitors brake resistor and brake IGBT for a short circuit and runs a test for brake resistor disconnection during power-up.
[2]	Trip	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the drive cuts out while showing an alarm (trip lock).
[3]	Stop and trip	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the drive ramps down to coast and then trips. A trip lock alarm is shown (for example, warnings 25, 27, or 28).
[4]	AC brake	Monitors for a short circuit or disconnection of the brake resistor, or a short circuit of the brake IGBT. If a fault occurs, the drive performs a controlled ramp-down.

2-16 AC Brake Max. Current

Default value:	100%	Parameter type:	Range, 0 - 1000.0%
Setup:	All setups	Conversion index:	-1
Data type:	Uint32	Change during operation:	True

Enter the maximum allowed current when using AC braking to avoid overheating of motor windings.



NOTE: Parameter *2-16 AC brake Max. Current* has no effect when parameter *1-10 Motor Construction* = *[1] PM, non salient SPM*.

2-17 Over-voltage Control

Default value:	[2] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Overvoltage control (OVC) reduces the risk of the drive tripping due to an overvoltage on the DC link caused by generative power from the load.



NOTE: Do not enable OVC in hoisting applications.

Option	Name	Description
[0]	Disabled	No OVC required.
[2]*	Enabled	Activates OVC.

2-19 Over-voltage Gain

Default value:	100%	Parameter type:	Range, 10 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Use this parameter for adjusting the overvoltage gain for parameter **2-17 Over-voltage Control** in the low-speed area.

5.5 Parameter Group 3-** Reference/Ramps

5.5.1 3-0* Reference Limits

3-02 Minimum Reference

Default value:	Size related	Parameter type:	Range, -999999.999 ReferenceFeedbackUnit - par. 3-03 Maximum Reference
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the minimum reference. The minimum reference is the lowest value obtainable by summing all references. Minimum reference is active only when parameter **3-00 Reference Range** is set to **[0] Min. - Max.** The minimum reference unit matches:

- The configuration of parameter **1-00 Configuration Mode**: For **[1] Speed closed loop, RPM**; for **[2] Torque, Nm**.
- The unit selected in parameter **3-01 Reference/ Feedback Unit**.

If option **[10] Synchronization** is selected in parameter **1-00 Configuration Mode**, this parameter defines the maximum speed deviation when performing the position offset defined in parameter **3-26 Master Offset**. Also see parameter **3-28 Master Offset Speed Ref.**

3-03 Maximum Reference

Default value:	Size related	Parameter type:	Range, par. 3-02 Minimum Reference - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the maximum reference. The maximum reference is the highest value obtainable by summing all references. The maximum reference unit matches:

- The configuration selected in parameter **1-00 Configuration Mode**: For **[1] Speed closed loop, RPM**; for **[2] Torque, Nm**.
- The unit selected in parameter **3-00 Reference Range**.

If **[9] Positioning** is selected in parameter **1-00 Configuration Mode**, this parameter defines the default speed for positioning.

3-04 Reference Function

Default value:	[0] Sum	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]*	Sum	Sums both external and preset reference sources.
[1]	External/Preset	Use either the preset or the external reference source. Shift between external and preset via a command or a digital input.

3-05 On Reference Window

Default value:	Size related	Parameter type:	Range, 0 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the tolerance window for on-reference status. Depending on the option selected in parameter **1-00 Configuration Mode**, this parameter defines the following:

- Speed mode: Speed window for on-reference status.
- Torque mode: Torque window for on-reference status.

5.5.2 3-1* References

Select the preset references. Select **[16] Preset ref bit 0**, **[17] Preset ref bit 1**, or **[18] Preset ref bit 2** for the corresponding digital inputs in parameter group **5-1* Digital Inputs**.

3-10 Preset Reference

Default value:	0%	Parameter type:	Array [8]
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter up to 8 different preset references (0–7) in this parameter, using array programming. The preset reference is stated as a percentage of the value Ref_{MAX} (parameter **3-03 Maximum Reference**). If a Ref_{MIN} different from 0 (parameter **3-02 Minimum Reference**) is programmed, the preset reference is calculated as a percentage of the full reference range, that is on the basis of the difference between Ref_{MAX} and Ref_{MIN} . Afterwards, the value is added to Ref_{MIN} . When using preset references, select preset reference bit 0/1/2 [16], [17] or [18] for the corresponding digital inputs in parameter group **5-1* Digital Inputs**.

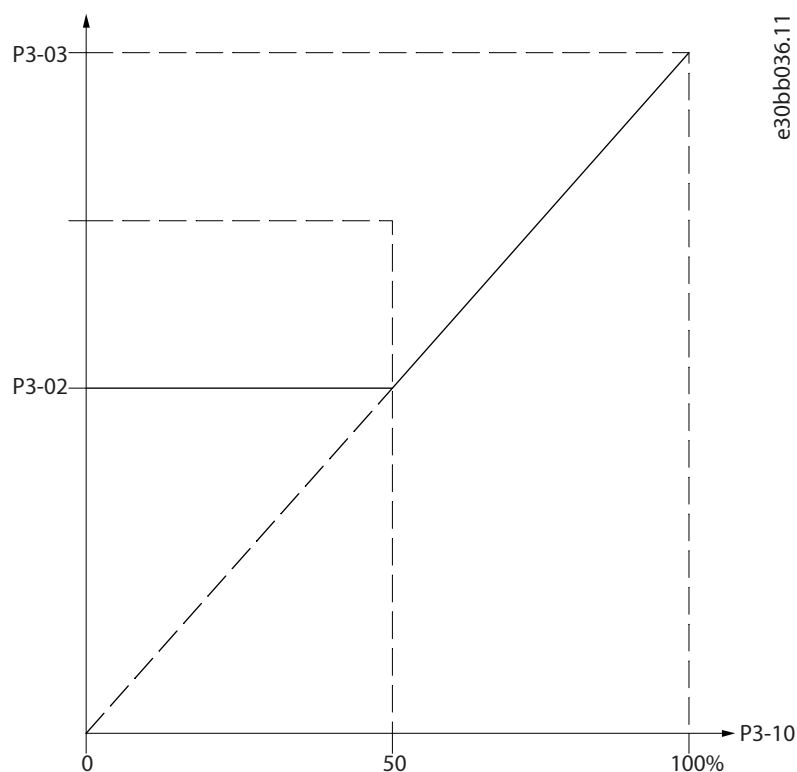


Figure 45: Preset Reference

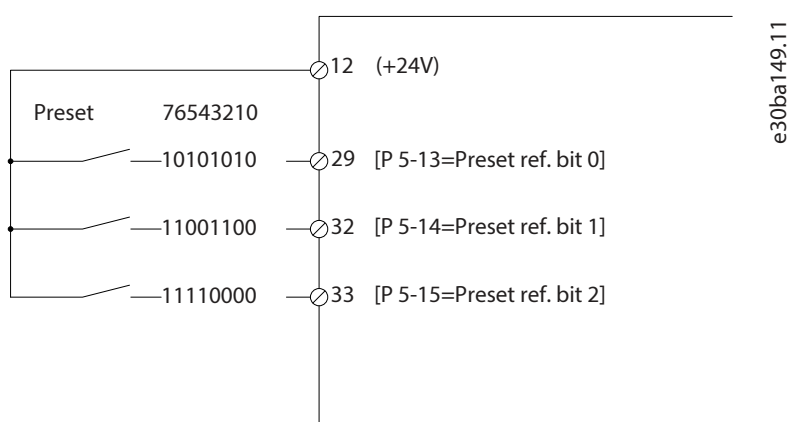


Figure 46: Preset Reference Scheme

Table 20: Preset Reference Bits

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

3-11 Jog Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-14 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

The jog speed is a fixed output speed at which the drive is running when the jog function is activated. See also parameter **3-80 Jog/Homing Ramp Time**.

3-13 Reference Site

Default value:	[0] Linked to hand/auto	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select which reference site to activate.

Option	Name	Description
[0]*	Linked to hand/auto	Use local reference when in hand-on mode, or remote reference when in auto-on mode.
[1]	Remote	Use remote reference in both hand-on mode and auto-on mode.
[2]	Local	Use local reference in both hand-on and auto-on mode.
 NOTE: When set to [2] Local, the drive starts with this setting again after a power-down.		
[3]	Linked to H/A MCO	Select this option to enable the FFACC factor in parameter 32-66 Acceleration Feed-Forward . Enabling FFACC reduces jitter and makes the transmission from the motion controller to the control card of the drive faster. This leads to faster response times for dynamic applications and position control. For more information about FFACC, see VLT® Motion Control MCO 305 Operating Instructions.

3-14 Preset Relative Reference

Default value:	0%	Parameter type:	Range, -100 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

The actual reference, X, is increased or decreased with percentage Y, which gives the resulting actual reference, Z. The actual reference (X) is the sum of the inputs selected in:

- Parameter **3-15 Reference Resource 1**.
- Parameter **3-16 Reference Resource 2**.
- Parameter **3-17 Reference Resource 3**.
- Parameter **8-02 Control Word Source**.

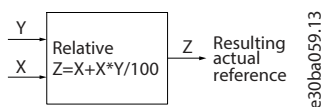


Figure 47: Preset Relative Reference

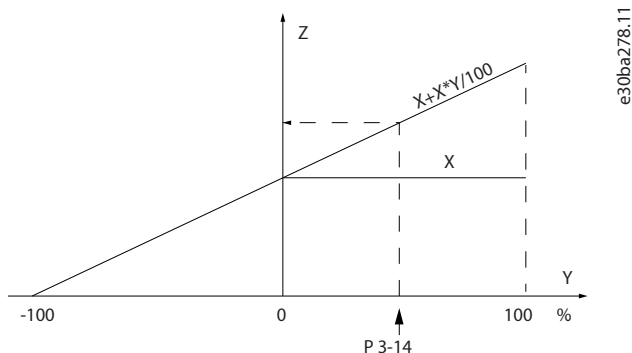


Figure 48: Actual Reference

3-15 Reference Resource 1

Default value:	[1] Analog input 53	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the reference input to be used for the 1st reference signal. Parameter **3-15 Resource Reference 1**, parameter **3-16 Resource Reference 2**, and parameter **3-17 Resource Reference 3** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Option	Name	Description
[0]	No function	
[1]*	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency Input 29	
[8]	Frequency Input 33	
[11]	Local Bus Reference	Reference from terminals 68 and 69.
[20]	Digital Potmeter	
[21]	Analog Input X30/11	VLT® General Purpose I/O MCB 101
[22]	Analog Input X30/12	VLT® General Purpose I/O MCB 101
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	

Option	Name	Description
[35]	Digital input select	The drive selects AI53 or AI54 as the reference source based on the input signal defined in option [42] Ref source bit 0 as 1 of the digital inputs. For more information, see parameter group 5-1* Digital Inputs, [42] Ref source bit 0 .
[37]	Analog Input X49/1	
[38]	Analog Input X49/3	
[39]	Analog Input X49/5	
[133]	Fieldbus REF 1	

3-16 Reference Resource 2

Default value	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the reference input to be used for the 2nd reference signal. Parameter **3-15 Resource Reference 1**, parameter **3-16 Resource Reference 2**, and parameter **3-17 Resource Reference 3** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Option	Name	Description
[0]*	No function	Reference from terminals 68 and 69.
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency Input 29	
[8]	Frequency Input 33	
[11]	Local Bus Reference	VLT® General Purpose I/O MCB 101
[15]	MCO Encoder 1 X56	
[20]	Digital Potmeter	
[21]	Analog Input X30/11	
[22]	Analog Input X30/12	
[23]	Analog Input X42/1	The drive selects AI53 or AI54 as the reference source based on the input signal defined in option [42] Ref source bit 0 as 1 of the digital inputs. For more information, see parameter group 5-1* Digital Inputs, option [42] Ref source bit 0 .
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[35]	Digital input select	
[37]	Analog Input X49/1	

Option	Name	Description
[38]	Analog Input X49/3	
[39]	Analog Input X49/5	
[133]	Fieldbus REF 1	

3-17 Reference Resource 3

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the reference input to be used for the 3rd reference signal. Parameter **3-15 Resource Reference 1**, parameter **3-16 Resource Reference 2**, and parameter **3-17 Resource Reference 3** define up to 3 different reference signals. The sum of these reference signals defines the actual reference.

Option	Name	Description
[0]*	No function	
[1]	Analog Input 53	
[2]	Analog Input 54	
[7]	Frequency Input 29	
[8]	Frequency Input 33	
[11]	Local Bus Reference	Reference from terminals 68 and 69.
[20]	Digital Potmeter	
[21]	Analog Input X30/11	
[22]	Analog Input X30/12	
[23]	Analog Input X42/1	
[24]	Analog Input X42/3	
[25]	Analog Input X42/5	
[29]	Analog Input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[35]	Digital input select	The drive selects AI53 or AI54 as the reference source based on the input signal defined in option [42] Ref source bit 0 as 1 of the digital inputs. For more information, see parameter group 5-1* Digital inputs, [42] Ref source bit 0 .
[37]	Analog Input X49/1	
[38]	Analog Input X49/3	
[39]	Analog Input X49/5	
[133]	Fieldbus REF 1	

3-19 Jog Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter a value for the jog speed n_{JOG} , which is a fixed output speed. The drive runs at this speed when the jog function is activated. The maximum limit is defined in parameter **4-13 Motor Speed High Limit [RPM]**. See also parameter **3-80 Jog/Homing Ramp Time**.

5.5.3 3-4* Ramp 1

Configure the ramp times for each of the 2 ramps (parameter group **3-4* Ramp 1** and parameter group **3-5* Ramp 2**).

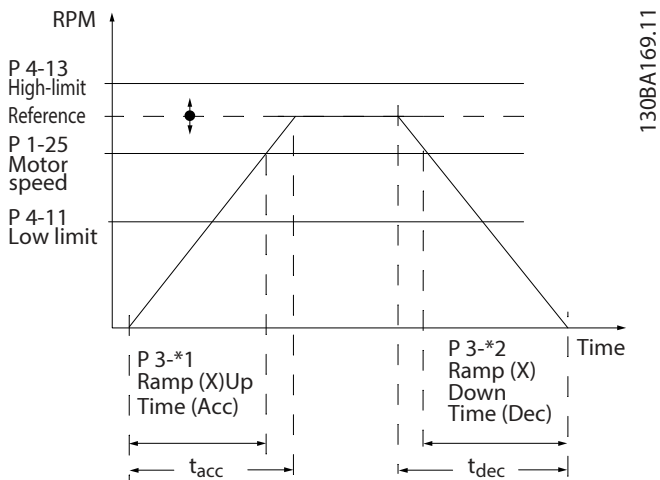


Figure 49: Ramp 1

3-41 Ramp 1 Ramp Up Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the ramp-up time, that is the acceleration time from 0 RPM to parameter **1-25 Motor Nominal Speed**. Select a ramp-up time such that the output current does not exceed the current limit in parameter **4-18 Current Limit** during ramping. See ramp-down time in parameter **3-42 Ramp 1 Ramp Down Time**.

$$\text{par.3-41} = \frac{t_{\text{acc}} \times n_{\text{nom}}[\text{par.}]}{\text{ref}[\text{RPM}]} [\text{s}]$$

3-42 Ramp 1 Ramp Down Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the ramp-down time, that is the deceleration time from parameter **1-25 Motor Nominal Speed**–0 RPM. Select a ramp-down time preventing overvoltage from arising in the inverter due to regenerative operation of the motor. The ramp-down time should also be long enough to prevent that the generated current exceeds the current limit set in parameter **4-18 Current Limit**. See ramp-up time in parameter **3-41 Ramp 1 Ramp Up Time**.

$$\text{par.3-42} = \frac{t_{\text{dec}} \times n_{\text{nom}}[\text{par.}]}{\text{ref}[\text{RPM}]} [\text{s}]$$

5.5.4 3-5* Ramp 2

To select ramp parameters, see parameter group **3-4* Ramp 1**.

3-51 Ramp 2 Ramp Up Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the ramp-up time, that is the acceleration time from 0 RPM to parameter **1-25 Motor Nominal Speed**. Select a ramp-up time such that the output current does not exceed the current limit in parameter **4-18 Current Limit** during ramping. See ramp-down time in parameter **3-52 Ramp 2 Ramp Down Time**.

$$\text{par.3-51} = \frac{t_{\text{acc}} \times n_{\text{nom}}[\text{par.}]}{\text{ref}[\text{RPM}]} [\text{s}]$$

3-52 Ramp 2 Ramp Down Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the ramp-down time, that is the deceleration time from parameter **1-25 Motor Nominal Speed**–0 RPM. Select a ramp-down time preventing overvoltage from arising in the inverter due to regenerative operation of the motor. The ramp-down time should also be long enough to prevent that the generated current exceeds the current limit set in parameter **4-18 Current Limit**. See ramp-up time in parameter **3-51 Ramp 2 Ramp Up Time**.

$$\text{par.3-52} = \frac{t_{\text{dec}} \times n_{\text{nom}}[\text{par.}]}{\text{ref}[\text{RPM}]} [\text{s}]$$

5.5.5 3-8* Other Ramps

3-80 Jog Ramp Time

Default value:	Size related	Parameter type:	Range, 0.1 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the jog ramp time, that is the acceleration/deceleration time between 0 RPM and the nominal motor speed ($n_{M,N}$) (set in parameter **1-25 Motor Nominal Speed**). Ensure that the resulting output current required for the given jog ramp time does not exceed the current limit in parameter **4-18 Current Limit**. The jog ramp time starts after activating a jog signal via the control panel, a selected digital input, or the serial communication port.

$$\text{par.3-80} = \frac{t_{\text{jog}} \times n_{\text{nom}}[\text{par.}]}{\text{jog speed}[\text{par.}]} [\text{s}]$$

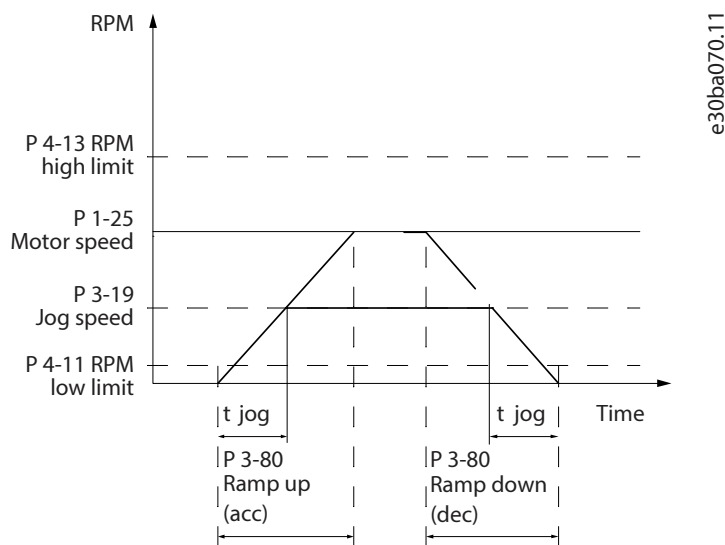


Figure 50: Jog Ramp Time

3-81 Quick Stop Ramp Time

Default value:	Size related	Parameter type:	Range, 1 - 3600 s
Setup:	2 setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the quick-stop ramp-down time, that is the deceleration time from the synchronous motor speed to 0 RPM. Ensure that no resulting overvoltage occurs in the inverter due to regenerative operation of the motor required to achieve the given ramp-down time. Ensure also that the generated current required to achieve the given ramp-down time does not exceed the current limit (set in parameter **4-18 Current Limit**). Quick stop is activated with a signal on a selected digital input, or via the serial communication port.

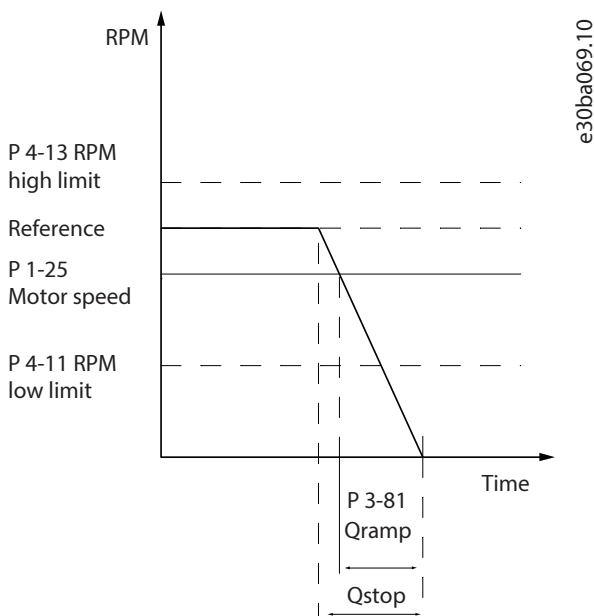


Figure 51: Quick Stop Ramp Time

3-84 Initial Ramp Time

Default value:	0 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	-2

Data type: Uint16 **Change during operation:** True

Enter the initial ramp-up time from 0 speed to motor speed low limit (parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]**). Submersible deep-well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from 0 speed to motor low speed limit, see the figure below.

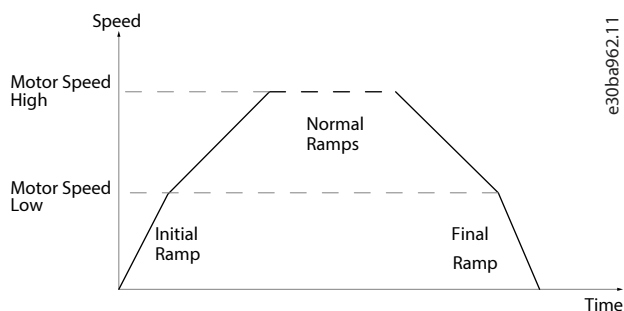


Figure 52: Initial and Final Ramp Time

3-85 Check Valve Ramp

Default value: 0 s **Parameter type:** Range, 0 - 650 s
Setup: All setups **Conversion index:** -2
Data type: Uint16 **Change during operation:** True

To protect ball check valves in a stop situation, the check valve ramp can be utilized as a slow ramp rate from parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]** to check valve ramp and speed, which is set in parameter **3-86 Check Valve Ramp End Speed [RPM]** or parameter **3-87 Check Valve Ramp End Speed [Hz]**. When parameter **3-85 Check Valve Ramp Time** is different from 0 s, the check valve ramp time is effectuated and is used to ramp down the speed from motor speed low limit to the check valve end speed in parameter **3-86 Check Valve Ramp End Speed [RPM]** or parameter **3-87 Check Valve Ramp End Speed [Hz]**. See the figure below.

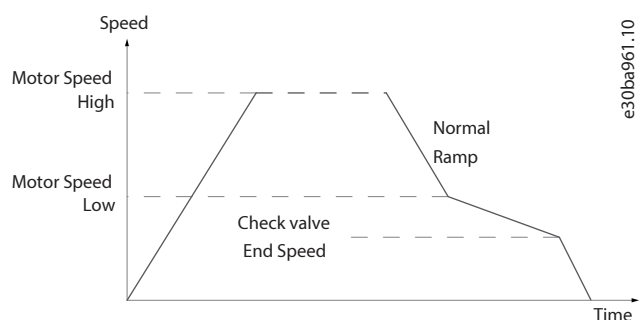


Figure 53: Check Valve Ramp

3-86 Check Valve Ramp End Speed [RPM]

Default value: Size related **Parameter type:** Range, 0 - par. 4-11 RPM
Setup: All setups **Conversion index:** 67
Data type: Uint16 **Change during operation:** True

Set the speed in [RPM] below motor speed low limit where the check valve is expected to be closed. Check that the valve is no longer active.

3-87 Check Valve Ramp End Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-12
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the speed in [Hz] below motor speed low limit where the check valve ramp is no longer active.

3-88 Final Ramp Time

Default value:	0 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the final ramp time to be used when ramping down from parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]** to 0 speed.

Submersible deep-well pumps can be damaged by running below minimum speed. A fast ramp time below minimum pump speed is recommended. This parameter may be applied as a fast ramp rate from parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]** to 0 speed.

5.5.6 3-9* Digital Pot.Meter

Use the digital potentiometer function to increase or decrease the actual reference by adjusting the setup of the digital inputs using the functions increase, decrease, or clear. To activate the function, at least 1 digital input must be set to increase or decrease.

3-90 Step Size

Default value:	0.10%	Parameter type:	Range, 0.01 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the increment size required for increase/decrease as a percentage of the synchronous motor speed, n_s . If increase/decrease is activated, the resulting reference is increased or decreased by the value set in this parameter.

3-91 Ramp Time

Default value:	1 s	Parameter type:	Range, 0 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the ramp time, that is the time for adjustment of the reference 0–100% of the specified digital potentiometer function (increase, decrease, or clear). If increase/decrease is activated for longer than the ramp delay period specified in parameter **3-95 Ramp Delay**, the actual reference is ramped up/down according to this ramp time. The ramp time is defined as the time used to adjust the reference by the step size specified in parameter **3-90 Step Size**.

3-92 Power Restore

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Off	Resets the digital potentiometer reference to 0% after power-up.
[1]	On	Restores the most recent digital potentiometer reference at power-up.

3-93 Maximum Limit

Default value:	100%	Parameter type:	Range, -200 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Set the maximum allowed value for the resulting reference. This is recommended if the digital potentiometer is used for fine-tuning of the resulting reference.

3-94 Minimum Limit

Default value:	0%	Parameter type:	Range, -200 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Set the minimum allowed value for the resulting reference. This is recommended if the digital potentiometer is used for fine-tuning of the resulting reference.

3-95 Ramp Delay

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	All setups	Conversion index:	-3
Data type:	TimD	Change during operation:	True

Enter the delay required from activation of the digital potentiometer function until the drive starts to ramp the reference. With a delay of 0 ms, the reference starts to ramp when increase/decrease is activated. See also parameter **3-91 Ramp Time**.

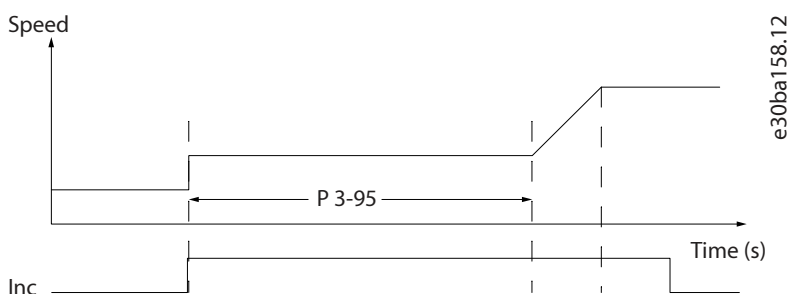


Figure 54: Ramp Delay, Case 1

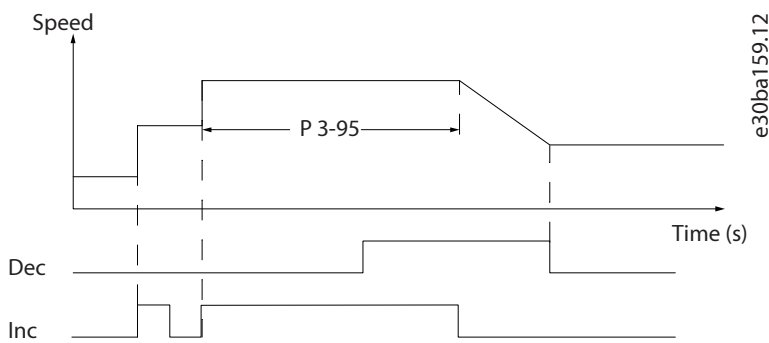


Figure 55: Ramp Delay, Case 2

5.6 Parameter Group 4-** Limits/Warnings

5.6.1 4-1* Motor Limits

Define torque, current, and speed limits for the motor, and the reaction of the drive when the limits are exceeded.

A limit may generate a message in the display. A warning always generates a message in the display or on the fieldbus. A monitoring function may initiate a warning or a trip, after which the drive stops and generates an alarm message.

4-10 Motor Speed Direction

Default value:	[0] Clockwise	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Select the motor speed directions required. Use this parameter to prevent unwanted reversing. When parameter **1-00 Configuration Mode** is set to **[3] Process**, parameter **4-10 Motor Speed Direction** is set to **[0] Clockwise** as default. The setting in parameter **4-10 Motor Speed Direction** does not limit options for setting parameter **4-13 Motor Speed High Limit [RPM]**.

Option	Name	Description
[0]*	Clockwise	The reference is set to CW rotation. Reversing input (default terminal 19) must be open.
[2]	Both directions	Allows the motor to rotate in both directions.

4-11 Motor Speed Low Limit [RPM]

Default value:	Size related	Parameter type:	Range, 0 - setting in par. 4-13 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the manufacturer's recommended minimum motor speed. The motor speed low limit must not exceed the setting in parameter **4-13 Motor Speed High Limit [RPM]**.

4-12 Motor Speed Low Limit [Hz]

Default value:	Size related	Parameter type:	Range, 0 - setting in par. 4-14 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Enter the minimum limit for motor speed. The motor speed low limit can be set to correspond to the minimum output frequency of the motor shaft. The motor speed low limit must not exceed the setting in parameter **4-14 Motor Speed High Limit [Hz]**.

4-13 Motor Speed High Limit [RPM]

Default value:	Size related	Parameter type:	Range, 0 - 60000 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter the maximum limit for motor speed. The motor speed high limit can be set to correspond to the manufacturer's maximum nominal motor speed. The motor speed high limit must exceed the setting in parameter **4-11 Motor Speed Low Limit [RPM]**.

4-14 Motor Speed High Limit [Hz]

Default value:	Size related	Parameter type:	Range, 0.1 - 1000.0 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Enter the maximum limit for motor speed in Hz. Parameter **4-14 Motor Speed High Limit [Hz]** can be set to correspond to the manufacturer's recommended maximum motor speed. The motor speed high limit must exceed the value in parameter **4-12 Motor Speed Low Limit [Hz]**. The output frequency must not exceed 10% of the switching frequency (parameter **14-01 Switching Frequency**).

4-16 Torque Limit Motor Mode

Default value:	Size related	Parameter type:	Range, 0 - 1000.0%
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: If changing parameter **4-16 Torque Limit Motor Mode** when parameter **1-00 Configuration Mode** is set to **[0] Speed open loop**, parameter **1-66 Min. Current at Low Speed** is automatically readjusted.



NOTE: When parameter **1-00 Configuration Mode** is set to **[0] Speed open loop**, parameter **1-66 Min. Current at Low Speed** is automatically readjusted.



NOTE: The torque limit reacts to the actual, non-filtered torque, including torque spikes. This is not the torque that is seen from the LCP or the fieldbus as the torque is filtered.

This function limits the torque on the shaft to protect the mechanical installation.

4-17 Torque Limit Generator Mode

Default value:	100%	Parameter type:	Range, 0 - 1000.0%

Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

This function limits the torque on the shaft to protect the mechanical installation.

4-18 Current Limit

Default value:	Size related	Parameter type:	Range, 1.0 - 1000.0%
Setup:	All setups	Conversion index:	-1
Data type:	Uint32	Change during operation:	True



NOTE: If [20] *ATEX ETR* is selected in parameter *1-90 Motor Thermal Protection*, set parameter *4-18 Current Limit* current limit to 150%.

This is a true current limit function that continues in the oversynchronous range. However, due to field weakening the motor torque at current limit will drop accordingly when the voltage increase stops above the synchronized speed of the motor.

4-19 Max Output Frequency

Default value:	Size related	Parameter type:	Range, 1 - 590 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Maximum output frequency cannot exceed 10% of the inverter switching frequency (parameter *14-01 Switching Frequency*).

Provides a final limit on the output frequency for improved safety in applications where overspeeding is to be avoided. This limit is final in all configurations (independent of the setting in parameter *1-00 Configuration Mode*).

5.6.2 4-4* Motor Monitoring

4-46 Motor Protection Current Limit

Default value:	0 A	Parameter type:	Range, 0 - 10000.00 A
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	False

Set the peak motor current at which the drive disables the PWM to protect the motor.

4-47 Motor Protection Reaction Time

Default value:	10 us	Parameter type:	Range, 0.1 - 100 us
Setup:	All setups	Conversion index:	-7
Data type:	Uint16	Change during operation:	False

The maximum time the peak motor current can exceed the motor protection current limit before the drive disables the PWM to protect the motor.

4-49 Motor Check Time Interval

Default value:	[0] As fast as possible	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the time interval at which the connections between the motor and the drive are checked, when the motor is stopped. The motor check is performed at a specified interval, unless the motor is started in between.

Option	Name	Description
[0]*	As fast as possible	The motor time constant (x10) is used as the time interval to check the motor.
[5]	Every 1 hour	
[10]	Every 2 hours	
[15]	Every 12 hours	
[20]	Every 24 hours	

5.6.3 4-5* Adj. Warnings

Define adjustable warning limits for current, speed, reference, and feedback.

Warnings are shown on the LCP and can be programmed to be outputs or to be read out via fieldbus in the extended status word.

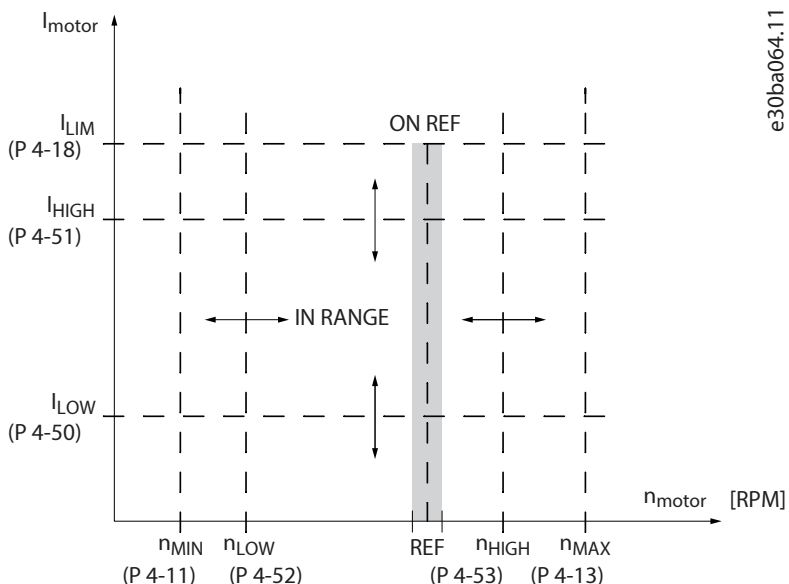


Figure 56: Adjustable Warnings

4-50 Warning Current Low

Default value:	0 A	Parameter type:	Range, 0 - setting in par. 4-51
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the I_{LOW} value. When the motor current drops below this limit, the display reads *Current Low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-51 Warning Current High

Default value:	Size related	Parameter type:	Range, setting in par. 4-50 - setting in par. 16-37
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the I_{HIGH} value. When the motor current exceeds this limit, the display reads *Current High*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29.

4-52 Warning Speed Low

Default value:	0 RPM	Parameter type:	Range, 0 - setting in par. 4-53 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter the n_{LOW} value. When the motor speed exceeds this limit, the display reads *Speed low*. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-53 Warning Speed High

Default value:	Size related	Parameter type:	Range, setting in par. 4-52 - 60000 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter the n_{HIGH} value. When the motor speed exceeds this value, the display reads *Speed high*. The signal outputs can be programmed to produce a status signal on terminals 27 or 29 and on relay outputs 01 or 02.

4-54 Warning Reference Low

Default value:	-999999.999	Parameter type:	Range, -999999.999 - setting in par. 4-55
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the lower reference limit. When the actual reference drops below this limit, the display indicates Ref_{LOW} . The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-55 Warning Reference High

Default value:	999999.999	Parameter type:	Range, setting in par. 4-54 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the upper reference limit. When the actual reference exceeds this limit, the display reads Ref_{high} . The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-56 Warning Feedback Low

Default value:	-999999.999 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - par. 4-57 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the lower feedback limit. When the feedback drops below this limit, the display reads Feedb_{Low}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-57 Warning Feedback High

Default value:	999999.999 ReferenceFeedbackUnit	Parameter type:	Range, par 4-56 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the upper feedback limit. When the feedback exceeds this limit, the display reads Feedb_{High}. The signal outputs can be programmed to produce a status signal on terminal 27 or 29 and on relay output 01 or 02.

4-58 Missing Motor Phase Function

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

The function detects missing motor phase while the motor is running. Shows alarms 30, 31, 32 if a motor phase is missing. Enable this function to protect the application and motor from malfunctioning if a motor phase is missing.

Option	Name	Description
[0]	Disabled	The drive does not issue a missing motor phase alarm.
[1]	Trip 100 ms	The drive performs a scan for 100 ms to detect missing motor phase. When a missing motor phase is detected, the drive trips. This selection is recommended when the motor is running at a speed of 10 Hz and above.
[2]	Trip 1000 ms	The drive performs a scan for 1000 ms to detect missing motor phase. When a missing motor phase is detected, the drive trips. This selection is recommended when the motor is running at a low speed of 1 Hz and above.
[5]	Motor check	 NOTE: The motor automatically resumes operation when the motor is reconnected. This option allows disconnection of the motor with a service switch without issuing an alarm. The drive coasts and automatically resumes operation when the motor is reconnected.

5.6.4 4-6* Speed Bypass

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. A maximum of 4 frequency or speed ranges can be avoided.

4-60 Bypass Speed From [RPM]

Default value:	Size related	Parameter type:	Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-61 Bypass Speed From [Hz]

Default value:	Size related	Parameter type:	Array [4]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the lower limits of the speeds to be avoided.

4-62 Bypass Speed To [RPM]

Default value:	Size related	Parameter type:	Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Some systems call for avoiding certain output speeds due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

4-63 Bypass Speed To [Hz]

Default value:	Size related	Parameter type:	Array [4]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system. Enter the upper limits of the speeds to be avoided.

4-64 Semi-auto Bypass Set-up

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Option	Name	Description
[0]*	Off	No function.
[1]	Enabled	Starts the semi-automatic bypass setup, which facilitates programming of the frequencies to be skipped due to resonances in the system.

5.6.5 Semi-automatic Bypass Speed Setup

Use semi-automatic bypass speed setup to facilitate the programming of frequencies to be skipped due to resonances in the system.

Procedure

1. Stop the motor.
2. Select **[1] Enabled** in parameter **4-64 Semi-auto Bypass Set-up**.
3. Press **[Hand On]** on the LCP to start the search for frequency bands causing resonances. The motor ramps up according to the ramp set.
4. When sweeping through a resonance band, press **[OK]** on the LCP when leaving the band. The actual frequency is stored as the 1st element in parameter **4-62 Bypass Speed To [RPM]** or parameter **4-63 Bypass Speed To [Hz]** (array). Repeat this step for each resonance band identified at the ramp-up (maximum 4 can be adjusted).

➡ When maximum speed has been reached, the motor automatically begins to ramp down.

5. Repeat the preceding procedure when speed is leaving the resonance bands during deceleration. The actual frequencies registered when pressing **[OK]** are stored in parameter **4-60 Bypass Speed From [RPM]** or parameter **4-61 Bypass Speed From [Hz]**.
6. When the motor has ramped down to stop, press **[OK]**.

➡ Parameter **4-64 Semi-auto Bypass Set-up** automatically resets to Off. The drive stays in hand-on mode until **[Off]** or **[Auto On]** is pressed on the LCP. If the frequencies for a certain resonance band are not registered in the right order, all registrations are canceled, and the following message is shown: *Collected speed areas overlapping or not completely determined. Press [Cancel] to abort.* Registration in the wrong order is when frequency values stored in parameter **4-62 Bypass Speed To [RPM]** are higher than the values in parameter **4-60 Bypass Speed From [RPM]**, or if they do not have the same numbers of registrations for the Bypass From and Bypass To.

5.7 Parameter Group 5-** Digital In/Out

5.7.1 5-0* Digital I/O Mode

Parameters for configuring the input and output using NPN and PNP.

5-00 Digital I/O Mode

Default value:	[0] PNP - Active at 24V	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: Perform a power cycle to activate the parameter once it has been changed.

Digital inputs and programmed digital outputs are preprogrammable for operation either in PNP or NPN systems.

Option	Name	Description
[0]*	PNP - Active at 24V	Action on positive directional pulses (0). PNP systems are pulled down to GND.
[1]	NPN - Active at 0V	Action on negative directional pulses (1). NPN systems are pulled up to +24 V, internally in the drive.

5-01 Terminal 27 Mode

Default value:	[0] Input	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True
Option	Name	Description	
[0]*	Input	Defines terminal 27 as a digital input.	
[1]	Output	Defines terminal 27 as a digital output.	

5-02 Terminal 29 Mode

Default value:	[0] Input	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True
Option	Name	Description	
[0]*	Input	Defines terminal 29 as a digital input.	
[1]	Output	Defines terminal 29 as a digital output.	

5.7.2 5-1* Digital Inputs

The digital inputs are used for selecting various functions in the drive. Refer to [Table 21](#) for functions which can be assigned to digital inputs.

Functions in function group 1 have higher priority than functions in function group 2.

Table 21: Function Groups

Group	Functions
1	Reset, coast stop, reset and coast stop, quick stop, DC brake, stop, and the [Off] key.
2	Start, latched start, reversing, start reversing, jog, and freeze output.

Table 22: Digital Input Functions and Terminals

Digital input function	Select	Terminal
No operation	[0]	All, terminal 32, 33
Reset	[1]	All
Coast inverse	[2]	All, terminal 27
Coast and reset inv	[3]	All
DC-brake inverse	[5]	All
Stop inverse	[6]	All
External interlock	[7]	All
Start	[8]	All, terminal 18
Latched start	[9]	All
Reversing	[10]	All
Start reversing	[11]	All
Jog	[14]	All, terminal 29

Table 22: Digital Input Functions and Terminals - (continued)

Digital input function	Select	Terminal
Preset reference on	[15]	All
Preset ref bit 0	[16]	All
Preset ref bit 1	[17]	All
Preset ref bit 2	[18]	All
Freeze reference	[19]	All
Freeze output	[20]	All
Speed up	[21]	All
Speed down	[22]	All
Set-up select bit 0	[23]	All
Set-up select bit 1	[24]	All
Pulse input	[32]	All
Ramp bit 0	[34]	All
Mains failure inverse	[36]	All
Emergency mode	[37]	All
Ref source bit 0	[42]	All
Hand/auto start	[51]	All
Run permissive	[52]	All
Hand start	[53]	All
Auto Start	[54]	All
DigiPot increase	[55]	All
DigiPot decrease	[56]	All
DigiPot clear	[57]	All
Counter A (up)	[60]	Terminal 29, 33
Counter A (down)	[61]	Terminal 29, 33
Reset counter A	[62]	All
Counter B (up)	[63]	Terminal 29, 33
Counter B (down)	[64]	Terminal 29, 33
Reset counter B	[65]	All
Sleep mode	[66]	All
Timed actions disabled	[68]	All
Constant OFF actions	[69]	All
Constant ON actions	[70]	All
MCO specific	[75]	All
Reset preventive maintenance. word	[78]	All
PTC card 1	[80]	
Latched pump derog	[85]	All

Table 22: Digital Input Functions and Terminals - (continued)

Digital input function	Select	Terminal
Flow confirmation	[86]	All
Reset flow totalized volume counter	[87]	All
Reset flow actual volume counter	[88]	All
Reset derag counter	[89]	All
Lead pump start	[120]	All
Lead pump alternation	[121]	All
Pump 1 interlock	[130]	All
Pump 2 interlock	[131]	All
Pump 3 interlock	[132]	All
Pump 4 interlock	[133]	All
Pump 5 interlock	[134]	All
Pump 6 interlock	[135]	All
Pump 7 interlock	[136]	All
Pump 8 interlock	[137]	All
Pump 9 interlock	[138]	All
Pump 1 inverse interlock	[139]	All
Pump 2 inverse interlock	[140]	All
Pump 3 inverse interlock	[141]	All
Pump 4 inverse interlock	[142]	All
Pump 5 inverse interlock	[143]	All
Pump 6 inverse interlock	[144]	All
Pump 7 inverse interlock	[145]	All
Pump 8 inverse interlock	[146]	All
Pump 9 inverse interlock	[147]	All
Emcy mode ref bit 0	[190]	All
Emcy mode ref bit 1	[191]	All
Emcy mode ref bit 2	[192]	All
Emergency setup bit 0	[193]	All
Emergency setup bit 1	[194]	All
Test emcy mode	[195]	All
Reset emcy mode	[196]	All

All = Terminals 18, 19, 27, 29, 32, 33, X30/2, X30/3, X30/4. X30/ are the terminals on VLT® General Purpose I/O MCB 101.

Functions dedicated to only 1 digital input are stated in the associated parameter.

All digital inputs can be programmed to these functions:

Table 23: Digital Inputs, Function Descriptions - 1

Option		Function
[0]	No operation	No reaction to signals transmitted to the terminal.
[1]	Reset	Resets the drive after a trip/alarm. Not all alarms can be reset.
[2]	Coast inverse	(Default digital input 27): Coast stop, inverted input (NC). The drive leaves the motor in free mode. Logic 0 = coast stop.
[3]	Coast and reset inverse	Reset and coast stop inverted input (NC). Leaves the motor in free mode and resets the drive. Logic 0 = coast stop and reset.
[5]	DC-brake inverse	Inverted input for DC brake (NC). Stops motor by energizing it with a DC current for a certain time period. See parameter 2-01 DC Brake Current to parameter 2-03 DC Brake Cut In Speed [RPM] . The function is only active when the value in parameter 2-02 DC Braking Time is different from 0. Logic 0 = DC brake.
[6]	Stop inverse	Stop inverted function. Generates a stop function when the selected terminal goes from logical level 1 to logical level 0. The stop is performed according to the selected ramp time: - Parameter 3-42 Ramp 1 Ramp Down Time. - Parameter 3-52 Ramp 2 Ramp Down Time.  NOTE: When the drive is at the torque limit and has received a stop command, it may not stop by itself. To ensure that the drive stops, configure a digital output to [27] Torque limit and stop. Connect this digital output to a digital input that is configured as coast.
[7]	External interlock	Same function as coasting inverse and stop inverse, but this option generates the alarm message <i>External fault</i> on the display when the terminal programmed for coast inverse has signal 0. The alarm message is also active via digital outputs and relay outputs if programmed for external interlock. When the external interlock is removed, the alarm can be reset using a digital input or the [Reset] key. A delay can be programmed in parameter 22-00 External Interlock Delay . After applying a signal to the input, the reaction described above is delayed with the time set in parameter 22-00 External Interlock Delay .
[8]	Start	(Default digital input 18): Select start for a start/stop command. Logic 1 = start, logic 0 = stop.
[9]	Latched start	If a pulse is applied for minimum 2 ms, the motor starts. The motor stops when stop inverse is activated, or a reset command (via DI, bus, or LCP) is given.
[10]	Reversing	(Default digital input 19): Change the direction of motor shaft rotation. Select logic 1 to reverse. The reversing signal only changes the direction of rotation. It does not activate the start function. Select both directions in parameter 4-10 Motor Speed Direction .
[11]	Start reversing	Used for start/stop and for reversing on the same wire. Signals on start are not allowed at the same time.
[14]	Jog	(Default digital input 29): Activate jog speed. See parameter 3-11 Jog Speed [Hz] .

Table 23: Digital Inputs, Function Descriptions - 1 - (continued)

Option		Function
[15]	Preset reference on	Shifts between external reference and preset reference. It is assumed that <i>[1] External/preset</i> has been selected in parameter 3-04 Reference Function . Logic 0 = external reference active; logic 1 = 1 of the 8 preset references is active.
[16]	Preset ref bit 0	Preset reference bit 0, 1, and 2 enable a choice between 1 of the 8 preset references according to Table 24 .
[17]	Preset ref bit 1	Same as <i>[16] Preset ref bit 0</i> .
[18]	Preset ref bit 2	Same as <i>[16] Preset ref bit 0</i> .

Table 24: Preset Reference Bit

Preset ref. bit	2	1	0
Preset ref. 0	0	0	0
Preset ref. 1	0	0	1
Preset ref. 2	0	1	0
Preset ref. 3	0	1	1
Preset ref. 4	1	0	0
Preset ref. 5	1	0	1
Preset ref. 6	1	1	0
Preset ref. 7	1	1	1

Table 25: Digital Inputs, Function Descriptions - 2

Option		Function
[19]	Freeze ref	Freezes the actual reference, which is now the point of enable/condition to be used for [21] Speed up and [22] Speed down . If speed up/speed down is used, the speed change always follows ramp 2 (parameter 3-51 Ramp 2 Ramp Up Time and parameter 3-52 Ramp 2 Ramp Down Time) in the range 0–parameter 3-03 Maximum Reference .
[20]	Freeze output	Freezes the actual motor frequency (Hz), which is now the point of enable/condition to be used for [21] Speed up and [22] Speed down . If speed up/speed down is used, the speed change always follows ramp 2 (parameter 3-51 Ramp 2 Ramp Up Time and parameter 3-52 Ramp 2 Ramp Down Time) in the range 0–parameter 1-23 Motor Frequency .  NOTE: When freeze output is active, the drive cannot be stopped via a low [8] Start signal. Stop the drive via a terminal programmed for [2] Coasting inverse or [3] Coast and reset inverse.
[21]	Speed up	Select [21] Speed up and [22] Speed down for digital control of the up/down speed (motor potentiometer). Activate this function by selecting either [19] Freeze ref or [20] Freeze output . When speed up/speed down is activated for less than 400 ms, the resulting reference is increased/decreased by 0.1%. If speed up/speed down is activated for more than 400 ms, the resulting reference follows the setting in ramping up/down parameters 3- x1/3-x2.

Table 26: Shut Down/Catch Up

Speed	Shut down	Catch up
Unchanged speed	0	0
Reduced by %-value	1	0
Increased by %-value	0	1
Reduced by %-value	1	1

Table 27: Digital Inputs, Function Descriptions - 3

Option		Function
[22]	Speed down	Same as [21] Speed up .
[23]	Set-up select bit 0	Select [23] Set-up select bit 0 or select [24] Set-up select bit 1 to select 1 of the 4 set-ups. Set parameter 0-10 Active Set-up to [9] Multi Set-up .
[24]	Set-up select bit 1	(Default digital input 32): Same as [23] Set-up select bit 0 .
[30]	Counter input	Precise stop function in parameter 1-83 Precise Stop Function acts as counter stop or speed-compensated counter stop with or without reset. Set the counter value in parameter 1-84 Precise Stop Counter Value .
[32]	Pulse input	Select this option when using a pulse sequence as either reference or feedback. Scaling is done in parameter group 5-5* Pulse Input .

Table 27: Digital Inputs, Function Descriptions - 3 - (continued)

Option		Function
[34]	Ramp bit 0	Select which ramp to use. Logic 0 selects ramp 1, while logic 1 selects ramp 2.
[36]	Mains failure inverse	Activates the function selected in parameter 14-10 Mains Failure . Mains failure is active in the logic 0 situation.

Table 28: Preset Ramp Bit

Preset ramp bit	1	0
Ramp 1	0	0
Ramp 2	0	1
Ramp 3	1	0
Ramp 4	1	1

Table 29: Digital Inputs, Function Descriptions - 4

Option		Function
[37]	Emergency mode	A signal applied puts the drive into emergency mode and the preset ref bits 0–2 define the operation mode of emergency mode where all other commands are disregarded. See parameter group 24-0* Emergency Mode and parameter group 24-2* Emergency Mode 2 .
[42]	Ref source bit 1	An active input in bit 0 selects AI54 as the reference source (see parameter group 3-1* References , option [35] Digital input select). An inactive input selects AI53.
[51]	Hand/auto start	Selects hand or auto start. High signal selects auto on only, low signal selects hand on only.
[52]	Run permissive	The input terminal, for which the run permissive has been programmed, must be logic 1 before a start command can be accepted. Run permissive has a logic AND function related to the terminal, which is programmed for [8] Start, [14] Jog, or [20] Freeze Output. To start running the motor, both conditions must be fulfilled. If run permissive is programmed on multiple terminals, [52] Run permissive needs only be logic 1 on 1 of the terminals to carry out the function. The digital output signal for run request ([8] Start, [14] Jog, or [20] Freeze output) programmed in parameter group 5-3* Digital Outputs or parameter group 5-4* Relays is not affected by run permissive.  NOTE: If no run permissive signal is applied, but either run, jog, or freeze commands are activated, the status line in the display shows either <i>Run Requested</i>, <i>Jog Requested</i>, or <i>Freeze Requested</i>.

Table 29: Digital Inputs, Function Descriptions - 4 - (continued)

Option		Function
[53]	Hand start	A signal applied puts the drive into hand-on mode as if [Hand On] was pressed on the LCP and a normal stop command is overridden. If disconnecting the signal, the motor stops. To make any other start commands valid, another digital input must be assigned to [54] Auto start , and a signal applied to this. The [Hand On] and [Auto On] keys on the LCP have no impact. The [Off] key on the LCP overrides [53] Hand start and [54] Auto start . Press either [Hand On] or [Auto On] to make [53] Hand start and [54] Auto start active again. If there is no signal on neither [53] Hand start nor [54] Auto start , the motor stops regardless of any normal start command applied. If signals are applied to both [53] Hand start and [54] Auto start , the function is auto start. If pressing [Off] on the LCP, the motor stops regardless of the signal on [53] Hand start and [54] Auto start .
[54]	Auto start	This selection puts the drive into auto mode as if [Auto On] has been pressed. The function is similar to [53] Hand start .
[55]	DigiPot increase	Increase signal to the digital potentiometer function described in parameter group 3-9* Digital Pot. Meter .
[56]	DigiPot Decrease	Decrease signal to the digital potentiometer function described in parameter group 3-9* Digital Pot. Meter .
[57]	DigiPot Clear	Clears the digital potentiometer reference described in parameter group 3-9* Digital Pot. Meter .
[60]	Counter A (up)	(Terminal 29 or 33 only). Input for increment counting in the SLC counter.
[61]	Counter A (down)	(Terminal 29 or 33 only). Input for decrement counting in the SLC counter.
[62]	Reset Counter A	Input for reset of counter A.
[63]	Counter B (up)	(Terminal 29 or 33 only). Input for increment counting in the SLC counter.
[64]	Counter B (down)	(Terminal 29 or 33 only). Input for decrement counting in the SLC counter.
[65]	Reset Counter B	Input for reset of counter B.
[66]	Sleep mode	Forces the drive into sleep mode (see parameter group 22-4* Sleep Mode).
[68]	Timed actions disabled	Timed actions are disabled (see parameter group 23-0* Timed Actions).
[69]	Constant OFF actions	Timed actions are set for constant OFF (see parameter group 23-0* Timed Actions).
[70]	Constant ON actions	Timed actions are set for constant ON (see parameter group 23-0* Timed Actions).
[75]	MCO specific	
[78]	Reset main. word	Resets all data in parameter 16-96 Maintenance Word to 0.

Table 29: Digital Inputs, Function Descriptions - 4 - (continued)

Option		Function
[80]	PTC card 1	All digital inputs can be set to [80] PTC Card 1 . However, only 1 digital input must be set to this option.
[85]	Latched pump derag	Start deragging.
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[96]	Mains loss	Select to improve kinetic backup. When the mains voltage goes back to a level that is close to (but still lower than) the detection level, the output speed increases and kinetic backup remains active. To avoid this situation, send a status signal to the drive. When the signal on the digital input is low (0), the drive forcibly turns off the kinetic backup. NOTE: Only available for pulse inputs at terminals 32/33.
[97]	Mains loss inverse	When the signal on the digital input is high (1), the drive forcibly turns off the kinetic backup. For more details, see the description of [96] Mains Loss. NOTE: Only available for pulse inputs at terminals 32/33.
[120]	Lead pump start	Starts/stops the lead pump (controlled by the drive). A start also requires applying a system start signal, for example, to 1 of the digital inputs set for [8] Start .
[121]	Lead pump alternation	Forces alternation of the lead pump in a cascade controller. Set parameter 25-50 Lead Pump Alternation to either [2] At command or [3] At staging or at command . Parameter 25-51 Alternation Event can be set to any of the 4 options.
[130]	Pump 1 interlock	The function depends on the setting in parameter 25-06 Number of Pumps . If set to [0] No , Pump1 refers to the pump controlled by relay1, and so on. If set to [1] Yes , Pump1 refers to the pump controlled by the drive only (without any of the built-in relays involved) and Pump2 to the pump controlled by relay1. Variable speed pump (lead) cannot be interlocked in the basic cascade controller.
[131]	Pump 2 interlock	See explanation in [130] Pump1 interlock .
[132]	Pump 3 interlock	See explanation in [130] Pump1 interlock .
[133]	Pump 4 interlock	See explanation in [130] Pump1 interlock .
[134]	Pump 5 interlock	See explanation in [130] Pump1 interlock .
[135]	Pump 6 interlock	See explanation in [130] Pump1 interlock .
[136]	Pump 7 interlock	See explanation in [130] Pump1 interlock .
[137]	Pump 8 interlock	See explanation in [130] Pump1 interlock .
[138]	Pump 9 interlock	See explanation in [130] Pump1 interlock .

Table 29: Digital Inputs, Function Descriptions - 4 - (continued)

Option		Function
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	Enables a choice between 1 of the 8 preset references according to Table 24 .
[191]	Emcy mode ref bit 1	Enables a choice between 1 of the 8 preset references according to Table 24 .
[192]	Emcy mode ref bit 2	Enables a choice between 1 of the 8 preset references according to Table 24 .
[193]	Emergency mode setup bit 0	Switch between emergency mode setup 1 to 4 in parameter group 24-0* Emergency Mode and parameter group 24-4* Emergency Mode 2 without changing starting setup mode for the rest of the parameters.
[194]	Emergency mode setup bit 1	Switch between emergency mode setup 1 to 4 in parameter group 24-0* Emergency Mode and parameter group 24-4* Emergency Mode 2 without changing starting setup mode for the rest of the parameters.
[195]	Test emcy mode	Activation of emergency mode via parameter 24-09 Emergency Mode Alarm Handling , option [2] <i>Trip all alarms/test</i> with stop on all alarms and in normal operation mode. The test timer is set in parameter 24-42 Timeout for Emergency Mode Test , and countdown starts when the test signal is active.
[196]	Reset emcy mode	When operating in emergency mode with impulse signals (parameter 24-43 Emergency Mode Signal Operation , option [2] <i>Impulse, set-reset</i>), the reset signal stops the emergency mode operation.

5-10 Terminal 18 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the function from the available digital input range. All functions are described in [Table 23](#), [Table 25](#), [Table 27](#), and [Table 29](#).

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	Hand/auto on	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset counter A	
[65]	Reset counter B	
[66]	Sleep mode	
[68]	Timed actions disabled	

Option	Name	Description
[69]	Constant OFF actions	
[70]	Constant ON actions	
[75]	MCO specific	
[78]	Reset maint. word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[96]	Mains loss	
[97]	Mains loss inverse	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency mode setup bit 0	
[194]	Emergency mode setup bit 1	

Option	Name	Description
[195]	Test emcy mode	
[196]	Reset emcy mode	

5-11 Terminal 19 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-10 Terminal 18 Digital Input*.

5-12 Terminal 27 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-10 Terminal 18 Digital Input*.

5-13 Terminal 29 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the function from the available digital input range. All functions are described in [Table 23](#), [Table 25](#), [Table 27](#), and [Table 29](#).

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	

Option	Name	Description
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[30]	Counter input	
[32]	Pulse input	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	Hand/auto on	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[60]	Counter A (up)	
[61]	Counter A (down)	
[62]	Reset counter A	
[63]	Counter B (up)	
[64]	Counter B (down)	
[65]	Reset counter B	
[66]	Sleep mode	
[68]	Timed actions disabled	
[69]	Constant OFF actions	
[70]	Constant ON actions	
[75]	MCO specific	
[78]	Reset maint. word	
[80]	PTC card 1	
[85]	Latched pump derog	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derog counter	

Option	Name	Description
[96]	Mains loss	
[97]	Mains loss inverse	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency mode setup bit 0	
[194]	Emergency mode setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

5-14 Terminal 32 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-10 Terminal 18 Digital Input*.

5-15 Terminal 33 Digital Inputs

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-13 Terminal 29 Digital Input*.

5-16 Terminal X30/2

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-10 Terminal 18 Digital Input*.

5-17 Terminal X30/3 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-10 Terminal 18 Digital Input*.

5-18 Terminal X30/4 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-10 Terminal 18 Digital Input*.

Parameter 5-19 Terminal 37 Safe Stop

Default value:	[1] Safe stop alarm	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Options [4] PTC 1 Alarm to [9] PTC 1 & Relay W/A are only available when the VLT® PTC Thermistor Card MCB 112 is connected.



NOTE: Selecting Auto Reset/Warning enables automatic restart of the drive.

Use this parameter to configure the Safe Torque Off functionality. A warning message makes the drive coast the motor and enables the automatic restart. An alarm message makes the drive coast the motor and requires a manual restart (via a fieldbus, Digital I/O, or by pressing [RESET] on the LCP). When the VLT® PTC Thermistor Card MCB 112 is mounted, configure the PTC options to get the full benefit from the alarm handling.

Option	Name	Description
[1]*	Safe stop alarm	Coasts the drive when Safe Torque Off is activated. Manual reset from LCP, digital input, or fieldbus.
[3]	Safe stop warning	Coasts the drive when Safe Torque Off is activated (terminal 37 off). When the Safe Torque Off circuit is re-established, the drive continues without manual reset.
[4]	PTC 1 alarm	Coasts the drive when Safe Torque Off is activated. Manual reset from LCP, digital input, or fieldbus.
[5]	PTC 1 warning	Coasts the drive when Safe Torque Off is activated (terminal 37 off). When the Safe Torque Off circuit is re-established, the drive continues without manual reset, unless a digital input set to [80] PTC Card 1 is still enabled.
[6]	PTC 1 & Relay A	This option is used when the VLT® PTC Thermistor Card MCB 112 gates with a stop key through a safety relay to terminal 37. Coasts the drive when Safe Torque Off is activated. Manual reset from LCP, digital input, or fieldbus.
[7]	PTC 1 & Relay W	This option is used when the VLT® PTC Thermistor Card MCB 112 gates with a stop key through a safety relay to terminal 37. Coasts the drive when Safe Torque Off is activated (terminal 37 off). When the Safe Torque Off circuit is re-established, the drive continues without manual reset, unless a digital input set to [80] PTC Card 1 is still enabled.
[8]	PTC 1 & Relay A/W	This option enables using a combination of alarm and warning.
[9]	PTC 1 & Relay W/A	This option enables using a combination of warning and alarm.

Table 30: Overview of Functions, Alarms, and Warnings

Function	Number	PTC	Relay
No function	[0]	–	–
Safe Torque Off alarm	[1]*	–	Safe Torque Off [A68 ⁽¹⁾]
Safe Torque Off warning	[3]	–	Safe Torque Off [W68 ⁽¹⁾]
PTC 1 alarm	[4]	PTC 1 Safe Torque Off [A71]	–
PTC 1 warning	[5]	PTC 1 Safe Torque Off [W71]	–
PTC 1 and relay A	[6]	PTC 1 Safe Torque off [A71]	Safe Torque Off [A68]
PTC 1 and relay W	[7]	PTC 1 Safe Torque Off [W71]	Safe Torque Off [W68]
PTC 1 and relay A/W	[8]	PTC 1 Safe Torque Off [A71]	Safe Torque Off [W68]
PTC 1 and relay W/A	[9]	PTC 1 Safe Torque Off [W71]	Safe Torque Off [A68]

1) W means warning and A means alarm.

A dangerous failure related to STO issues *alarm 72, Dangerous Failure*.

Parameter 5-20 Terminal X46/1 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the function from the available digital input range. All functions are described in [Table 23](#), [Table 25](#), [Table 27](#), and [Table 29](#).

Option	Name	Description
[0]	No operation	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	External interlock	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset counter A	
[65]	Reset counter B	
[66]	Sleep mode	

Option	Name	Description
[68]	Timed actions disabled	
[69]	Constant OFF actions	
[70]	Constant ON actions	
[75]	MCO specific	
[78]	Reset maint. word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[96]	Mains loss	
[97]	Mains loss inverse	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency setup bit 0	

Option	Name	Description
[194]	Emergency setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

5-21 Terminal X46/3 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-20 Terminal X46/1 Digital Input*.

5-22 Terminal X46/5 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-20 Terminal X46/1 Digital Input*.

5-23 Terminal X46/7 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-20 Terminal X46/1 Digital Input*.

5-24 Terminal X46/9

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-20 Terminal X46/1 Digital Input*.

5-25 Terminal X46/11 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-20 Terminal X46/1 Digital Input*.

5-26 Terminal X46/13 Digital Input

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter **5-20 Terminal X46/1 Digital Input**.

5.7.3 5-3* Digital Outputs

Parameters for configuring the output functions for the output terminals. The 2 solid-state digital outputs are common for terminals 27 and 29. Set the I/O function for terminal 27 in parameter **5-01 Terminal 27 Mode** and set the I/O function for terminal 29 in parameter **5-02 Terminal 29 Mode**.



NOTE: These parameters cannot be adjusted while the motor is running.

5-30 Terminal 27 Digital Output

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the function from the available digital output range.

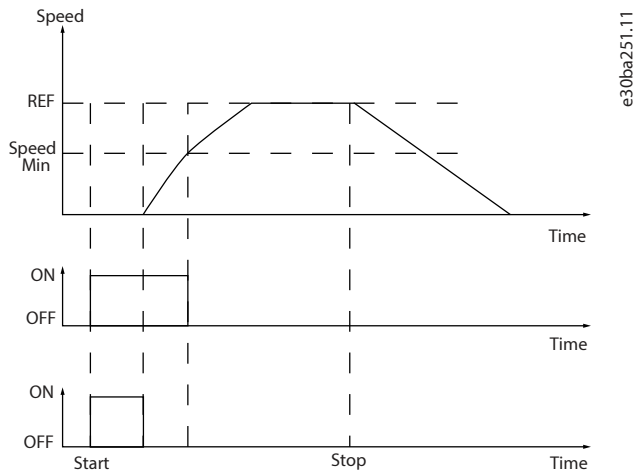
Option	Name	Description
[0]	No operation	Default for all digital outputs and relay outputs.
[1]	Control ready	The control board receives supply voltage.
[2]	Drive ready	The drive is ready for operation and applies a supply signal on the control board.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Standby/no warning	The drive is ready for operation. No start or stop command has been given (start/disable). There are no warnings.
[5]	Running	The motor is running.
[6]	Running/no warning	The output speed is higher than the speed set in parameter 1-81 Min Speed for Function at Stop . The motor is running and there are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed.
[9]	Alarm	An alarm activates the output. There are no warnings.
[10]	Alarm or warning	An alarm or warning activates the output.
[11]	At torque limit	The torque limit set in parameter 4-16 Torque Limit Motor Mode has been exceeded.
[12]	Out of current range	The motor current is outside the range set in parameter 4-18 Current Limit .
[13]	Below current, low	The motor current is lower than the setting in parameter 4-50 Warning Current Low .
[14]	Above current, high	The motor current is higher than the setting in parameter 4-51 Warning Current High .
[15]	Out of speed range	The output speed is outside the ranges set in parameter 4-52 Warning Speed Low and parameter 4-53 Warning Speed High .
[16]	Below speed, low	The output speed is lower than the setting in parameter 4-52 Warning Speed Low .

Option	Name	Description
[17]	Above speed, high	The output speed is higher than the setting in parameter 4-53 Warning Speed High .
[18]	Out of feedb. range	Feedback is outside the ranges set in parameter 4-56 Warning Feedback Low and parameter 4-57 Warning Feedback High .
[19]	Below feedback, low	Feedback is below the limit set in parameter 4-56 Warning Feedback Low .
[20]	Above feedback, high	Feedback is above the limit set in parameter 4-57 Warning Feedback High .
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the drive, the brake resistor, or the thermistor.
[25]	Reverse	Reversing. Logic 1 = relay activated, 24 V DC when the motor rotates clockwise. Logic 0 = relay not activated, no signal, when the motor rotates counterclockwise.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Used in performing a coast stop and in torque limit condition. If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[28]	Brake, no brake war	The brake is ready for operation and there are no warnings.
[29]	Brake ready, no fault	The brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	The output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/relay to cut out the mains voltage from the drive.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	The external interlock function has been activated via 1 of the digital inputs.
[40]	Out of ref range	Active when the actual speed is outside the settings in parameter 4-52 Warning Speed Low and parameter 4-53 Warning Speed High .
[41]	Below reference, low	Active when the actual speed is below the speed reference setting.
[42]	Above ref, high	Active when the actual speed is above the speed reference setting.
[45]	Bus ctrl.	Controls the output via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . If a bus timeout occurs, the output state is retained.
[46]	Bus ctrl, 1 if timeout	Controls the output via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . If a bus timeout occurs, the output state is set high (on).
[47]	Bus ctrl, 0 if timeout	Controls the output via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . If a bus timeout occurs, the output state is set low (off).

Option	Name	Description
[51]	MCO controlled	Active when a VLT® Advanced Cascade Controller MCO 102 or VLT® Motion Control MCO 305 is connected. The output is controlled from the option.
[55]	Pulse output	
[59]	Remote,enable,no TW	
[60]	Comparator 0	See parameter group 13-1* Comparators . If comparator 0 is evaluated as true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See parameter group 13-1* Comparators . If comparator 1 is evaluated as true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See parameter group 13-1* Comparators . If comparator 2 is evaluated as true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See parameter group 13-1* Comparators . If comparator 3 is evaluated as true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See parameter group 13-1* Comparators . If comparator 4 is evaluated as true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See parameter group 13-1* Comparators . If comparator 5 is evaluated as true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See parameter group 13-1* Comparators . If comparator 6 is evaluated as true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See parameter group 13-1* Comparators . If comparator 7 is evaluated as true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See parameter group 13-1* Comparators . If comparator 8 is evaluated as true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See parameter group 13-1* Comparators . If comparator 9 is evaluated as true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See parameter group 13-4* Logic Rules . If logic rule 0 is evaluated as true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See parameter group 13-4* Logic Rules . If logic rule 1 is evaluated as true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See parameter group 13-4* Logic Rules . If logic rule 2 is evaluated as true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See parameter group 13-4* Logic Rules . If logic rule 3 is evaluated as true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See parameter group 13-4* Logic Rules . If logic rule 4 is evaluated as true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See parameter group 13-4* Logic Rules . If logic rule 5 is evaluated as true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See parameter group 13-4* Logic Rules . If logic rule 6 is evaluated as true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See parameter group 13-4* Logic Rules . If logic rule 7 is evaluated as true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See parameter group 13-4* Logic Rules . If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.

Option	Name	Description
[79]	Logic rule 9	See parameter group 13-4* Logic Rules . If logic rule 9 is evaluated as true, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [38] Set digital out A high is executed. The output goes low whenever the smart logic action [32] Set digital out A low is executed.
[81]	SL digital output B	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [39] Set digital out B high is executed. The output goes low whenever the smart logic action [33] Set digital out B low is executed.
[82]	SL digital output C	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [40] Set digital out C high is executed. The output goes low whenever the smart logic action [34] Set digital out C low is executed.
[83]	SL digital output D	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [41] Set digital out D high is executed. The output goes low whenever the smart logic action [35] Set digital out D low is executed.
[84]	SL digital output E	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [42] Set digital out E high is executed. The output goes low whenever the smart logic action [36] Set digital out E low is executed.
[85]	SL digital output F	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [43] Set digital out F high is executed. The output goes low whenever the smart logic action [37] Set digital out F low is executed.
[90]	kWh counter pulse	Creates a pulse on the digital output every time the drive uses 1 kWh.
[120]	System on ref	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If Alarm 164 ATEX ETR <i>cur.lim.alarm</i> is active, the output is 1.
[152]	ATEX ETR freq. alarm	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If Alarm 166 ATEX ETR <i>freq.lim.alarm</i> is active, the output is 1.
[153]	ATEX ETR cur. warning	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If Alarm 163 ATEX ETR <i>cur.lim.warning</i> is active, the output is 1.
[154]	ATEX ETR freq. warning	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If Alarm 165 ATEX ETR <i>freq.lim.warning</i> is active, the output is 1.
[155]	Verifying flow	
[160]	No alarm	The output is high when no alarm is present.

Option	Name	Description
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[164]	Local ref active, not OFF	
[165]	Local ref active	The output is high when parameter 3-13 Reference Site = [2] Local or when parameter 3-13 Reference Site = [0] Linked to hand auto at the same time as the LCP is in hand-on mode.
[166]	Remote ref active	The output is high when parameter 3-13 Reference Site is set to [1] Remote or [0] Linked to hand/auto while the LCP is in auto-on mode.
[167]	Start command activ	 NOTE: All inverse stop/coast commands must be inactive. The output is high when there is an active start command, for example auto on, and a start command via digital input or bus is active, or <i>[Hand On]</i>.
[168]	Hand mode	The output is high when the drive is in hand-on mode (as indicated by the indicator light above <i>[Hand On]</i>).
[169]	Auto mode	The output is high when the drive is in auto-on mode (as indicated by the indicator light above <i>[Auto On]</i>).
[173]	10Wh counter pulse	
[178]	RS Flipflops 8	
[179]	RS flipflops 9	
[180]	Clock fault	The clock function has been reset to default (2000-01-01) because of a power failure.
[181]	Prev. Maintenance	One or more preventive maintenance events programmed in parameter 23-10 Maintenance Item has passed the time for the specified action in parameter 23-11 Maintenance Action .
[182]	Deragging	Deragging is active.
[183]	Pre/post lube	
[188]	AHF Capacitor Connect	See parameter 5-80 AHF Cap Reconnect Delay .
[189]	External Fan Control	External fan control is active.
[190]	No-flow	A no-flow situation or minimum speed situation has been detected if enabled in parameter 22-21 Low Power Detection .
[191]	Dry pump	A dry-pump condition has been detected. Enable this function in parameter 22-26 Dry Pump Function .
[192]	End of curve	Active when an end-of-curve condition is present.
[193]	Sleep mode	The drive/system has entered sleep mode. See parameter group 22-4* Sleep Mode .
[194]	Broken belt	A broken-belt condition has been detected. Enable this function in parameter 22-60 Broken Belt Function .

Option	Name	Description
[195]	Bypass valve control	The bypass valve control (digital/relay output in the drive) is used for compressor systems to unload the compressor during start-up by using a bypass valve. After the start command is given, the bypass valve is open until the drive reaches the value set in parameter 4-11 Motor Speed Low Limit [RPM]. After the limit has been reached, the bypass valve is closed, allowing the compressor to operate normally. This procedure is not activated again before a new start is initiated and the drive speed is 0 during the receiving of the start signal. Parameter 1-71 Start Delay can be used to delay the motor start.  e30ba251.11
[196]	Emergency mode	The drive operates in emergency mode. See parameter group 24-0* Emergency Mode .
[197]	Emcy mode was act.	The drive has been operating in emergency mode. See parameter group 24-0* Emergency Mode .
[198]	Drive bypass	To be used as signal for activating an external electromechanical bypass, switching the motor directly on line. See parameter group 24-0* Emergency Mode .
NOTICE LOSS OF CERTIFICATION If enabling the drive bypass function, the drive is no longer certified for using the Safe Torque Off in versions where included.		
[199]	Pipe filling	Active when the pipe fill function is operating. See parameter group 29-** Water Application Functions .
[200]	Full capacity	All pumps are running at full speed.

Option	Name	Description
[201]	Pump 1 running	One or more of the pumps controlled by the cascade controller are running. The function also depends on the setting in parameter 25-05 Fixed Lead Pump . If set to [0] No , Pump 1 refers to the pump controlled by relay1, and so on. If set to [1] Yes , Pump 1 refers to the pump controlled by the drive only (without any of the built-in relays involved) and Pump 2 to the pump controlled by relay1.
[202]	Pump 2 running	See [201] Pump 1 running .
[203]	Pump 3 running	See [201] Pump 1 running .
[204]	Pump 4 running	See [201] Pump 1 running .
[205]	Pump 5 running	See [201] Pump 1 running .
[206]	Pump 6 running	See [201] Pump 1 running .
[207]	Pump 7 running	See [201] Pump 1 running .
[208]	Pump 8 running	See [201] Pump 1 running .
[209]	Pump 9 running	See [201] Pump 1 running .
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[241]	RS flipflop 1	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[242]	RS flipflop 2	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[243]	RS flipflop 3	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[244]	RS flipflop 4	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[245]	RS flipflop 5	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[246]	RS flipflop 6	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[247]	RS flipflop 7	See parameter 13-15 RS-FF Operand S and parameter 13-16 RS-FF Operand R .
[249]	Emcy m. OPR unexpected	Emergency mode input or safe stop is not operating as expected, for example, live zero monitoring on an analog input is activated.
[250]	Emcy mode limits	During emergency mode operation, 1 of the critical alarms has been activated and suppressed by emergency mode. This may lead to reduced drive performance and expected operation lifetime before service is required.
[254]	Testing emcy mode	Emergency mode is activated in a special test mode where the drive stops on all alarms.

Table 31: Pumps Controlled by the Cascade Controller

Setting in parameter group 5-3* Digital Outputs	Setting in parameter 25-05 Fixed Lead Pump	
	[0] No	[1] Yes
[201] Pump 1 running	Controlled by relay1	Controlled by drive
[202] Pump 2 running	Controlled by relay2	Controlled by relay1
[203] Pump 3 running	–	Controlled by relay2

5-31 Terminal 29 Digital Output

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *5-30 Terminal 27 Digital Output*.

5-32 Term X30/6 Digi Out (MCB 101)

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is active when option module VLT® General Purpose I/O MCB 101 is mounted in the drive. The options for this parameter are the same as those listed for parameter *5-30 Terminal 27 Digital Output*.

5-33 Term X30/7 Digi Out (MCB 101)

Default value:	Size related	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is active when option module VLT® General Purpose I/O MCB 101 is mounted in the drive. The options for this parameter are the same as those listed for *parameter 5-30 Terminal 27 Digital Output*.

5.7.4 5-4* Relays

Parameters for configuring the timing and the output functions for the relays.

5-40 Function Relays

Default value:	–	Parameter type:	Option, Array [20]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select options to define the function of the relays. The selection of each mechanical relay is realized in an array parameter.

Option	Name	Description
[0]	No operation	All digital and relay outputs are by default set to No Operation.
[1]	Control ready	The control card is ready.

Option	Name	Description
[2]	Drive ready	The drive is ready to operate. Mains and control supplies are OK.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Standby/no warning	The drive is ready for operation. No start or stop command is given (start/disable). There are no warnings.
[5]	Running	The motor is running, and shaft torque is present.
[6]	Running/no warning	Output speed is higher than the speed set in parameter 1-81 Min Speed for Function at Stop [RPM] . The motor runs and there are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output. No warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in parameter 4-16 Torque Limit Motor Mode or parameter 4-17 Torque Limit Generator Mode has been exceeded.
[12]	Out of current range	The motor current is outside the range set in parameter 4-18 Current Limit .
[13]	Below current, low	The motor current is lower than set in parameter 4-50 Warning Current Low .
[14]	Above current, high	The motor current is higher than set in parameter 4-51 Warning Current High .
[15]	Out of speed range	Output speed/frequency is outside the frequency range set in parameter 4-52 Warning Speed Low and parameter 4-53 Warning Speed High .
[16]	Below speed, low	Output speed is lower than the setting in parameter 4-52 Warning Speed Low .
[17]	Above speed, high	Output speed is higher than the setting in parameter 4-53 Warning Speed High .
[18]	Out of feedb. range	Feedback is outside the range set in parameter 4-56 Warning Feedback Low and parameter 4-57 Warning Feedback High .
[19]	Below feedback, low	Feedback is below the limit set in parameter 4-56 Warning Feedback Low .
[20]	Above feedback, high	Feedback is above the limit set in parameter 4-57 Warning Feedback High .
[21]	Thermal warning	Thermal warning turns on when the temperature exceeds the limit either in motor, drive, brake resistor, or connected thermistor.
[25]	Reverse	The motor runs (or is ready to run) clockwise when logic = 0 and counterclockwise when logic = 1. The output changes as soon as the reversing signal is applied.

Option	Name	Description
[26]	Bus OK	Active communication (no timeout) via the serial communication port.
[27]	Torque limit & stop	Use for performing a coasted stop in a torque limit condition. If the drive has received a stop signal and is in torque limit, the signal is logic 0.
[28]	Brake, no brake war	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake module. Use the digital output/relay to cut out the main voltage from the drive.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	The external interlock function has been activated via 1 of the digital inputs.
[36]	Control word bit 11	Activate relay 1 by control word from fieldbus. No other functional impact in the drive. Typical application: Controlling auxiliary device from fieldbus. The function is valid when [0] FC profile in parameter 8-10 Control Word Profile is selected.
[37]	Control word bit 12	Activate relay 2 by control word from fieldbus. No other functional impact in the drive. Typical application: Controlling auxiliary device from fieldbus. The function is valid when [0] FC profile in parameter 8-10 Control Word Profile is selected.
[40]	Out of ref range	Active when the actual speed is outside the settings in parameter 4-52 Warning Speed Low to parameter 4-55 Warning Reference High .
[41]	Below reference, low	Active when the actual speed is below speed reference setting.
[42]	Above ref, high	Active when actual speed is above speed reference setting.
[45]	Bus ctrl.	Controls digital output/relay via bus. The state of the output is set in parameter 5-90 Digital and Relay Bus Control . The output state is retained in the event of a bus timeout.
[46]	Bus ctrl, 1 if timeout	Controls output via bus. The state of the output is set in parameter 5-90 Digital and Relay Bus Control . If a bus timeout occurs, the output state is set high (on).
[47]	Bus ctrl, 0 if timeout	Controls output via bus. The state of the output is set in parameter 5-90 Digital and Relay Bus Control . If a bus timeout occurs, the output state is set low (off).

Option	Name	Description
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	See parameter group 13-1* Comparators . If comparator 0 in SLC is true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See parameter group 13-1* Comparators . If comparator 1 in SLC is true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See parameter group 13-1* Comparators . If comparator 2 in SLC is true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See parameter group 13-1* Comparators . If comparator 3 in SLC is true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See parameter group 13-1* Comparators . If comparator 4 in SLC is true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See parameter group 13-1* Comparators . If comparator 5 in SLC is true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See parameter group 13-1* Comparators . If comparator 6 in SLC is true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See parameter group 13-1* Comparators . If comparator 7 in SLC is true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See parameter group 13-1* Comparators . If comparator 8 in SLC is true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See parameter group 13-1* Comparators . If comparator 9 in SLC is true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See parameter group 13-4* Logic Rules . If logic rule 0 in SLC is true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See parameter group 13-4* Logic Rules . If logic rule 1 in SLC is true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See parameter group 13-4* Logic Rules . If logic rule 2 in SLC is true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See parameter group 13-4* Logic Rules . If logic rule 3 in SLC is true, the output goes high. Otherwise, it is low.

Option	Name	Description
[74]	Logic rule 4	See parameter group 13-4* Logic Rules . If logic rule 4 in SLC is true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See parameter group 13-4* Logic Rules . If logic rule 5 in SLC is true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See parameter group 13-4* Logic Rules . If logic rule 6 in SLC is true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See parameter group 13-4* Logic Rules . If logic rule 7 in SLC is true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See parameter group 13-4* Logic Rules . If logic rule 8 in SLC is true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See parameter group 13-4* Logic Rules . If logic rule 9 in SLC is true, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See parameter 13-52 SL Controller Action . Output A is low on smart logic action [32] Set digital out A low . Output A is high on smart logic action [38] Set digital out A high .
[81]	SL digital output B	See parameter 13-52 SL Controller Action . Output B is low on smart logic action [33] Set digital out B low . Output B is high on smart logic action [39] Set digital out B high .
[82]	SL digital output C	See parameter 13-52 SL Controller Action . Output C is low on smart logic action [34] Set digital out C low . Output C is high on smart logic action [40] Set digital out C high .
[83]	SL digital output D	See parameter 13-52 SL Controller Action . Output D is low on smart logic action [35] Set digital out D low . Output D is high on smart logic action [41] Set digital out D high .
[84]	SL digital output E	See parameter 13-52 SL Controller Action . Output E is low on smart logic action [36] Set digital out E low . Output E is high on smart logic action [42] Set digital out E high .
[85]	SL digital output F	See parameter 13-52 SL Controller Action . Output F is low on smart logic action [37] Set digital out F low . Output F is high on smart logic action [43] Set digital out F high .
[150]	CBM warning	

Option	Name	Description
[151]	ATEX ETR cur. alarm	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 164 , ATEX ETR cur.lim.alarm is active, the output is 1.
[152]	ATEX ETR freq. alarm	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 166 , ATEX ETR freq.lim.alarm is active, the output is 1.
[153]	ATEX ETR cur. warning	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 163 , ATEX ETR cur.lim.warning is active, the output is 1.
[154]	ATEX ETR freq. warning	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If warning 165 , ATEX ETR freq.lim.warning is active, the output is 1.
[155]	Verifying flow	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[164]	Local ref active, not OFF	
[165]	Local ref active	The output is high when parameter 3-13 Reference Site is set to [2] Local or when parameter 3-13 Reference Site is set to [0] Linked to hand/auto at the same time as the LCP is in hand-on mode.
[166]	Remote ref active	The output is high when parameter 3-13 Reference Site is set to [1] Remote or [0] Linked to hand/auto while the LCP is in auto-on mode.
[167]	Start command activ	The output is high when there is an active start command (via digital input, bus connection, [Hand On] , or [Auto On]), and no stop command is active.
[168]	Hand/Off	The output is high when the drive is in hand-on mode (as indicated by the LED light above [Hand On]).
[169]	Auto mode	The output is high when the drive is in auto-on mode (as indicated by the LED light above [Auto On]).
[173]	10Wh counter pulse	
[178]	RS flipflop 8	
[179]	RS flipflop 9	
[180]	Clock fault	The clock function has been reset to default (2000-01-01) because of a power failure.

Option	Name	Description
[181]	Prev. maintenance	One or more of the preventive maintenance events programmed in parameter 23-10 Maintenance Item has passed the time for the specified action in parameter 23-22 Maintenance Action .
[183]	Pre/post lube	
[188]	AHF capacitor connect	
[189]	External fan control	The internal logics for internal fan control is transferred to this output to make it possible to control an external fan (relevant for hp duct cooling).
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	The drive/system has entered sleep mode. See parameter group 22-4* Sleep Mode .
[194]	Broken belt	A broken-belt condition has been detected. Enable this function in parameter 22-60 Broken Belt Function .
[195]	Bypass valve control	
[196]	Fire mode	The drive operates in fire mode. See parameter group 24-0* Fire Mode .
[197]	Fire mode was act.	The drive has been operating in fire mode. In software version 7.2X, this output is only active 1 min after fire mode is stopped. See parameter group 24-0* Fire Mode .
[198]	Drive bypass	To be used as signal for activating an external electromechanical bypass, switching the motor direct on line. See parameter group 24-1* Drive Bypass .
NOTICE LOSS OF CERTIFICATION If enabling the drive bypass function, the drive is no longer certified for using the Safe Torque Off in versions where included.		
[199]	Pipe filling	
[211]	Cascade pump 1	
[212]	Cascade pump 2	
[213]	Cascade pump 3	
[214]	Cascade pump 4	
[215]	Cascade pump 5	
[216]	Cascade pump 6	
[217]	Cascade pump 7	

Option	Name	Description
[218]	Cascade pump 8	
[219]	Cascade pump 9	
[230]	Ext. cascade ctrl	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	See parameter group 13-1* Comparators .
[241]	RS flipflop 1	See parameter group 13-1* Comparators .
[242]	RS flipflop 2	See parameter group 13-1* Comparators .
[243]	RS flipflop 3	See parameter group 13-1* Comparators .
[244]	RS flipflop 4	See parameter group 13-1* Comparators .
[245]	RS flipflop 5	See parameter group 13-1* Comparators .
[246]	RS flipflop 6	See parameter group 13-1* Comparators .
[247]	RS flipflop 7	See parameter group 13-1* Comparators .

5-41 On Delay, Relay

Default value:	0.01 s	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the delay of the relay cut-in time. Select 1 of 2 internal mechanical relays in an array function. See parameter **5-40 Function Relay** for details.

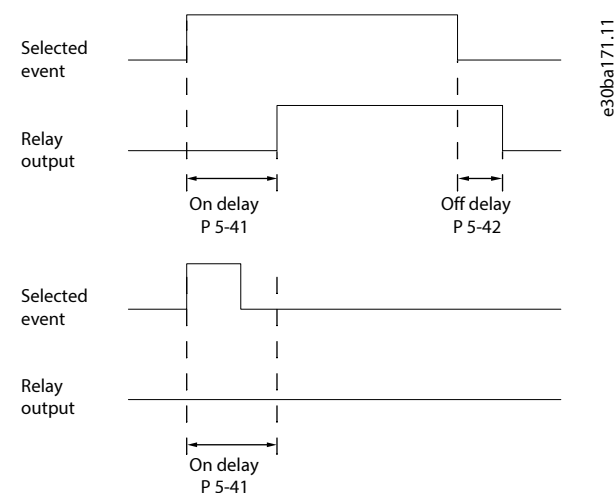


Figure 58: On Delay, Relay

5-42 Off Delay, Relay

Default value:	0.01 s	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the delay of the relay cutout time. Select 1 of 2 internal mechanical relays in an array function. See parameter **5-40 Function Relay** for details. If the selected event condition changes before a delay timer expires, the relay output is unaffected.

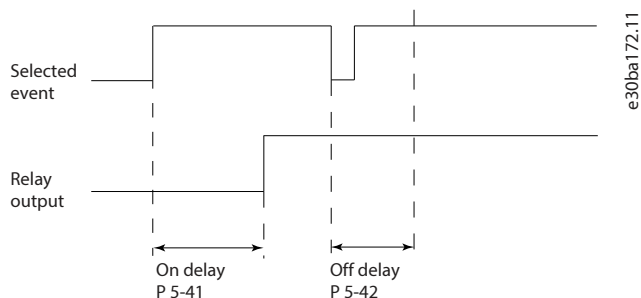


Figure 59: Off Delay, Relay

If the selected event condition changes before the on delay or off delay timer expires, the relay output is unaffected.

5.7.5 5-5* Pulse Input

The pulse input parameters are used to define an appropriate window for the impulse reference area by configuring the scaling and filter settings for the pulse inputs. Input terminal 29 or 33 acts as frequency reference inputs. Set terminal 29 (parameter **5-13 Terminal 29 Digital Input**) or terminal 33 (parameter **5-15 Terminal 33 Digital Input**) to **[32] Pulse input**. If terminal 29 is used as an input, set parameter **5-02 Terminal 29 Mode** to **[0] Input**.

5-50 Term. 29 Low Frequency

Default value:	100 Hz	Parameter type:	Range, 0 – 110000 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Enter the low frequency limit corresponding to the low motor shaft speed (that is low reference value) in parameter **5-52 Term. 29 Low Ref./Feedb. Value**. Refer to the illustration below.

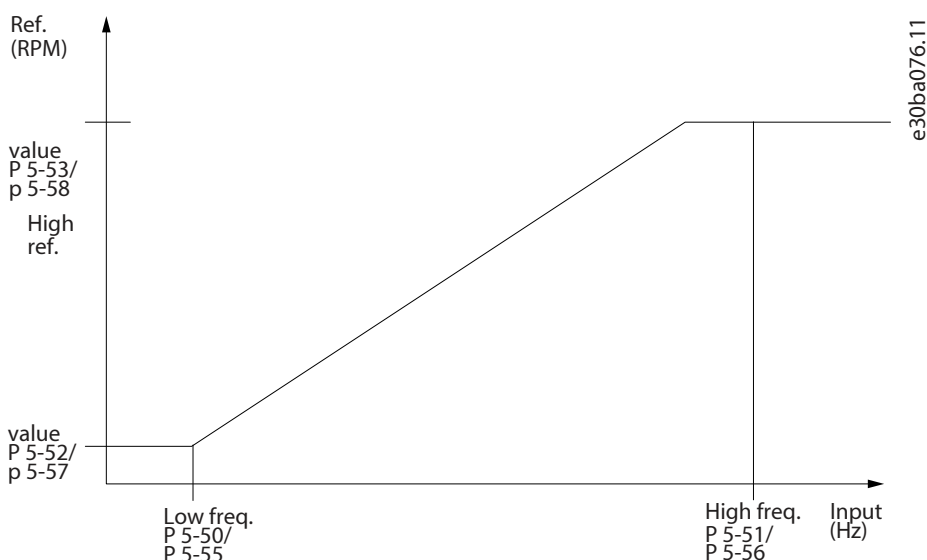


Figure 60: Pulse Input

5-51 Term. 29 High Frequency

Default value:	100 Hz	Parameter type:	Range, 0 – 110000 Hz
Setup:	All setups	Conversion index:	0

Data type:	Uint32	Change during operation:	True

Enter the high frequency limit corresponding to the high motor shaft speed (that is high reference value) in parameter **5-53 Term. 29 High Ref./Feedb. Value**.

5-52 Term. 29 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 Reference-FeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the low reference value limit for the motor shaft speed [RPM]. This is also the lowest feedback value, see also parameter **5-57 Term. 33 Low Ref./Feedb. Value**. Set terminal 29 to digital input (parameter **5-02 Terminal 29 Mode = [0] Input** (default) and parameter **5-13 Terminal 29 Digital Input** = applicable value).

5-53 Term. 29 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the high reference value [RPM] for the motor shaft speed and the high feedback value, see also parameter **5-58 Term. 33 High Ref./Feedb. Value**. Select terminal 29 as a digital input (parameter **5-02 Terminal 29 Mode = [0] Input** (default) and parameter **5-13 Terminal 29 Digital Input** = applicable value).

5-54 Pulse Filter Time Constant #29

Default value:	100 ms	Parameter type:	Range, 5 - 1000 ms
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	False

Enter the pulse filter time constant. The pulse filter dampens oscillations of the feedback signal. If there is much noise in the system this is an advantage. A high time constant value results in better dampening but also increases the time delay through the filter.

5-55 Term. 33 Low Frequency

Default value:	100 Hz	Parameter type:	Range, 0 - 110000 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Enter the low frequency corresponding to the low motor shaft speed (that is low reference value) in parameter **5-57 Term. 33 Low Ref./Feedb. Value**.

5-56 Term. 33 High Frequency

Default value:	100 Hz	Parameter type:	Range, 0 - 110000 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Enter the high frequency corresponding to the high motor shaft speed (that is high reference value) in parameter **5-58 Term. 33 High Ref./Feedb. Value**.

5-57 Term. 33 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the low reference value [RPM] for the motor shaft speed. This is also the low feedback value, see also parameter **5-52 Term. 29 Low Ref./Feedb. Value**.

5-58 Term. 33 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the high reference value [RPM] for the motor shaft speed. See also parameter **5-53 Term. 29 High Ref./Feedb. Value**.

5-59 Pulse Filter Time Constant #33

Default value:	100 ms	Parameter type:	Range, 5 - 1000 ms
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the pulse filter time constant. The low-pass filter reduces the influence and dampens oscillations on the feedback signal from the control. This is an advantage if there is a lot of noise in the system.

5.7.6 5-6* Pulse Outputs

Parameters for configuring the scaling and output functions of pulse outputs. The pulse outputs are designated to terminal 27 or 29. Select terminal 27 output in parameter **5-01 Terminal 27 Mode** and terminal 29 in parameter **5-02 Terminal 29 Mode**.

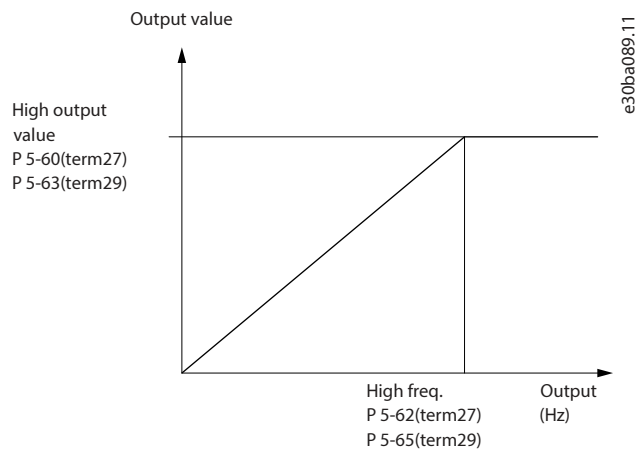


Figure 61: Pulse Output

5-60 Terminal 27 Pulse Output Variable

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]*	No operation	Select the display output for terminal 27.
[45]	Bus ctrl.	
[48]	Bus ctrl, timeout	
[51]	MCO controlled	
[100]	Output freq. 0–100	
[101]	Reference min–max	
[102]	Feedback $\pm 200\%$	
[103]	Motor cur. 0– I_{MAX}	
[104]	Torque 0– T_{lim}	
[105]	Torque 0– T_{nom}	
[106]	Power 0– P_{nom}	
[107]	Speed 0–HighLim	
[108]	Torque $\pm 160\%$	
[109]	Out frq 0– F_{MAX}	
[113]	Ext. closed loop 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[116]	Cascade reference	

5-62 Pulse Output Max Freq #27

Default value:	5000 Hz	Parameter type:	Range, 0 - 32000 Hz
Setup:	All setups	Conversion index:	0

Data type:	Uint32	Change during operation:	True

Set the maximum frequency for terminal 27 corresponding to the output variable selected in parameter **5-60 Terminal 27 Pulse Output Variable**.

5-63 Terminal 29 Pulse Output Variable

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	No operation	Select the display output for terminal 27.
[45]	Bus ctrl.	Control the digital outputs via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . The output state is retained if a bus timeout occurs.
[48]	Bus ctrl., timeout	
[51]	MCO controlled	
[100]	Output freq. 0–100	
[101]	Reference min–max	
[102]	Feedback $\pm 200\%$	
[103]	Motor cur. 0– I_{MAX}	
[104]	Torque 0– T_{lim}	
[105]	Torque 0– T_{nom}	
[106]	Power 0– P_{nom}	
[107]	Speed 0–HighLim	
[108]	Torque $\pm 160\%$	
[109]	Out frq 0– F_{MAX}	
[113]	Ext. closed loop 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[116]	Cascade reference	

5-65 Pulse Output Max Freq #29

Default value:	5000 Hz	Parameter type:	Range, 0 - 32000 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Set the maximum frequency for terminal 27 corresponding to the output variable selected in parameter **5-60 Terminal 27 Pulse Output Variable**.

5-66 Terminal X30/6 Pulse Output Variable

Default value:	[0] No operation	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True
Option	Name	Description	
[0]*	No operation	Select the display output for terminal 27.	
[45]	Bus ctrl.	Control the digital outputs via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . The output state is retained if a bus timeout occurs.	
[48]	Bus ctrl., timeout		
[51]	MCO controlled		
[100]	Output freq. 0–100		
[101]	Reference min–max		
[102]	Feedback ±200%		
[103]	Motor cur. 0– I_{MAX}		
[104]	Torque 0– T_{lim}		
[105]	Torque 0– T_{nom}		
[106]	Power 0– P_{nom}		
[107]	Speed 0–HighLim		
[108]	Torque ±160%		
[109]	Out freq. 0– F_{MAX}		
[113]	Ext. closed loop 1		
[114]	Ext. closed loop 2		
[115]	Ext. closed loop 3		
[116]	Cascade reference		

5-68 Pulse Output Max Freq #30/6

Default value:	5000 Hz	Parameter type:	Range, 0 - 32000 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Set the maximum frequency for terminal 27 corresponding to the output variable selected in parameter **5-60 Terminal 27 Pulse Output Variable**.

5.7.7 5-8* I/O Options

AHF capacitor connect output function for digital and relay outputs

Functional description:

- Connect capacitors at 20% nominal power.
- Hysteresis ±50% of 20% nominal power (=minimum 10% and maximum 30% nominal power).
- Off delay timer = 10 s. The nominal power must be below 10% for 10 s to disconnect the capacitors. If the nominal power exceeds 10% during the 10 s delay, the timer (10 s) restarts.

- The capacitor reconnect delay (default = 25 s with a range of 1–120 s, see parameter **5-80 AHF Cap Reconnect Delay**) is used for the minimum off-time for the AHF capacitor output function.
- If there is a power loss, the drive guarantees that the minimum off-time is respected when power is restored.

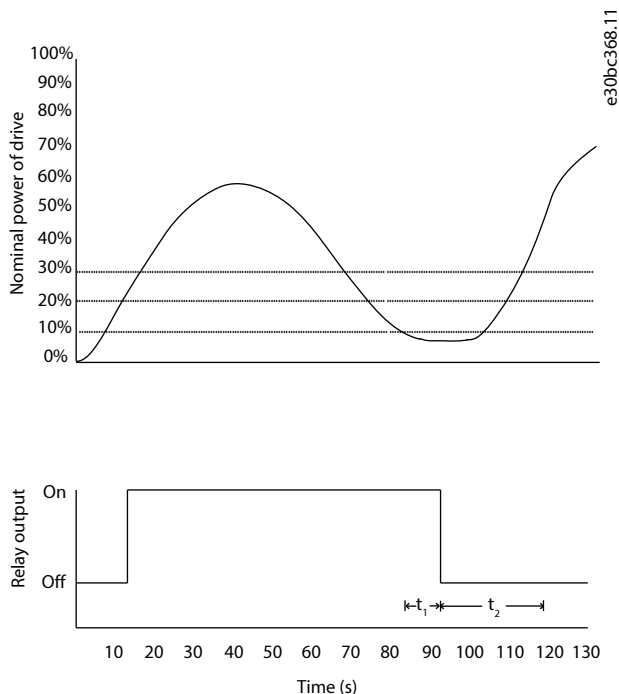


Figure 62: Example of the Output Function

t_1 shows the off delay timer (10 s).

t_2 shows the capacitor reconnect delay (parameter **5-80 AHF Cap Reconnect Delay**).

When the nominal power of the drive exceeds 20%, the output function turns on. When the power goes below 10%, and off delay timer has to expire before the output goes low. This is represented by t_1 . After the output goes low, the capacitor reconnect delay timer has to expire before the output is allowed to be on again, shown by t_2 . When t_2 expires, the nominal power is above 30% and the relay does not turn on.

5-80 AHF Cap Reconnect Delay

Default value:	25 s	Parameter type:	Range, 1 - 120 s
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Guarantees a minimum off-time for the capacitors. The timer starts once the AHF capacitor disconnects and has to expire before the output is allowed to be on again. It only turns on again if the drive power is 20–30%.

5.7.8 5-9* Bus-controlled

This parameter group selects digital and relay outputs via a fieldbus setting.

5-90 Digital & Relay Bus Control

Default value:	0	Parameter type:	Range, 0 - 0xFFFFFFFF
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter holds the state of the digital outputs and relays that is controlled by bus. A logical 1 indicates that the output is high or active. A logical 0 indicates that the output is low or inactive.

5-92 Application Bus Control

Default value:	0	Parameter type:	Range, 0 - 0xFFFFFFFF
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Use this parameter for writing control words from BacNetIP to sleep, external interlock, and latched pump derag requests.

5-93 Pulse Out #27 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Set the output frequency transferred to output terminal 27 when the terminal is configured as **[45] Bus Controlled** in parameter **5-60 Terminal 27 Pulse Output Variable**.

5-94 Pulse Out #27 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the output frequency transferred to output terminal 27 when the terminal is configured as **[48] Bus Ctrl Timeout** in parameter **5-60 Terminal 27 Pulse Output Variable** and a timeout is detected.

5-95 Pulse Out #29 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Set the output frequency transferred to output terminal 29 when the terminal is configured as **[45] Bus Controlled** in parameter **5-63 Terminal 29 Pulse Output Variable**.

5-96 Pulse Out #29 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the output frequency transferred to output terminal 29 when the terminal is configured as **[48] Bus Ctrl Timeout** in parameter **5-63 Terminal 29 Pulse Output Variable** and a timeout is detected.

5-97 Pulse Out #30/6 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Set the output frequency transferred to output terminal X30/6 when the terminal is configured as **[45] Bus ctrl.** in parameter **5-66 Terminal X30/6 Pulse Output Variable**.

5-98 Pulse Out #30/6 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Changing during operation:	True

Set the output frequency transferred to output terminal X30/6 when the terminal is configured as **[48] Bus Ctrl Timeout** in parameter **5-66 Terminal X30/6 Pulse Output Variable** and a timeout is detected.

5.8 Parameter Group 6-** Analog In/Out

5.8.1 6-0* Analog I/O Mode

Parameter group for setting up the analog I/O configuration.

The drive is equipped with 2 analog inputs:

- Terminal 53
- Terminal 54

The analog inputs can be allocated freely to either voltage (0–10 V) or current input (0/4–20 mA).



NOTE: Thermistors may be connected to either an analog or a digital input.

6-00 Live Zero Timeout Time

Default value:	10 s	Parameter type:	Range, 1 - 99 s
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the live zero timeout in s. Live zero timeout time is active for analog inputs, that is terminal 53 or terminal 54, used as reference or feedback sources. If the reference signal value associated with the selected current input drops below 50% of the value set in:

- Parameter **6-10 Terminal 53 Low Voltage**
- Parameter **6-12 Terminal 53 Low Current**
- Parameter **6-20 Terminal 54 Low Voltage**
- Parameter **6-22 Terminal 54 Low Current**

for a time period longer than the time set in parameter **6-00 Live Zero Timeout Time**, the function selected in parameter **6-01 Live Zero Timeout Function** is activated.

6-01 Live Zero Timeout Function

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the timeout function. If the input signal on terminal 53 or 54 is below 50% of the value in

- Parameter **6-10 Terminal 53 Low Voltage**

- Parameter **6-12 Terminal 53 Low Current**
- Parameter **6-20 Terminal 54 Low Voltage**
- Parameter **6-22 Terminal 54 Low Current**

for a time period defined in parameter **6-00 Live Zero Timeout Time**, the function set in parameter **6-01 Live Zero Timeout Function** is activated. If several timeouts occur simultaneously, the drive prioritizes the timeout functions as follows:

- Parameter **6-01 Live Zero Timeout Function**
- Parameter **8-04 Control Word Timeout Function**

Option	Name	Description
[0]*	Off	
[1]	Freeze output	Frozen at the present value.
[2]	Stop	Overruled to stop.
[3]	Jogging	Overruled to jog speed.
[4]	Max. speed	Overruled to maximum speed.
[5]	Stop and trip	Overruled to stop with subsequent trip.
[30]	Warning only	

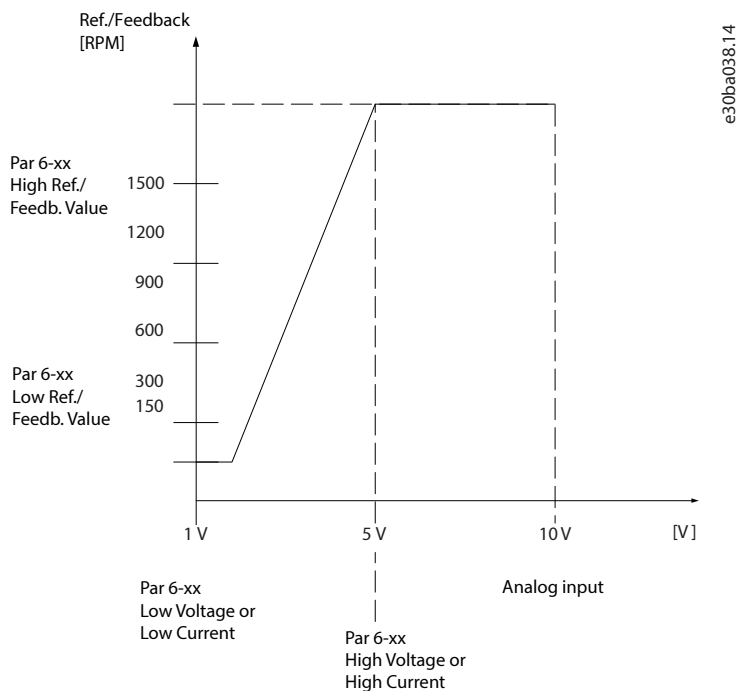


Figure 63: Live Zero Conditions

6-02 Emergency Mode Live Zero Timeout Function

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the timeout function when emergency mode is active. The function set in this parameter is activated if the input signal on analog inputs is below 50% of the low value for a period defined in parameter **6-00 Live Zero Timeout Time**.

Option	Name	Description
[0]*	Off	
[1]	Freeze output	Frozen at the present value.
[2]	Stop	Overruled to stop.
[3]	Jogging	Overruled to jog speed.
[4]	Max. speed	Overruled to maximum speed.

5.8.2 6-1* Analog Input 1

Parameters for configuring the scaling and limits for analog input 1 (terminal 53).

6-10 Terminal 53 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - par. 6-11 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the low voltage value. This analog input scaling value should correspond to the minimum reference value set in parameter **6-14 Terminal 53 Low Ref./Feedb. Value**.

6-11 Terminal 53 High Voltage

Default value:	10 V	Parameter type:	Range, par. 6-10 V - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the high voltage value. This analog input scaling value should correspond to the high reference feedback value set in parameter **6-15 Terminal 53 High Ref./Feedb. Value**.

6-12 Terminal 53 Low Current

Default value:	4 mA	Parameter type:	Range, 0 - par. 6-13 mA
Setup:	All setups	Conversion index:	-5
Data type:	Int16	Change during operation:	True

Enter the low current value. This reference signal should correspond to the minimum reference value, set in parameter **3-02 Minimum Reference**. Set the value to exceed 2 mA to activate the live zero timeout function in parameter **6-01 Live Zero Timeout Function**.

6-13 Terminal 53 High Current

Default value:	20 mA	Parameter type:	Range, par. 6-12 mA - 20 mA
Setup:	All setups	Conversion index:	-5
Data type:	Int16	Change during operation:	True

Enter the high current value corresponding to the high reference/feedback set in parameter **6-15 Terminal 53 High Ref./Feedb. Value**.

6-14 Terminal 53 Low Ref./Feedb. Value

Default value:	Size related	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit

Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the low voltage/low current set in parameter **6-10 Terminal 53 Low Voltage** and parameter **6-12 Terminal 53 Low Current**.

6-15 Terminal 53 High Ref./Feedb. Value

Default value:	Size related	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the maximum reference feedback value set in parameter **6-11 Terminal 53 High Voltage** and parameter **6-13 Terminal 53 High Current**.

6-16 Terminal 53 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	-3
Data type:	UInt16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This constant is a first-order digital low-pass filter time for suppressing electrical noise in terminal 53. A high value improves dampening but also increases the delay through the filter.

6-17 Terminal 53 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (if these are used to feed a building management system with data, and not as part of any control functions related to the drive).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.3 6-2* Analog Input 2

Parameters for configuring the scaling and limits for analog input 2 (terminal 54).

6-20 Terminal 54 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - par. 6-21 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the low voltage value. This analog input scaling value should correspond to the minimum reference value set in parameter **3-02 Minimum Reference**.

6-21 Terminal 54 High Voltage

Default value:	10 V	Parameter type:	Range, par. 6-20 V - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the high voltage value. This analog input scaling value should correspond to the high reference feedback value set in parameter **6-25 Terminal 54 High Ref./Feedb. Value**.

6-22 Terminal 54 Low Current

Default value:	4 mA	Parameter type:	Range, 0 - par. 6-23 mA
Setup:	All setups	Conversion index:	-5
Data type:	Int16	Change during operation:	True

Enter the low current value. This reference signal should correspond to the minimum reference value, set in parameter **3-02 Minimum Reference**. Enter the value that exceeds 2 mA to activate the live zero timeout function in parameter **6-01 Live Zero Timeout Function**.

6-23 Terminal 54 High Current

Default value:	20 mA	Parameter type:	Range, par. 6-22 mA - 20 mA
Setup:	All setups	Conversion index:	-5
Data type:	Int16	Change during operation:	True

Enter the high current value corresponding to the high reference feedback value set in parameter **6-25 Terminal 54 High Ref./Feedb. Value**.

6-24 Terminal 54 Low Ref./Feedb. Value

Default value:	0	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the minimum reference feedback value set in parameter **3-02 Minimum Reference**.

6-25 Terminal 54 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	-999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the maximum reference feedback value set in parameter **3-03 Maximum Reference**.

6-26 Terminal 54 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s

Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal 54. Increasing the value improves dampening but also increases the time delay through the filter.

6-27 Terminal 54 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (if these are used to feed a building management system with data, and not as part of any control functions related to the drive).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.4 6-3* Analog Input X30/11

Parameter group for configuring the scale and limits for analog input 3 (X30/11) placed on VLT® General Purpose I/O MCB 101.

6-30 Terminal X30/11 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - par. 6-31 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Sets the analog input scaling value to correspond to the low reference feedback value (set in parameter **6-34 Term. X30/11 Low Ref./Feedb. Value**).

6-31 Terminal X30/11 High Voltage

Default value:	10 V	Parameter type:	Range, par. 6-30 V - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Sets the analog input scaling value to correspond to the high reference feedback value (set in parameter **6-35 Term. X30/11 High Ref./Feedb. Value**).

6-34 Term. X30/11 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Sets the analog input scaling value to correspond to the low voltage value (set in parameter **6-30 Terminal X30/11 Low Voltage**).

6-35 Term. X30/11 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Sets the analog input scaling value to correspond to the high-voltage value (set in parameter **6-31 Terminal X30/11 High Voltage**).

6-36 Term. X30/11 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X30/11. Increasing the value improves dampening but also increases the time delay through the filter.

6-37 Terminal X30/11 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (when an analog output does not fulfill any control function, but feeds a data storage device).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.5 6-4* Analog Input X30/12

Parameter group for configuring the scale and limits for analog input 4 (X30/12) placed on VLT® General Purpose I/O MCB 101.

6-40 X30/12 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - par. 6-41 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Sets the analog input scaling value to correspond to the low reference feedback value set in parameter **6-44 Term. X30/12 Low Ref./Feedb. Value**.

6-41 Terminal X30/12 High Voltage

Default value:	10 V	Parameter type:	Range, par. 6-40 V - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Sets the analog input scaling value to correspond to the high reference feedback value set in parameter **6-45 Term. X30/12 High Ref./Feedb. Value**.

6-44 Term. X30/12 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Sets the analog output scaling value to correspond to the low voltage value set in parameter **6-40 Terminal X30/12 Low Voltage**.

6-45 Term. X30/12 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackValue	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackValue
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Sets the analog input scaling value to correspond to the high voltage value set in parameter **6-41 Terminal X30/12 High Voltage**.

6-46 X30/12 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	-3
Data type:	UInt16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X30/12. Increasing the value improves dampening but also increases the time delay through the filter.

6-47 Terminal X30/12 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Disables the live zero monitoring, for example, if the analog outputs are used as part of a decentral I/O system (when an analog output does not fulfill any control function, but feeds a data storage device).

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.8.6 6-5* Analog Output 1

Parameters for configuring the scaling and limits for analog output 1 (terminal 42). Analog outputs are current outputs: 0/4–20 mA. Common terminal (terminal 39) is the same terminal and has the same electrical potential for analog common and digital common connection. Resolution on the analog output is 12 bit.

6-50 Terminal 42 Output

Default value:	[100] Output freq. 0–100	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Values for setting the minimum reference are found in parameter **3-02 Minimum Reference** and values for maximum reference are found in parameter **3-03 Maximum Reference**.

Select the function of terminal 42 as an analog current output. A motor current of 20 mA corresponds to I_{MAX} .

Option	Name	Description
[0]	No operation	There is no signal on the analog output.
[52]	MCO	The analog value is set by the MCO 305 application program using the command OUTDA.
[53]	MCO 4–20mA	The analog value is set by the MCO 305 application program using the command OUTDA.
[100]*	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of parameter 3-03 Maximum Reference (0–20 mA).
[103]	Motor cur. 0– I_{max}	0–Inverter maximum current (parameter 16-37 Inv. Max. Current), (0–20 mA).
[104]	Torque 0– T_{lim}	0–Torque limit (parameter 4-16 Torque Limit Motor Mode), (0–20 mA).
[105]	Torque 0– T_{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0– P_{nom}	0–Motor rated power (0–20 mA).
[107]	Speed 0–HighLim	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit [Hz] , 0–20 mA).
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0– f_{max}	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed loop 1	0–100% (0–20 mA).
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).

Option	Name	Description
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of parameter 3-03 Maximum Reference .
[133]	Motor cur. 4–20mA	0–Inverter maximum current (parameter 16-37 Inv. Max. Current).
[134]	Torq.0–lim 4–20mA	0–Torque limit (parameter 4-16 Torque Limit Motor Mode).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit (Hz)).
[138]	Torque 4–20mA	Torque reference related to 160% torque.
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	An output value based on main actual value from serial communication.
[148]	Main act val 4–20mA	An output value based on main actual value from serial communication.
[150]	Out frq 0–F _{max} 4–20mA	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[156]	Flow rate	
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the next 2 tables and the following drawing.
[255]	DC link 4–20mA	The function is the same as [254] DC Link 0–20 mA .

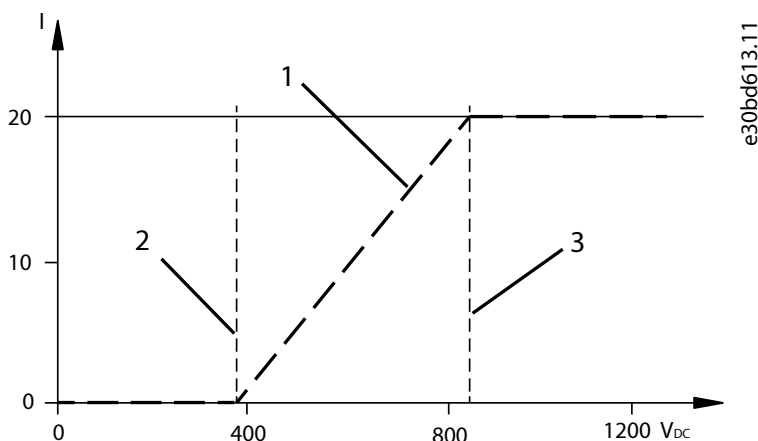
Table 32: Relationship Between the DC-link Voltage and the Terminal Output

DC-link voltage (V)	Terminal output
$V \leq \text{undervoltage limit}$	0%
$V \geq \text{overvoltage limit}$	100%
Voltage within range: Undervoltage $< V < \text{Overvoltage}$	Linearly interpolated

Table 33: Undervoltage and Overvoltage Limits for Different Drive Sizes

Drive size	Unervoltage limit [V]	Overvoltage limit [V]
T2/S2	185	410
T4/S4	373	855
T6/T7	553	1130

Figure 64: The Analog Output of Terminal 42 on the T4 Drive with Option [254] DC Link 0–20 mA Selected



1	Analog output	2	Undervoltage limit
3	Overvoltage limit		

6-51 Terminal 42 Output Min Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale for the minimum output (0 mA or 4 mA) of the analog signal at terminal 42. Set the value to be the percentage of the full range of the variable selected in parameter **6-50 Terminal 42 Output**.

6-52 Terminal 42 Output Max Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the maximum output of the selected analog signal at terminal 42. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale; or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value 0–100% of the full-scale output, program the percentage value in the parameter, that is 50% = 20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows: 20 mA/desired maximum current x 100%

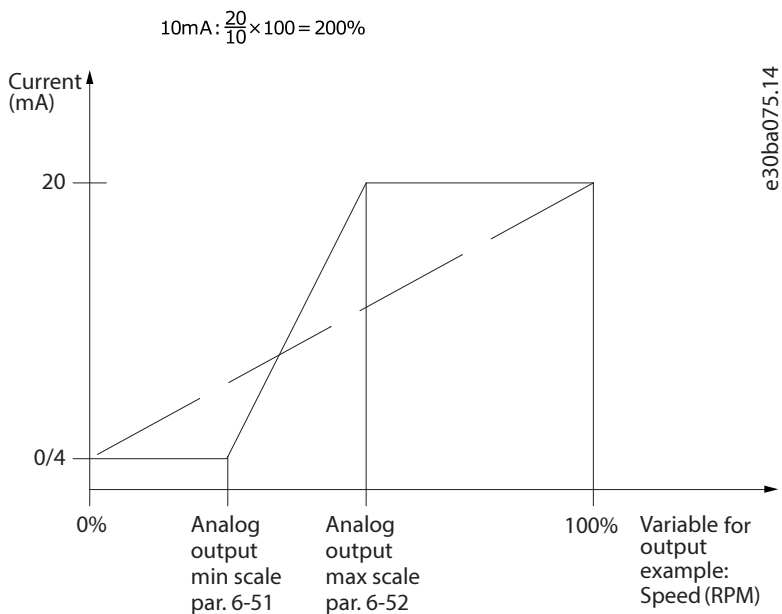


Figure 65: Output Maximum Scale

Example 1

Variable value = output frequency, range = 0–100 Hz.

Range needed for output = 0–50 Hz.

Output signal 0 mA or 4 mA is needed at 0 Hz (0% of range). Set parameter **6-51 Terminal 42 Output Min Scale** to 0%.

Output signal 20 mA is needed at 50 Hz (50% of range). Set parameter **6-52 Terminal 42 Output Max Scale** to 50%.

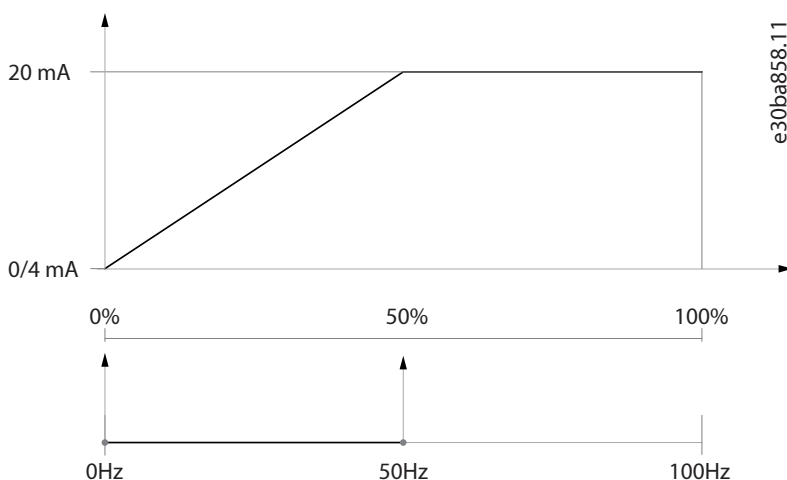


Figure 66: Example 1

Example 2

Variable = feedback, range = -200% to +200%.

Range needed for output = 0–100%.

Output signal 0 mA or 4 mA is needed at 0% (50% of range). Set parameter **6-51 Terminal 42 Output Min Scale** to 50%.

Output signal 20 mA is needed at 100% (75% of range). Set parameter **6-52 Terminal 42 Output Max Scale** to 75%.

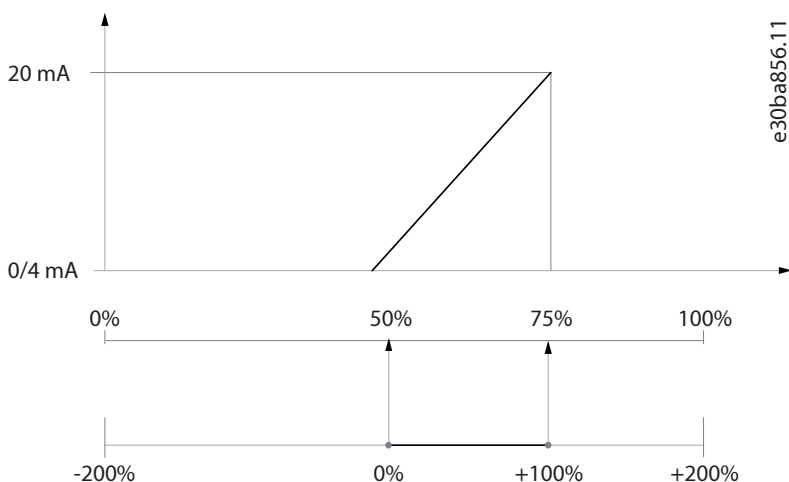


Figure 67: Example 2

Example 3

Variable value = reference, range = minimum reference–maximum reference.

Range needed for output = minimum reference (0%)–maximum reference (100%), 0–10 mA.

Output signal 0 mA or 4 mA is needed at minimum reference. Set parameter **6-51 Terminal 42 Output Min Scale** to 0%.

Output signal 10 mA is needed at maximum reference (100% of range). Set parameter **6-52 Terminal 42 Output Max Scale** to 200%.

(20 mA/10 mA x 100% = 200%).

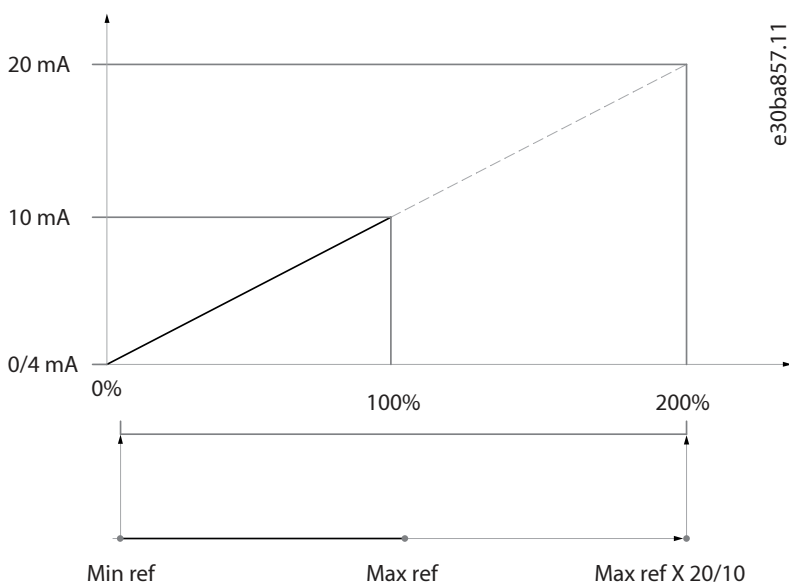


Figure 68: Example 3

6-53 Term 42 Output Bus Ctrl

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Holds the level of output 42 if controlled by bus.

6-54 Term 42 Output Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Holds the preset level of output 42. If a timeout function is selected in parameter **6-50 Terminal 42 Output**, the output is preset to this level if a fieldbus timeout occurs.

6-55 Analog Output Filter

Default value:	[0] Off	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The following readout parameters from selection in parameter **6-50 Terminal 42 Output** have a filter selected when parameter **6-55 Analog Output Filter** is on.

Table 34: Readout Parameters

Selection	0–20 mA	4–20 mA
Motor current ($I_{\max}$)	[103]	[133]
Torque limit ($0-T_{\lim}$)	[104]	[134]
Rated torque ($0-T_{\text{nom}}$)	[105]	[135]
Power ($0-P_{\text{nom}}$)	[106]	[136]
Speed ($0\text{--Speed}_{\max}$)	[107]	[137]

Option	Name	Description
[0]*	Off	Filter off.
[1]	On	Filter on.

5.8.7 6-6* Analog Output X30/8

Analog outputs are current outputs: 0/4–20 mA. Common terminal (terminal X30/8) is the same terminal and electrical potential for analog common connection. Resolution on the analog output is 12 bit.

6-60 Terminal X30/8 Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the function of terminal X30/8 as an analog current output.

Option	Name	Description
[0]*	No operation	There is no signal on the output.
[52]	MCO	The analog value is set by the MCO 305 application program using the command OUTDA.

Option	Name	Description
[53]	MCO 4–20mA	The analog value is set by the MCO 305 application program using the command OUTDA.
[100]	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of parameter 3-03 Maximum Reference (0–20 mA).
[103]	Motor cur. 0–I _{max}	0–Inverter maximum current (parameter 16-37 Inv. Max. Current), (0–20 mA).
[104]	Torque 0–T _{lim}	0–Torque limit (parameter 4-16 Torque Limit Motor Mode), (0–20 mA).
[105]	Torque 0–T _{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0–P _{nom}	0–Motor rated power (0–20 mA).
[107]	Speed 0–HighLim	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit [Hz] , 0–20 mA).
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0–f _{max}	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed loop 1	0–100% (0–20 mA).
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of parameter 3-03 Maximum Reference .
[133]	Motor cur. 4–20mA	0–Inverter maximum current (parameter 16-37 Inv. Max. Current).
[134]	Torq.0–lim 4–20mA	0–Torque limit (parameter 4-16 Torque Limit Motor Mode).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit (Hz)).
[138]	Torque 4–20mA	Torque reference related to 160% torque.
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%

Option	Name	Description
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	An output value based on main actual value from serial communication.
[148]	Main act val 4–20mA	An output value based on main actual value from serial communication.
[150]	Out frq 0–F _{max} 4–20mA	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[156]	Flow rate	
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the tables and the illustration in parameter 6-50 Terminal 42 Output .
[255]	DC link 4–20mA	The function is the same as [254] DC Link 0–20 mA .

6-61 Terminal X30/8 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scales the minimum output of the selected analog signal on terminal X30/8. Scale the minimum value as a percentage of the maximum signal value. For example, enter the value 25% if the output should be 0 mA at 25% of the maximum output value. The value cannot exceed the corresponding setting in parameter **6-62 Terminal X30/8 Max. Scale** if the value is below 100%. This parameter is active when VLT® General Purpose I/O MCB 101 is mounted in the drive.

6-62 Terminal X30/8 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scales the maximum output of the selected analog signal on terminal X30/8. Scale the value to the required maximum value of the current signal output. Scale the output to give a lower current than 20 mA at full scale or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the fullscale output, program the percentage value in the parameter, that is 50%=20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows: 20 mA/desired maximum current x 100%

$$10\text{mA} : \frac{20-4}{10} \times 100 = 160\%$$

6-63 Terminal X30/8 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2

Data type:	N2	Change during operation:	True

Holds the level of output X30/8 if controlled by bus.

6-64 Terminal X30/8 Output Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Holds the preset level of output X30/8. If a timeout function is selected in parameter **6-60 Terminal X30/8 Output**, the output is preset to this level if a fieldbus timeout occurs.

5.8.8 6-7* Analog Output X45/1

Parameters for configuring the scaling and limits for analog output 3, terminal X45/1. Analog outputs are current outputs: 0/4–20 mA. Resolution on the analog output is 11 bit.

6-70 Terminal X45/1 Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the output of terminal X45/1 of VLT® Extended Relay Card MCB 113.

Option	Name	Description
[0]*	No operation	There is not signal on the analog output.
[52]	MCO	The analog value is set by the MCO 305 application program using the command OUTDA.
[53]	MCO 4–20mA	The analog value is set by the MCO 305 application program using the command OUTDA.
[100]	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of parameter 3-03 Maximum Reference (0–20 mA).
[103]	Motor cur. 0– I_{max}	0–Inverter maximum current (parameter 16-37 Inv. Max. Current), (0–20 mA).
[104]	Torque 0– T_{lim}	0–Torque limit (parameter 4-16 Torque Limit Motor Mode), (0–20 mA).
[105]	Torque 0– T_{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0– P_{nom}	0–Motor rated power (0–20 mA).
[107]	Speed 0–HighLim	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit [Hz] , 0–20 mA).
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0– f_{max}	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed loop 1	0–100% (0–20 mA).

Option	Name	Description
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	-200% to 200% of parameter 3-03 Maximum Reference .
[133]	Motor cur. 4–20mA	0–Inverter maximum current (parameter 16-37 Inv. Max. Current).
[134]	Torq.0–lim 4–20mA	0–Torque limit (parameter 4-16 Torque Limit Motor Mode).
[135]	Torq.0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit (Hz)).
[138]	Torque 4–20mA	
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	An output value based on main actual value from serial communication.
[148]	Main act val 4–20mA	An output value based on main actual value from serial communication.
[150]	Out frq 0–F _{max} 4–20mA	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[156]	Flow rate	
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the tables and illustration in parameter 6-50 Terminal 42 Output .
[255]	DC link 4–20mA	The function is the same as [254] DC Link 0–20 mA .

6-71 Terminal X45/1 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the minimum output of the selected analog signal at terminal X45/1 as a percentage of the maximum signal value. For example, if 0 mA (or 0 Hz) is required at 25% of the maximum output value, then program 25%. Scaling values up to 100% cannot exceed the corresponding setting in parameter **6-72 Terminal X45/1 Max. Scale**.

6-72 Terminal X45/1 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the maximum output of the selected analog signal at terminal X45/1. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale, or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, for example 50% = 20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows (example where required maximum output is 10 mA):

$$\frac{I_{\text{RANGE}}[\text{mA}]}{I_{\text{DESIREDMAX}}[\text{mA}]} \times 100\% = \frac{20 - 4 \text{ mA}}{10 \text{ mA}} \times 100\% = 160\%$$

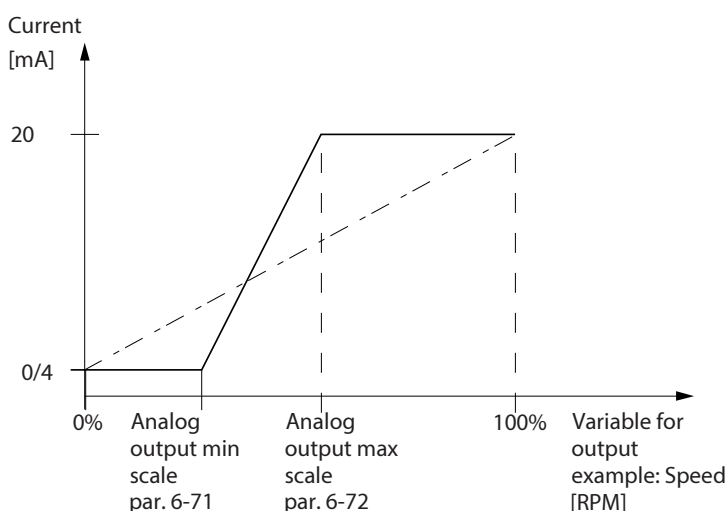


Figure 69: Output Maximum Scale

6-73 Terminal X45/1 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Holds the level of analog output 3 (terminal X45/1) if controlled by bus.

6-74 Terminal X45/1 Output Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%

Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Holds the preset level of analog output 3 (terminal X45/1). If there is a fieldbus timeout and a timeout function is selected in parameter **6-70 Terminal X45/1 Output**, the output is preset to this level.

5.8.9 6-8* Analog Output X45/3

Parameters for configuring the scaling and limits for analog input 4 (terminal X45/3). Analog outputs are current outputs: 0/4–20 mA. Resolution on the analog output is 11 bits.

6-80 Terminal X45/3 Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the output of terminal X45/3 of VLT® Extended Relay Card MCB 113.

Option	Name	Description
[0]*	No operation	There is no signal on the analog output.
[52]	MCO	The analog value is set by the MCO 305 application program using the command OUTDA.
[53]	MCO 4–20mA	The analog value is set by the MCO 305 application program using the command OUTDA.
[100]	Output freq. 0–100	0–100 Hz (0–20 mA).
[101]	Reference min-max	Minimum reference - maximum reference (0–20 mA).
[102]	Feedback ±200%	-200% to + 200% of parameter 3-03 Maximum Reference (0–20 mA).
[103]	Motor cur. 0–I _{max}	0–Inverter maximum current (parameter 16-37 Inv. Max. Current), (0–20 mA).
[104]	Torque 0–T _{lim}	0–Torque limit (parameter 4-16 Torque Limit Motor Mode), (0–20 mA).
[105]	Torque 0–T _{nom}	0–Motor rated torque (0–20 mA).
[106]	Power 0–P _{nom}	0–Motor rated power (0–20 mA).
[107]	Speed 0–HighLim	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit [Hz] , 0–20 mA).
[108]	Torque ±160%	0–20 mA.
[109]	Out frq 0–f _{max}	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed loop 1	0–100% (0–20 mA).
[114]	Ext. closed loop 2	0–100% (0–20 mA).
[115]	Ext. closed loop 3	0–100% (0–20 mA).
[116]	Cascade reference	
[117]	Shaft power	
[118]	Shaft power 4–20 mA	

Option	Name	Description
[130]	Out frq 0–100 4–20mA	0–100 Hz.
[131]	Reference 4–20mA	Minimum reference–maximum reference.
[132]	Feedback 4–20mA	–200% to 200% of parameter 3-03 Maximum Reference .
[133]	Motor cur. 4–20mA	0–Inverter maximum current (parameter 16-37 Inv. Max. Current).
[134]	Torq,0–lim 4–20mA	0–Torque limit (parameter 4-16 Torque Limit Motor Mode).
[135]	Torq,0–nom 4–20mA	0–Motor rated torque.
[136]	Power 4–20mA	0–Motor rated power.
[137]	Speed 4–20mA	0–Speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit (Hz)).
[138]	Torque 4–20mA	Torque reference related to 160% torque.
[139]	Bus ctrl	0–100% (0–20 mA)
[140]	Bus ctrl 4–20mA	0–100%
[141]	Bus ctrl t.o.	0–100% (0–20 mA)
[142]	Bus ctrl t.o. 4–20mA	0–100%
[143]	Ext. CL 1 4–20mA	0–100%
[144]	Ext. CL 2 4–20mA	0–100%
[145]	Ext. CL 3 4–20mA	0–100%
[146]	Cascade ref. 4–20mA	
[147]	Main act val	
[148]	Main act val 4–20mA	
[150]	Out frq 0–F _{max} 4–20mA	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[156]	Flow rate	
[157]	Flow rate 4–20mA	
[184]	Mirror AI53 mA	
[185]	Mirror AI54 mA	
[210]	Sensorless signal	
[254]	DC link	With this parameter selected, the terminal output shows the scaled DC-link voltage. See also the tables and illustration in parameter 6-50 Terminal 42 Output .
[255]	DC link 4–20mA	The function is the same as [254] DC Link 0–20 mA .

6-81 Terminal X45/3 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scales the minimum output of the selected analog signal on terminal X45/3. Scale the minimum value as a percentage of the maximum signal value, for example, 0 mA (or 0 Hz) is required at 25% of the maximum output value and 25% is programmed. The value cannot exceed the corresponding setting in parameter **6-82 Terminal X45/3 Max. Scale** if the value is below 100%. This parameter is active when VLT® Extended Relay Card MCB 113 is mounted in the drive.

6-82 Terminal X45/3 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the maximum output of the selected analog signal at terminal X45/3. Set the value to the maximum value of the current signal output. Scale the output to give a current lower than 20 mA at full scale, or 20 mA at an output below 100% of the maximum signal value. If 20 mA is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, for example 50% = 20 mA. If a current 4–20 mA is required at maximum output (100%), calculate the percentage value as follows (example where required maximum output is 10 mA):

$$\frac{I_{\text{RANGE}}[\text{mA}]}{I_{\text{DESIREDMAX}}[\text{mA}]} \times 100\% = \frac{20 - 4 \text{ mA}}{10 \text{ mA}} \times 100\% = 160\%$$

6-83 Terminal X45/3 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Holds the level of analog output 4 (terminal X45/3) if controlled by bus.

6-84 Terminal X45/3 Output Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Holds the preset level of output 4 (X45/3). If there is a fieldbus timeout and a timeout function is selected in parameter **6-80 Terminal X45/3 Output**, the output is preset to this level.

5.9 Parameter Group 7-** Controllers

5.9.1 Speed PID Droop

This feature implements precise torque sharing between multiple motors on a common mechanical shaft. Speed PID droop is useful for marine and mining applications where redundancy and higher dynamics are required. Speed PID droop reduces inertia by utilizing multiple small motors instead of 1 large motor.

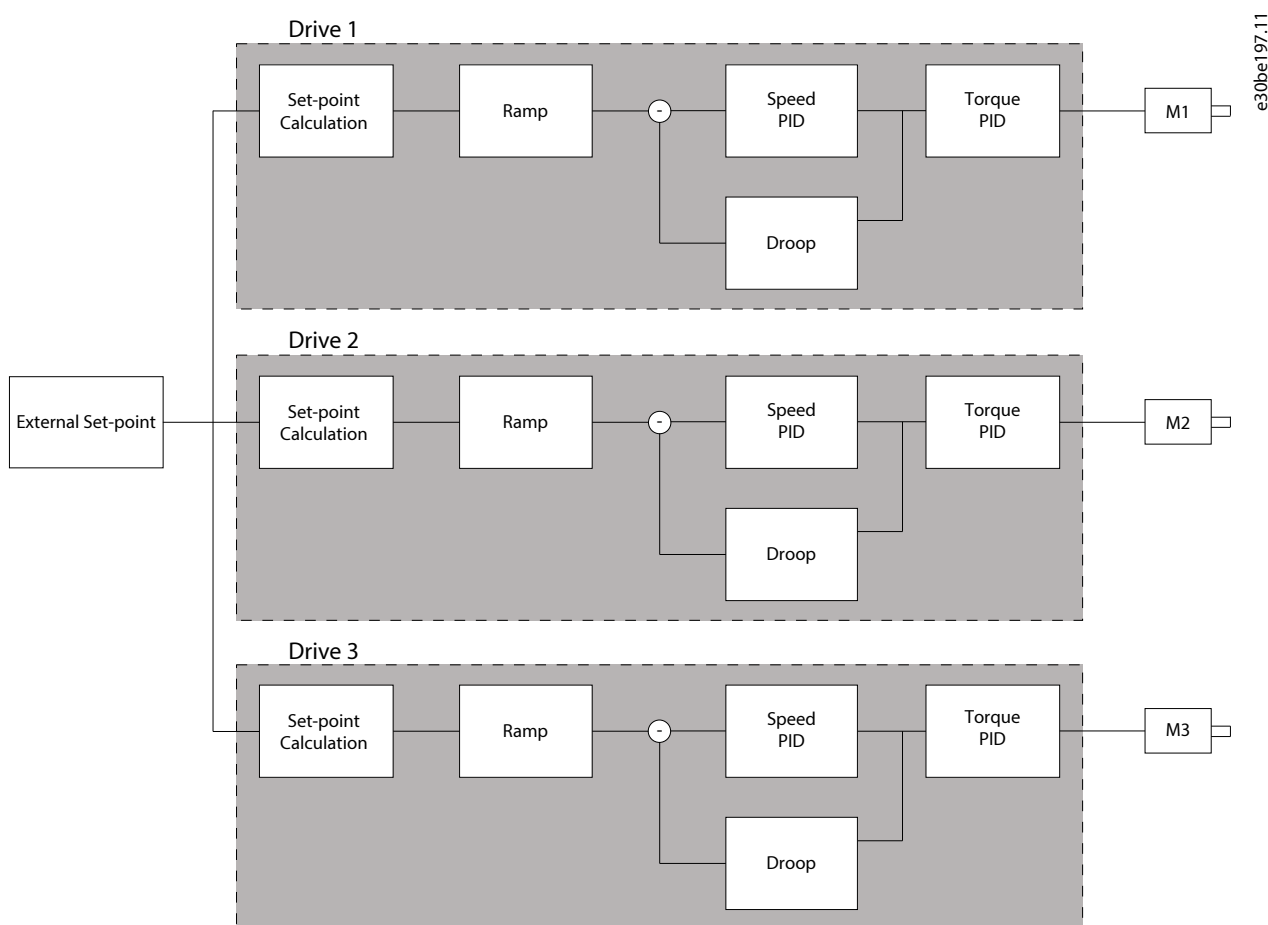


Figure 70: Concept of Speed PID Droop

The value in parameter **7-01 Speed PID Droop** ensures that the load is shared equally between the motors. If the torque on the motor is 100% of nominal motor torque, the drive reduces its output to this motor by 100% of the value in parameter **7-01 Speed PID Droop**. If the torque is 50% of nominal motor torque, the drive reduces its output to this motor by 50% of the value in parameter **7-01 Speed PID Droop**. This ensures that the motors share the load evenly. A side effect of using speed PID droop is that the actual shaft speed does not match the reference exactly. Speed PID droop is not efficient in low-speed applications because the adjustment range may be insufficient.

Use the speed trim function if the application requires the following features:

- Accurate speed (the actual shaft speed matches the reference speed).
- Precise speed adjustment down to 0 RPM.

Enabling PID droop

To enable speed PID droop:

- Run the drive in 1 of the following modes:
 - Flux closed loop (parameter **1-01 Motor Control Principle**, [3] *Flux w/ motor feedb*).
 - Flux sensorless (parameter **1-01 Motor Control Principle**, [2] *Flux sensorless*).
- Run the drive in speed mode (parameter **1-00 Configuration Mode**, option [0] *Speed open loop* or [1] *Speed closed loop*).
- Ensure that parameter **1-62 Slip Compensation** contains the default value (0%).
- Ensure that all drives in the torque sharing system use the same speed reference and start and stop signal.
- Ensure that all drives in the torque sharing system use the same parameter settings.

- Adjust the value in parameter **7-01 Speed PID Droop**.



NOTE: Do not use overvoltage control when using the PID droop function (select **[0] Disabled** in parameter **2-17 Over-voltage Control**).



NOTE: If the speed reference is lower than the value in parameter **7-01 Speed PID Droop**, the drive makes the PID droop factor equal to the speed reference.

5.9.2 Speed Trim

The speed trim function is an add-on to the speed PID droop. The speed trim provides torque sharing with precise speed down to 0 RPM. The function requires wiring of analog signals.

In speed trim, the master drive runs normal speed PID without droop. The follower drives use the speed PID droop, but instead of reacting on their own load, they compare their own load to the load of other drives in the system. The follower drives then use that data as input for the speed PID droop. A setup with a single source, where the master drive sends information about torque to all followers, is limited by the number of available analog outputs on the master drive. It is possible to use a cascade principle which overcomes this limitation, but makes the control slower and less accurate. The master drive operates in speed mode. The follower drives operate in speed mode with the speed trim. The trim function uses torque data from all drives in the system.

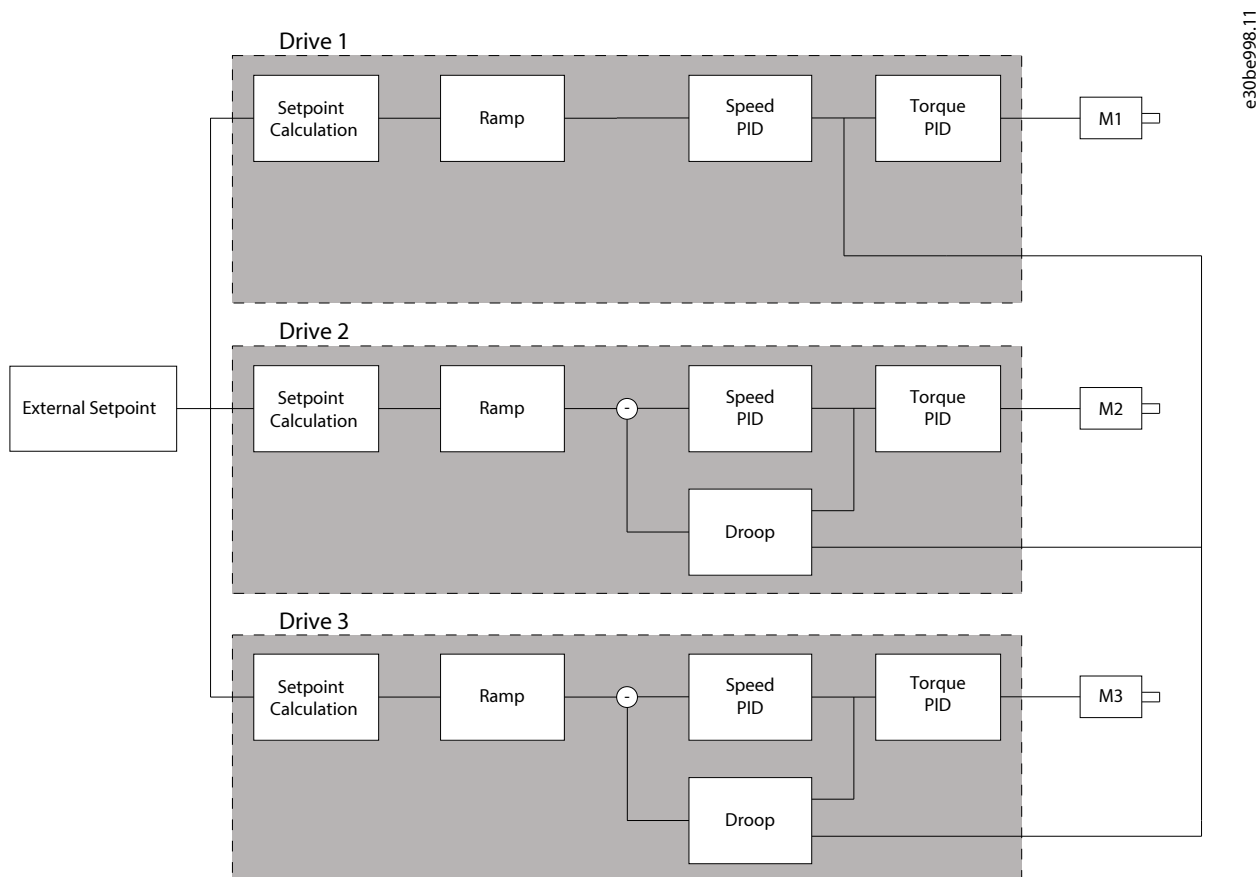


Figure 71: Concept of Speed Trim

The drawing shows a single-source setup where the master sends the torque signal to all followers. The number of available analog outputs on the master limits this setup. To overcome the limitation of the number of analog outputs, use a cascade principle. The cascade principle makes the control slower and less accurate compared with the setup using analog outputs.

5.9.3 7-0* Speed PID Ctrl.



NOTE: If separate encoders are used, adjust the ramp-related parameters according to the gear ratio between the 2 encoders.

7-02 Speed PID Proportional Gain

Default value:	Size related	Parameter type:	Range, 0 - 1
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True

Enter the speed controller proportional gain. The proportional gain amplifies the error (that is the deviation between the feedback signal and the setpoint). This parameter is used with parameter **1-00 Configuration Mode** [0] *Speed open loop* and [1] *Speed closed loop control*. Quick control is obtained at high amplification. Increasing amplification makes the process less stable. For values with 4 decimals, use parameter **30-83 Speed PID Proportional Gain**.

7-03 Speed PID Integral Time

Default value:	Size related	Parameter type:	Range, 1.0 - 20000 ms
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	True

Enter the speed controller integral time, which determines the time the internal PID control takes to correct errors. The greater the error, the more quickly the gain increases. The integral time causes a delay of the signal and therefore a dampening effect and can be used to eliminate steady-state speed error. Obtain quick control through a short integral time, though if the integral time is too short, the process becomes unstable. An excessively long integral time disables the integral action, leading to major deviations from the required reference, since the process regulator takes too long to regulate errors. This parameter is used with [0] *Speed open loop* and [1] *Speed closed loop control*, set in parameter **1-00 Configuration Mode**.

7-04 Speed PID Differentiation Time

Default value:	Size related	Parameter type:	Range, 0 - 200 ms
Setup:	All setups	Conversion index:	-4
Data type:	Uint16	Change during operation:	True

Enter the speed controller differentiation time. The differentiator does not react to constant error. It provides gain proportional to the rate of change of the speed feedback. The quicker the error changes, the stronger the gain from the differentiator. The gain is proportional with the speed at which errors change. Setting this parameter to 0 disables the differentiator. This parameter is used with parameter **1-00 Configuration Mode**, [1] *Speed closed loop control*.

7-05 Speed PID Diff. Gain Limit

Default value:	5	Parameter type:	Range, 1 - 20
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set a limit for the gain provided by the differentiator. Consider limiting the gain at higher frequencies. For example, set up a pure D-link at low frequencies and a constant D-link at higher frequencies. This parameter is used with parameter **1-00 Configuration Mode**, [1] *Speed closed loop control*.

7-06 Speed PID Lowpass Filter Time

Default value:	Size related	Parameter type:	Range, 0.1 - 100 ms
Setup:	All setups	Conversion index:	-4
Data type:	Uint16	Change during operation:	True



NOTE: Severe filtering can be detrimental to dynamic performance. This parameter is used with parameter **1-00 Configuration Mode**, **[1] Speed closed loop** and **[2] Torque control**. Adjust the filter time in flux sensorless to 3–5 ms.

Set a time constant for the speed control low-pass filter. The low-pass filter improves steady-state performance and dampens oscillations on the feedback signal. This is an advantage if there is a great amount of noise in the system. For example, if a time constant (τ) of 100 ms is programmed, the cut-off frequency for the low-pass filter is $1/0.1 = 10 \text{ RAD/s}$, corresponding to $(10/2 \times \pi) = 1.6 \text{ Hz}$. The PID regulator only regulates a feedback signal that varies by a frequency of less than 1.6 Hz. If the feedback signal varies by a higher frequency than 1.6 Hz, the PID regulator does not react. Practical settings of parameter **7-06 Speed PID Lowpass Filter Time** taken from the number of pulses per revolutions from encoder:

Table 35: Speed PID Low-pass Filter Time

Encoder PPR	Parameter 7-06 Speed PID Lowpass Filter Time [ms]
512	10
1024	5
2048	2
4096	1

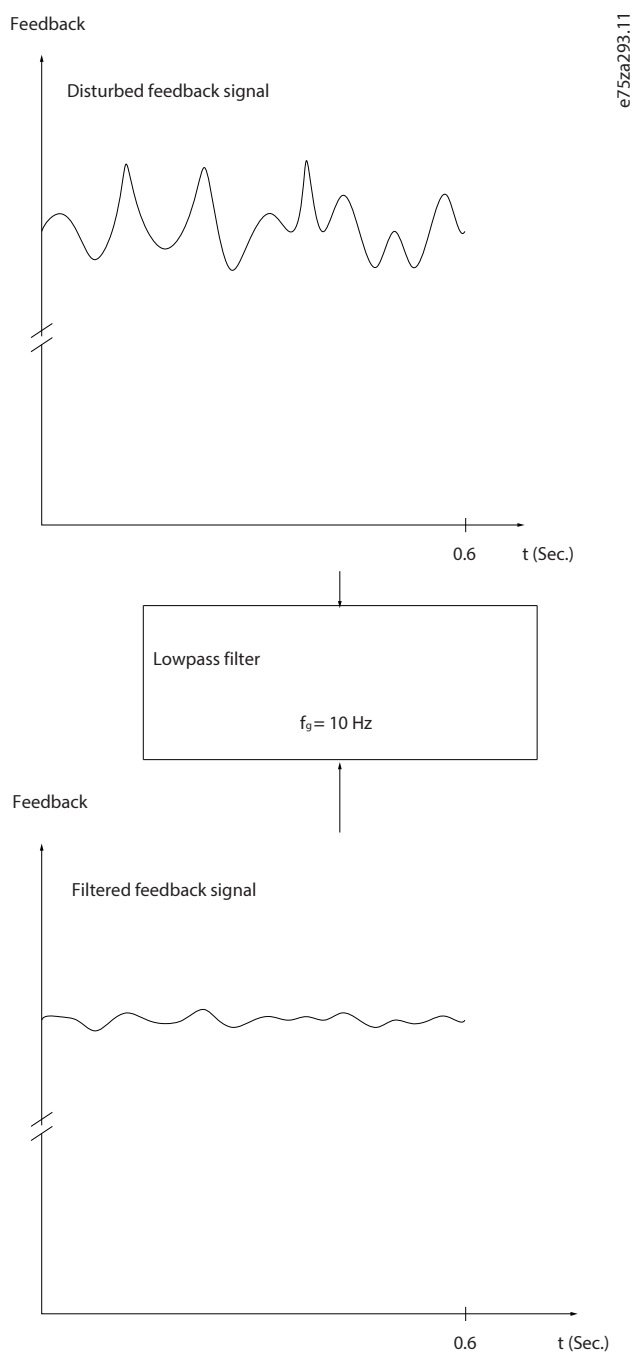


Figure 72: Feedback Signal

7-08 Speed PID Feed Forward Factor

Default value:	0%	Parameter type:	Range, 0 - 500%
Setup	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The reference signal bypasses the speed controller by the amount specified. This feature increases the dynamic performance of the speed control loop.

5.10 Parameter Group 8-** Comm. and Options

5.10.1 8-0* General Settings

8-01 Control Site

Default value:	[0] Digital and ctrl. word	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The setting in this parameter overrides the settings in parameter **8-50 Coasting Select** to parameter **8-56 Preset Reference Select**.

Option	Name	Description
[0]*	Digital and ctrl.word	Use both digital input and control word.
[1]	Digital only	Use digital inputs only.
[2]	Controlword only	Use control word only.

8-02 Control Word Source

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

Select the source of the control word: 1 of 2 serial interfaces or 4 installed options. During initial power-up, the drive automatically sets this parameter to **[3] Option A** if it detects a valid fieldbus option installed in slot A. When the option is removed, the drive detects a configuration change, sets parameter **8-02 Control Word Source** to default setting **[1] FC port**, and trips. If an option is installed after initial power-up, the setting of parameter **8-02 Control Word Source** does not change, but the drive trips and shows: *Alarm 67, Option Changed*. When retrofitting a bus option into a drive that did not have a bus option installed earlier, change the control to bus-based. This change is required for safety reasons to avoid an unintended change.

Option	Name	Description
[0]	None	Control via serial communication is disabled.
[1]	FC port	
[2]	USB port	Control via USB on the control card.
[3]	Option A	Control via option A.
[4]	Option B	Control via option B.
[5]	Option C0	Control via option C.
[6]	Option C1	Control via option D.
[30]	External can	Internal

8-03 Control Word Timeout Time

Default value:	Size related	Parameter type:	Range, 1 - 18000 s
Setup:	1 setup	Conversion index:	-1

Data type:	UInt32	Change during operation:	True

Enter the maximum time expected to pass between the reception of 2 consecutive telegrams. If this time is exceeded, it indicates that the serial communication has stopped. The function selected in parameter **8-04 Control Word Timeout Function** is then carried out. A valid control word triggers the timeout counter.

8-04 Control Word Timeout Function

Default value:	[0] Off	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the timeout function. The timeout function activates when the control word and reference fails to be updated within the time period specified in parameter **8-03 Control Word Timeout Time**.

To change the setup after a timeout, configure as follows:

1. Set parameter **0-10 Active Set-up** to **[9] Multi setup**.
2. Select the relevant link in parameter **0-12 This Set-up Linked to**.

Option	Name	Description
[0]*	Off	Resumes control via fieldbus (fieldbus or standard), using the most recent control word.
[1]	Freeze output	Freezes output frequency until communication resumes.
[2]	Stop	Stops with auto restart when communication resumes.
[3]	Jogging	Runs the motor at jog frequency until communication resumes.
[4]	Max. speed	Runs the motor at maximum frequency until communication resumes.
[5]	Stop and trip	Stops the motor, then resets the drive to restart: • Via the fieldbus. • Via <i>[Reset]</i>. • Via a digital input.
[7]	Select setup 1	Changes the setup after a control word timeout. If communication resumes after a timeout, parameter 8-05 End-of-Timeout Function either resumes the setup used before the timeout, or retains the setup endorsed by the timeout function.
[8]	Select setup 2	See [7] Select set-up 1 .
[9]	Select setup 3	See [7] Select set-up 1 .
[10]	Select setup 4	See [7] Select set-up 1 .
[20]	N2 Override release	
[27]	Forced stop and trip	
[30]	Warning only	

8-05 End-of-Timeout Function

Default value:	[1] Resume set-up	Parameter type:	Option
Setup:	1 setup	Conversion index:	–

Data type:	UInt8	Change during operation:	True

Select the action after receiving a valid control word following a timeout. This parameter is active only when parameter **8-04 Control Word Timeout Function** is set to:

- [7] Setup 1
- [8] Setup 2
- [9] Setup 3
- [10] Setup 4

Option	Name	Description
[0]	Hold set-up	Retains the setup selected in parameter 8-04 Control Word Timeout Function and shows a warning until parameter 8-06 Reset Control Word Timeout toggles. Then the drive resumes its original setup.
[1]*	Resume setup	Resumes the setup that was active before the timeout.

8-06 Reset Control Word Timeout

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter is active only when [0] **Hold set-up** has been selected in parameter **8-05 End-of-Timeout Function**.

Option	Name	Description
[0]*	Do not reset	Retains the setup specified in parameter 8-04 Control Word Timeout Function , following a control word timeout.
[1]	Do reset	Restores the drive to the original setup following a control word timeout. The drive resets and then immediately reverts to the [0] Do not reset setting.

8-07 Diagnosis Trigger

Default value:	[0] Disable	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter has no function for DeviceNet.

Option	Name	Description
[0]*	Disable	
[1]	Trigger on alarms	
[2]	Trigger alarm/warn.	

8-08 Readout Filtering

Default value:	–	Parameter type:	Option, Array [1]
Setup:	All setups	Conversion index:	–

Data type:	UInt8	Change during operation:	True

Use this function if the speed feedback value readouts on the fieldbus fluctuate. Select **[1] Motor Data LP-Filter** if the function is required. A power cycle is required for changes to take effect.

Option	Name	Description
[0]	Motor data Std-Filt.	Normal fieldbus readouts.
[1]	Motor data LP-Filter	Filtered fieldbus readouts of the following parameters: - Parameter 16-10 Power [kW] - Parameter 16-11 Power [hp] - Parameter 16-12 Motor Voltage - Parameter 16-14 Motor current - Parameter 16-16 Torque [Nm] - Parameter 16-17 Speed [RPM] - Parameter 16-22 Torque [%] - Parameter 16-25 Torque [Nm] High

8-09 Communication Charset

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the communication character set to be supported.

Option	Name	Description
[0]	ISO 8859-1	
[1]	ANSI X3.4	
[2]	UTF-8	

5.10.2 8-1* Ctrl. Word Settings

8-10 Control Word Profile

Default value:	[0] FC profile	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A are visible in the LCP display. For guidelines in selection of **[0] FC profile** and **[1] PROFIdrive profile**, refer to the product-specific design guide. For more guidelines in the selection of **[1] PROFIdrive profile**, refer to the installation guide for the installed fieldbus.

Option	Name	Description
[0]*	FC profile	
[1]	PROFIdrive profile	
[5]	ODVA	Available only with VLT® DeviceNet MCA 104 and VLT® EtherNet/IP MCA 121.

Option	Name	Description
[7]	CANopen DSP 402	
[22]	PROFIdrive v4_2 profile	
[24]	VIK-NAMUR	

8–13 Configurable Status Word STW

Default value:	[1] Profile default	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the interpretation of the control and status words corresponding to the installed fieldbus. Only the selections valid for the fieldbus installed in slot A are visible in the LCP display. For more guidelines in the selection of **[1] PROFIdrive profile**, refer to the installation guide for the installed fieldbus.

Option	Name	Description
[0]	No function	The input is always low.
[1]*	Profile default	Dependent on the profile set in parameter 8–10 Control Profile .
[2]	Alarm 68 Only	The input goes high whenever <i>Alarm 68 Safe Stop Activated</i> is active and goes low whenever <i>Alarm 68 Safe Stop Activated</i> is not activated.
[3]	Trip excl Alarm 68	Set if a trip occurs, unless alarm 68, Safe Torque Off is set to execute the trip.
[9]	Vir. master on ref.	
[10]	T18DI status	The bit indicates the status of terminal 18. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[11]	T19DI status	The bit indicates the status of terminal 19. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[12]	T27DI status	The bit indicates the status of terminal 27. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[13]	T29DI status	The bit indicates the status of terminal 29. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[14]	T32DI status	The bit indicates the status of terminal 32. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[15]	T33DI status	The bit indicates the status of terminal 33. 0 indicates that the terminal is low. 1 indicates that the terminal is high.
[16]	T37DI status	The input goes high whenever T37 has 0 V and goes low whenever T37 has 24 V.
[17]	X30/2 DI status	
[18]	X30/3 DI status	
[19]	X30/4 DI status	
[20]	CTW timeout toggle inverse	
[21]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, drive, brake resistor, or thermistor.

Option	Name	Description
[30]	Brake fault (IGBT)	Output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake modules. Use the output/ relay to cut out the main voltage from the drive.
[40]	Out of ref range	
[54]	Running	
[59]	On reference	
[60]	Comparator 0	See parameter group 13-1* Comparators . If comparator 0 is evaluated as true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See parameter group 13-1* Comparators . If comparator 1 is evaluated as true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See parameter group 13-1* Comparators . If comparator 2 is evaluated as true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See parameter group 13-1* Comparators . If comparator 3 is evaluated as true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See parameter group 13-1* Comparators . If comparator 4 is evaluated as true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See parameter group 13-1* Comparators . If comparator 5 is evaluated as true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See parameter group 13-1* Comparators . If comparator 6 is evaluated as true, the output goes high. Otherwise, it is low.
[67]	Comparator 7	See parameter group 13-1* Comparators . If comparator 7 is evaluated as true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See parameter group 13-1* Comparators . If comparator 8 is evaluated as true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See parameter group 13-1* Comparators . If comparator 9 is evaluated as true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See parameter group 13-4* Logic Rules . If logic rule 0 is evaluated as true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See parameter group 13-4* Logic Rules . If logic rule 1 is evaluated as true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See parameter group 13-4* Logic Rules . If logic rule 2 is evaluated as true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See parameter group 13-4* Logic Rules . If logic rule 3 is evaluated as true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See parameter group 13-4* Logic Rules . If logic rule 4 is evaluated as true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See parameter group 13-4* Logic Rules . If logic rule 5 is evaluated as true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See parameter group 13-4* Logic Rules . If logic rule 6 is evaluated as true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See parameter group 13-4* Logic Rules . If logic rule 7 is evaluated as true, the output goes high. Otherwise, it is low.

Option	Name	Description
[78]	Logic rule 8	See parameter group 13-4* Logic Rules . If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See parameter group 13-4* Logic Rules . If logic rule 8 is evaluated as true, the output goes high. Otherwise, it is low.
[80]	SL digital out A	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [38] Set digital out A high is executed. The output goes low whenever the smart logic action [32] Set digital out A low is executed.
[81]	SL digital out B	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [39] Set digital out B high is executed. The output goes low whenever the smart logic action [33] Set digital out B low is executed.
[82]	SL digital out C	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [40] Set digital out C high is executed. The output goes low whenever the smart logic action [34] Set digital out C low is executed.
[83]	SL digital out D	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [41] Set digital out D high is executed. The output goes low whenever the smart logic action [35] Set digital out D low is executed.
[84]	SL digital out E	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [42] Set digital out E high is executed. The output goes low whenever the smart logic action [36] Set digital out E low is executed.
[85]	SL digital out F	See parameter 13-52 SL Controller Action . The output goes high whenever the smart logic action [43] Set digital out F high is executed. The output goes low whenever the smart logic action [37] Set digital out F low is executed.
[86]	ATEX ETR cur. alarm	
[87]	ATEX ETR freq. alarm	
[88]	ATEX ETR cur. warning	
[89]	ATEX ETR freq. warning	
[121]	Cavitation	
[122]	Cavitation S2	
[123]	Cavitation thld at min/max	
[181]	Prev. maintenance	
[182]	Deragging	
[183]	Port/pre lube	
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	

Option	Name	Description
[194]	Broken belt	
[196]	Emcy mode is active	
[197]	Emcy mode was active	
[198]	Emcy mode limits	
[199]	Pipe filling	
[200]	User defined alerts	
[234]	Emcy M. OPR unexpected	
[254]	Testing emcy mode	

8-14 Configurable Control Word CTW

Default value:	[1] Profile default	Parameter type:	Option, Array [16]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This is an array parameter with 16 elements, 1 element for each bit in range 0–15. Each of the bits can be configured to any of the following options.

Option	Name	Description
[0]	None	The drive ignores the information in this bit.
[1]*	Profile default	Dependent on the profile set in parameter 8–10 Control Profile .
[2]	CTW valid, active low	If set to 1, the drive ignores the remaining bits of the control word.
[7]	External interlock	
[10]	Bit 10=0 >CTW timeout	
[15]	Relay 1	
[16]	Relay 2	
[20]	Control word toggle command	Changes the sign of the set target position. For example, if the set target is to 1000, the activation of this option changes the value to -1000.
[22]	Digital out 27	
[23]	Digital out 29	
[24]	Digital out X30/6	
[25]	Digital out X39/7	
[33]	Bit 10=0 >CTW TO always	
[66]	Sleep mode	
[78]	Reset preventive maintenance word	
[85]	Latched pump derag	
[86]	Flow confirmation	
[189]	Emergency mode	
[190]	Emcy mode ref bit 0	Enables a choice between 1 of the 8 preset references.

Option	Name	Description
[191]	Emcy mode ref bit 1	Enables a choice between 1 of the 8 preset references.
[192]	Emcy mode ref bit 2	Enables a choice between 1 of the 8 preset references.
[193]	Emergency setup bit 0	
[194]	Emergency setup bit 1	
[195]	Test emcy mode	Emergency mode is activated in a special test mode where the drive stops on all alarms.
[235]	Setup bit 0	
[236]	Setup bit 1	

8-17 Configurable Alarm and Warning Word

Default value:	–	Parameter type:	Option, Array [16]
Setup:	All setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

This is an array parameter with 16 elements, 1 element for each bit in range 0–15. Each of the bits can be configured to any of the following options.

Option	Name	Description
[0]	Off	
[1]	10 Volts low warning	
[2]	Live zero warning	
[3]	No motor warning	
[4]	Mains phase loss warning	
[5]	DC link voltage high warning	
[6]	DC link voltage low warning	
[7]	DC overvoltage warning	
[8]	DC undervoltage warning	
[9]	Inverter overloaded warning	
[10]	Motor ETR overtemp warning	
[11]	Motor thermistor overtemp warning	
[12]	Torque limit warning	
[13]	Over current warning	
[14]	Earth fault warning	
[17]	Controlword timeout warning	
[19]	Discharge temp high warning	
[23]	Internal fans warning	
[24]	External fans warning	
[25]	Brake resistor short circuit warning	
[26]	Brake powerlimit warning	

Option	Name	Description
[27]	Brake chopper short circuit warning	
[28]	Brake check warning	
[29]	Heatsink temperature warning	
[30]	Motor phase U warning	
[31]	Motor phase V warning	
[32]	Motor phase W warning	
[34]	Fieldbus communication warning	
[36]	Mains failure warning	
[40]	T27 overload warning	
[41]	T29 overload warning	
[45]	Earth fault 2 warning	
[47]	24V supply low warning	
[58]	AMA internal fault warning	
[59]	Current limit warning	
[60]	External interlock warning	
[61]	Feedback error warning	
[62]	Frequency max warning	
[64]	Voltage limit warning	
[65]	Controlboard overtemp warning	
[66]	Heatsink temp low warning	
[68]	Safe stop warning	
[73]	Safe stop autorestart warning	
[76]	Power unit setup warning	
[77]	Reduced powermode warning	
[163]	ATEX ETR cur limit warning	
[165]	ATEX ETR freq limit warning	
[10002]	Live zero error alarm	
[10003]	No motor alarm	
[10004]	Mains phase loss alarm	
[10007]	DC overvoltage alarm	
[10008]	DC undervoltage alarm	
[10009]	Inverter overload alarm	
[10010]	ETR overtemperature alarm	
[10011]	Thermistor overtemp alarm	
[10012]	Torque limit alarm	
[10013]	Overcurrent alarm	
[10014]	Earth fault alarm	

Option	Name	Description
[10016]	Short circuit alarm	
[10017]	CTW timeout alarm	
[10026]	Brake powerlimit alarm	
[10027]	Brakechopper shortcircuit alarm	
[10028]	Brake check alarm	
[10029]	Heatsink temp alarm	
[10030]	Phase U missing alarm	
[10031]	Phase V missing alarm	
[10032]	Phase W missing alarm	
[10033]	Inrush fault alarm	
[10034]	Fieldbus com faul alarm	
[10036]	Mains failure alarm	
[10037]	Phase imbalance alarm	
[10038]	Internal fault	
[10039]	Heatsink sensor alarm	
[10045]	Earth fault 2 alarm	
[10046]	Powercard supply alarm	
[10047]	24V supply low alarm	
[10048]	1.8V supply low alarm	
[10049]	Speed limit alarm	
[10060]	Ext interlock alarm	
[10061]	Feedback error alarm	
[10063]	Mech brake low alarm	
[10065]	Controlboard overtemp alarm	
[10067]	Option config changed alarm	
[10068]	Safe stop alarm	
[10069]	Power card temp alarm	
[10073]	Safestop auto restart alarm	
[10074]	PTC thermistor alarm	
[10079]	Illegal PS config alarm	
[10081]	CSIV corrupt alarm	
[10082]	CSIV param error alarm	
[10090]	Feedback monitor alarm	
[10091]	AI54 settings alarm	
[10164]	ATEX ETR current lim alarm	
[10166]	ATEX ETR freq limit alarm	

8-18 Add Fieldbus ref. to Reference

Default value:	[1] Yes	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	Yes

This parameter specifies whether to use the fieldbus reference in reference calculations.

Option	Name	Description
[0]	No	The fieldbus reference is ignored, and only the fieldbus control word is used for reference calculations.
[1]*	Yes	The fieldbus reference is used for reference calculations.

8-19 Product Code

Default value:	Size related	Parameter type:	Array [2]
Setup:	1 setup	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Select 0 to read out the actual fieldbus product code according to the mounted fieldbus option. Select 1 to read out the actual vendor ID.

5.10.3 8-2* Counters

8-20 Invalid Memory Write Counter

Default value:	0 N/A	Parameter type:	Range, 0 - 65535
Setup:	1 setup	Conversion index:	–
Data type:	Uint16	Change during operation:	True

The error counter is incremented each time the Ethernet-based fieldbus options writes to an invalid memory.

5.10.4 8-3* FC Port Settings

8-30 Protocol

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the protocol to be used. Changing protocol is not effective until after powering off the drive.

Option	Name	Description
[0]	FC	Communication according to the FC Protocol as described in the product-specific design guide.
[1]	FC MC	Same as [0] FC but to be used when downloading SW to the drive or uploading a DLL file (covering information regarding parameters available in the drive and their inter-dependencies) to MCT 10 Setup software.

Option	Name	Description
[2]	Modbus RTU	Communication according to the Modbus RTU protocol as described in the product-specific design guide.
[3]	Metasys N2	Communication protocol. The N2 software protocol is general in nature to accommodate the unique properties each device may have.
[9]	FC option	To be used when a gateway is connected to the integrated RS-485 port.
[23]	Modbus multi master	

8-31 Address

Default value:	Size related	Parameter type:	Range, 1 - 255
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the address for the drive (standard) port. Valid range: Depends on the selected protocol.

8-32 FC Port Baud Rate

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	2400 Baud	Baud rate selection for the FC (standard) port.
[1]	4800 Baud	
[2]	9600 Baud	
[3]	19200 Baud	
[4]	38400 Baud	
[5]	57600 Baud	
[6]	76800 Baud	
[7]	115200 Baud	

8-33 Parity/Stop Bits

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	Even parity, 1 stop bit	
[1]	Odd parity, 1 stop bit	
[2]	No parity, 1 stop bit	
[3]	No parity, 2 stop bits	

8-34 Estimated Cycle Time

Default value:	0 ms	Parameter type:	Range, 0 - 1000000 ms
Setup:	2 setups	Conversion:	-3
Data type:	UInt32	Change during operation:	True

In noisy environments, the interface may be blocked due to overload or bad frames. This parameter specifies the time between 2 consecutive frames on the network. If the interface does not detect valid frames in that time, it flushes the receive buffer.

8-35 Minimum Response Delay

Default value:	10 ms	Parameter type:	Range, 5 - 10000 ms
Setup:	1 setup	Conversion index:	-3
Data type:	UInt16	Change during operation:	True

Specify the minimum delay time between receiving a request and transmitting a response. This is used for overcoming modem turnaround delays.

8-36 Max Response Delay

Default value:	Size related	Parameter type:	Range, 11 - 10001 ms
Setup:	1 setup	Conversion index:	-3
Data type:	UInt16	Change during operation:	True

Specify the maximum allowed delay time between transmitting a request and receiving a response. If a response from the drive exceeds the time setting, it is discarded.

8-37 Max Inter-Char Delay

Default value:	Size related	Parameter type:	Range, 0.00 - 35.00 ms
Setup:	1 setup	Conversion index:	-5
Data type:	UInt16	Change during operation:	True

Specify the maximum allowed time interval between receipt of 2 bytes. This parameter activates timeout if transmission is interrupted. This parameter is active only when parameter **8-30 Protocol** is set to **[1] FC MC protocol**.

8-39 Protocol/Profile Firmware Version

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr [10]	Change during operation:	False

This parameter shows the firmware revision as follows:

Index	Name
[0]	FC
[1]	Modbus
[2]	Metasys N2
[3]	FLN
[4]	BACnet

Index	Name
[5]	Future native protocol
[6]	PROFIdrive profile
[7]	DS402 profile

5.10.5 8-4* Telegram Selection

8-40 Telegram Selection

Default value:	[1] Standard telegram 1	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables use of freely configurable telegrams or standard telegrams for the FC port.

Option	Name	Description
[1]*	Standard telegram 1	
[20]	Standard telegram 20	
[100]	None	
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	
[109]	PPO 9	
[200]	Custom telegram 1	
[202]	Custom telegram 3	

8-42 PCD Write Configuration

Default value:	Size related	Parameter type:	Array [64]
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Select the parameters to be assigned to the telegrams of the PCD. The number of available PCDs depends on the telegram type. The values in the PCDs are then written to the selected parameters as data values.

8-43 PCD Read Configuration

Default value:	Size related	Parameter type:	Array [64]
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Select the parameters to be assigned to the PCDs of the telegrams. The number of available PCDs depends on the telegram type. PCDs contain the actual data values of the selected parameters.

8-45 BTM Transaction Command

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the motor is running.

Option	Name	Description
[0]*	Off	
[1]	Write to active setup	
[2]	Commit transaction	Commit all parameters that have been sent during BTM mode.
[3]	Clear error	When parameter 8-46 BTM Transaction Status shows an error (3–8), the parameter must be cleared by setting this value.
[4]	Write to setup 1	
[5]	Write to setup 2	
[6]	Write to setup 3	
[7]	Write to setup 4	
[8]	Cancel BTM transaction	Abort any BTM activity. Parameters are not committed.

8-46 BTM Transaction Status

Default value:	[0] Off	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Off	
[1]	Transaction started	
[2]	Transaction committing	
[3]	Transaction timeout	
[4]	Err. non-existing par.	
[5]	Err. par. out of range	
[6]	Transaction failed	

8-47 BTM Timeout

Default value:	60 s	Parameter type:	Range, 1 - 360 s
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Select the BTM timeout after a BTM transaction has been started. Timeout is between each acyclic write of parameters.

8-48 BTM Maximum Errors

Default value:	21	Parameter type:	Range, 0 - 21
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Select the maximum allowed number of bulk transfer mode errors before aborting. If it is set to maximum, there is no abort.

8-49 BTM Error Log

Default value:	Size related	Parameter type:	Array [22]
Setup:	1 setup	Conversion index:	-3
Data type:	Uint32	Change during operation:	True

List of parameters that failed during bulk transfer mode. The value after the decimal break is the fault code (255 stands for no error).

5.10.6 8-5* Digital/Bus

Parameters for configuring the control word merging.



NOTE: These parameters are only active when parameter *8-01 Control Site* is set to *[0] Digital and control word*.

8-50 Coasting Select

Default value:	[3] Logic OR	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the trigger for the coasting function.

Option	Name	Description
[0]	Digital input	A digital input triggers the coasting function.
[1]	Bus	A serial communication port or the fieldbus triggers the coasting function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the coasting function.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the coasting function.

8-51 Quick Stop Select

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the control of the quick stop function via the terminals and/or via the bus.

Option	Name	Description
[0]	Digital input	
[1]	Bus	
[2]	Logic AND	
[3]	Logic OR	
[4]	Disabled	The quick stop function is disabled.

8-52 DC Brake Select

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select control of the DC brake via the terminals (digital input) and/or via the fieldbus.



NOTE: When parameter *1-10 Motor Construction* is set to *[1] PM non-salient SPM*, only selection *[0] Digital input* is available.

Option	Name	Description
[0]	Digital input	Activate a start command via a digital input.
[1]	Bus	Activate a start command via a serial communication port or fieldbus option.
[2]	Logic AND	Activate a start command via the fieldbus/serial communication port and also via 1 of the digital inputs.
[3]	Logic OR	Activate a start command via the fieldbus/serial communication port or via 1 of the digital inputs.

8-53 Start Select

Default value:	[3] Logic OR	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the trigger for the start function.

Option	Name	Description
[0]	Digital input	A digital input triggers the start function.
[1]	Bus	A serial communication port or the fieldbus triggers the start function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the start function.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the start function.

8-54 Reversing Select

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the trigger for the reversing function.

Option	Name	Description
[0]	Digital input	A digital input triggers the reversing function.
[1]	Bus	A serial communication port or the fieldbus triggers the reversing function.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the reversing function.
[3]	Logic OR	The fieldbus/serial communication port or a digital input triggers the reversing function.

8-55 Set-up Select

Default value:	[3] Logic OR	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the trigger for the setup selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the setup selection.
[1]	Bus	A serial communication port or the fieldbus triggers the setup selection.
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the setup selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the setup selection.

8-56 Preset Reference Select

Default value:	[3] Logic OR	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the trigger for the preset reference selection.

Option	Name	Description
[0]	Digital input	A digital input triggers the preset reference selection.
[1]	Bus	A serial communication port or the fieldbus triggers the preset reference selection.

Option	Name	Description
[2]	Logic AND	The fieldbus/serial communication port and a digital input trigger the preset reference selection.
[3]*	Logic OR	The fieldbus/serial communication port or a digital input triggers the preset reference selection.

5.10.7 8-7* BACnet

8-70 BACnet Device Instance

Default value:	1	Parameter type:	Range, 0 - 4194302
Setup:	1 setup	Conversion index:	0
Data type:	Uint32	Change during operation:	True



NOTE: This parameter is active only when parameter *8-30 Protocol* is set to *[5] BACnet* or *[9] FC Option*.

Enter a unique ID number for the BACnet device.

8-72 MS/TP Max Masters

Default value:	127	Parameter type:	Range, 1 - 127
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is active only when parameter *8-30 Protocol* is set to *[5] BACnet* or *[9] FC Option*.

Define the address of the master which holds the highest address in this network. Decreasing this value optimizes polling for the token.

8-73 MS/TP Max Info Frames

Default value:	1	Parameter type:	Range, 1 - 65534
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is active only when parameter *8-30 Protocol* is set to *[5] BACnet* or *[9] FC Option*.

Define how many info/data frames the device is allowed to send while holding the token.

8-74 I-AM Service

Default value:	[0] Send at power-up	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is active only when parameter *8-30 Protocol* is set to *[5] BACnet* or *[9] FC Option*.

Choose whether the device should send the "I-Am" service message only at power-up or continuously with an interval of approximately 1 minute.

Option	Name	Description
*[0]	Send at power-up	
[1]	Continuously	

8-75 Initialization Password

Default value:	Size related	Parameter type:	Range, 1 - 20
Setup:	1 setup	Conversion index:	0
Data type:	VisStr [20]	Change during operation:	True



NOTE: This parameter is active only when parameter **8-30 Protocol** is set to **[5] BACnet** or **[9] FC Option**.

Enter the password needed for execution of Drive Re-initialization from BACnet.

5.10.8 8-8* FC Port Diagnostics

These parameters are used for monitoring the bus communication via the FC port.

8-80 Bus Message Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter shows the number of valid telegrams detected on the bus.

8-81 Bus Error Count

Default value:	0	Parameter type:	Readout, Array [6]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter shows the number of telegrams with faults (for example, CRC fault) detected on the bus.

Parameter 8-82 Slave Messages Rcvd

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter shows the number of valid telegrams addressed to the follower sent by the drive.

8-83 Slave Error Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter shows the number of error telegrams which are not executed by the drive.

5.10.9 8-9* Bus Jog

8-90 Bus Jog 1 Speed

Default value:	100 RPM	Parameter type:	Range, 0 - Par. 4-13 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter the jog speed. This is a fixed jog speed activated via the serial port or fieldbus option.

8-91 Bus Jog 2 Speed

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Enter the jog speed. Activate this fixed jog speed via the serial port or fieldbus option.

8-94 Bus Feedback 1

Default value:	0	Parameter type:	Range, -200 - 200
Setup:	1 setup	Conversion index:	0
Data type:	N2	Change during operation:	True

This parameter allows setting of a bus feedback value via the serial communication port or options. The feedback value forms part of the feedback handling. Bus feedback may be selected as feedback source.

8-95 Bus Feedback 2

Default value:	0	Parameter type:	Range, -200 - 200
Setup:	1 setup	Conversion index:	0
Data type:	N2	Change during operation:	True

This parameter allows setting of a bus feedback value via the serial communication port or options. The feedback value forms part of the feedback handling. Bus feedback may be selected as feedback source.

8-96 Bus Feedback 3

Default value:	0	Parameter type:	Range, -200 - 200
Setup:	1 setup	Conversion index:	0
Data type:	N2	Change during operation:	True

This parameter allows setting of a bus feedback value via the serial communication port or options. The feedback value forms part of the feedback handling. Bus feedback may be selected as feedback source.

8-97 Response Error Codes

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter is a 40-bytes buffer that contains the error words.

5.11 Parameter Group 9-** PROFIdrive

9-00 Setpoint

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter receives cyclic references from a master class 2. If the control priority is set to master class 2, the reference for the drive is taken from this parameter, whereas the cyclic reference is ignored.

9-07 Actual Value

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter delivers the MAV for a master class 2. The parameter is valid if the control priority is set to master class 2.

9-15 PCD Write Configuration

Default value:	–	Parameter type:	Option, Array [20]
Setup:	1 setup	Conversion index:	–
Data type:	Uint16	Change during operation:	True

Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 are written to the selected parameters as data. For standard PROFIBUS telegrams, see parameter **9-22 Telegram Selection**.

Option	Name	Description
[0]	None	
[177]	Compressor start max speed [RPM]	
[178]	Compressor start max speed [Hz]	
[302]	Minimum reference	
[303]	Maximum reference	
[311]	Jog speed [Hz]	
[319]	Jog speed [RPM]	
[341]	Ramp 1 ramp up time	
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	

Option	Name	Description
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Terminal 42 output bus control	
[663]	Terminal X30/8 output bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[890]	Bus jog 1 speed	
[891]	Bus jog 2 speed	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1444]	d-axis reference gain	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	

9-16 PCD Read Configuration

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

Select the parameters to be assigned to PCD 3–10 of the telegrams. The number of available PCDs depends on the telegram type. Values in PCD 3–10 are written to the selected parameters as data. For standard PROFIBUS telegrams, see parameter **9-22 Telegram Selection**.

Option	Name	Description
[0]	None	
[15]	Readout: actual setup	
[177]	Compressor start max speed [RPM]	

Option	Name	Description
[178]	Compressor start max speed [Hz]	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1444]	d-axis reference gain	
[1500]	Operating hours	
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	

Option	Name	Description
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[Unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1684]	Comm. option STW	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	

Option	Name	Description
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Warning word	
[1693]	Warning word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2 [mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog input X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[1866]	Actual switching frequency	
[1867]	Alarm word 4	
[1868]	Warning word 4	
[4589]	Cavitation [%]	
[4901]	Autonomous status	

Option	Name	Description
[4902]	Autonomous capacitance value	
[4911]	Baseline status	

9-18 Node Address

Default value:	126	Parameter type:	Range, 1 - 126
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the station address in this parameter or, alternatively, in the hardware switch. To adjust the station address in this parameter, set the hardware switch to 126 or 127 (that is all switches set to ON). Otherwise, this parameter shows the actual setting of the switch.

9-19 Drive Unit System Number

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint16	Change during operation:	True

For PROFINET, select which profile to be used with standard telegrams and drive-specific telegrams.

Option	Name	Description
[1]	PROFIDRIVE/FC telegrams	
[2]	FCD302	
[1034]	Danfoss FC series	
[1035]	FCD302	
[1687]	FID2000	
[15008]	VIK-NAMUR	

9-22 Telegram Selection

Default value:	[100] None	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select a standard PROFIBUS telegram configuration for the drive as an alternative to the freely configurable telegrams in parameter **9-15 PCD Write Configuration** and parameter **9-16 PCD Read Configuration**.

Option	Name	Description
[1]	Standard telegram 1	
[20]	Standard telegram 20	
[100]*	None	
[101]	PPO 1	
[102]	PPO 2	
[103]	PPO 3	
[104]	PPO 4	

Option	Name	Description
[105]	PPO 5	
[106]	PPO 6	
[107]	PPO 7	
[108]	PPO 8	
[109]	PPO 9	

9-23 Parameters for Signals

Default value:	[0] None	Parameter type:	Readout, Array [1000]
Setup:	All setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

This parameter contains a list of signals available for selection in parameter **9-15 PCD Write Configuration** and parameter **9-16 PCD Read Configuration**.

Option	Name	Description
[0]*	None	
[15]	Readout: actual setup	
[177]	Compressor start max speed [RPM]	
[178]	Compressor start max speed [Hz]	
[302]	Minimum reference	
[303]	Maximum reference	
[311]	Jog speed [Hz]	
[319]	Jog speed [RPM]	
[341]	Ramp 1 ramp up time	
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog/homing ramp time jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	

Option	Name	Description
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Term 42 output bus ctrl	
[663]	Terminal X30/8 bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[890]	Bus jog 1 speed	
[891]	Bus jog 2 speed	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1444]	d-axis reference gain	
[1500]	Operating hours	
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	

Option	Name	Description
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	

Option	Name	Description
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1684]	Comm. option STW	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	

Option	Name	Description
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[1866]	Actual switching frequency	
[1867]	Alarm word 4	
[1868]	Warning word 4	
[2021]	Setpoint 1	
[2022]	Setpoint 2	
[2023]	Setpoint 3	
[2643]	Terminal X42/7 bus control	
[2653]	Terminal X42/9 bus control	
[2663]	Terminal X42/11 bus control	
[2792]	% of total capacity	
[2795]	Advanced cascade relay output [bin]	
[2796]	Extended cascade relay output [bin]	
[2969]	Flow	
[3401]	PCD 1 write to MCO	
[3402]	PCD 2 write to MCO	
[3403]	PCD 3 write to MCO	
[3404]	PCD 4 write to MCO	
[3405]	PCD 5 write to MCO	
[3406]	PCD 6 write to MCO	
[3407]	PCD 7 write to MCO	
[3408]	PCD 8 write to MCO	
[3409]	PCD 9 write to MCO	
[3410]	PCD 10 write to MCO	
[3421]	PCD 1 read from MCO	
[3422]	PCD 2 read from MCO	
[3423]	PCD 3 read from MCO	
[3424]	PCD 4 read from MCO	
[3425]	PCD 5 read from MCO	
[3426]	PCD 6 read from MCO	
[3427]	PCD 7 read from MCO	

Option	Name	Description
[3428]	PCD 8 read from MCO	
[3429]	PCD 9 read from MCO	
[3430]	PCD 10 read from MCO	
[3644]	Terminal X49/7 bus control	
[3654]	Terminal X49/9 bus control	
[3664]	Terminal X49/11 bus control	
[4037]	Motor current	
[4038]	Motor power	
[4039]	Motor torque	
[4520]	Type	
[4521]	Status	
[4523]	Baseline failure	
[4589]	Cavitation [%]	
[4590]	Stator [%]	
[4591]	Load [%]	
[4592]	Sensor 1 [%]	
[4593]	Sensor 1 [unit]	
[4594]	Sensor 2 [%]	
[4595]	Sensor 3 [unit]	
[4596]	Sensor 3 [%]	
[4597]	Sensor 3 [unit]	
[4598]	Sensor 4 [%]	
[4599]	Sensor 4 [unit]	
[4901]	Autonomous status	
[4902]	Autonomous capacitance value	
[4911]	Baseline status	

9-27 Parameter Edit

Default value:	[1] Enabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint16	Change during operation:	False

Parameters can be edited via:

- PROFIBUS
- The standard RS-485 interface
- The LCP

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

9-28 Process Control

Default value:	[1] Enable cyclic master	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Process control (setting of control word, speed reference, and process data) is possible via either PROFIBUS or standard fieldbus, but not both simultaneously. Local control is always possible via the LCP. Control via process control is possible via either terminals or fieldbus depending on the settings in parameter **8-50 Coasting Select** to parameter **8-56 Preset Reference Select**.

Option	Name	Description
[0]	Disable	
[1]*	Enable cyclic master	

9-31 Safe Address

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the safe address in this parameter.

9-44 Fault Message Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Indicates the number of fault events presently stored in parameter **9-45 Fault Code**. The buffer capacity is maximum 8 error events. The buffer and counter are set to 0 by reset or power-up.

9-45 Fault Code

Default value:	0	Parameter type:	Readout, Array [64]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This buffer contains the alarm word for all alarms and warnings that have occurred since the last reset or power-up. The buffer capacity is maximum 8 error events.

9-47 Fault Number

Default value:	0	Parameter type:	Readout, Array [64]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This buffer contains the alarm word for all alarms and warnings that have occurred since the last reset or power-up. The buffer capacity is maximum 8 error events.

9-52 Fault Situation Counter

Default value:	0	Parameter type:	Range, 0 - 1000
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Indicates the number of fault events that have occurred since the last reset or power-up.

9-53 PROFIBUS Warning Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	True

This parameter shows PROFIBUS communication warnings.

Table 36: PROFIBUS Warning Word

Bit	Description
0	Connection with DP-master is not OK.
1	Not used.
2	FDL (fieldbus data link layer) is not OK.
3	Clear data command received.
4	Actual value is not updated.
5	Baud rate search.
6	PROFIBUS ASIC is not transmitting.
7	Initializing of PROFIBUS is not OK.
8	Drive is tripped.
9	Internal CAN error.
10	Wrong configuration data from PLC.
11	Wrong ID sent by PLC.
12	Internal fault occurred.
13	Not configured.
14	Timeout active.
15	Warning 34, Fieldbus Fault is active.

9-63 Actual Baud Rate

Default value:	[255] No baud rate found	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter shows the actual PROFIBUS baud rate. The PROFIBUS master automatically sets the baud rate.

Index	Name
[0]	9,6 kbit/s
[1]	19,2 kbit/s
[2]	93,75 kbit/s
[3]	187,5 kbit/s
[4]	500 kbit/s
[6]	1500 kbit/s
[7]	3000 kbit/s
[8]	6000 kbit/s
[9]	12000 kbit/s
[10]	31,25 kbit/s
[11]	45,45 kbit/s
[255]*	No baud rate found

9-64 Device Identification

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is not visible via LCP.

The device identification parameter. The data type is array [n] of unsigned16. The assignment of the 1st subindexes is defined and shown in the following table.

Index	Content	Value
[0]	Manufacturer	128 (for Danfoss)
[1]	Device type	1
[2]	Version	xxyy
[3]	Firmware date year	yyyy
[4]	Firmware date month	ddmm
[5]	No. of axes	Variable
[6]	Vendor specific: PB version	xxyy
[7]	Vendor specific: Database version	xxyy
[8]	Vendor specific: AOC version	xxyy
[9]	Vendor specific: MOC version	xxyy

9-65 Profile Number

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	OctStr[2]	Change during operation:	True



NOTE: This parameter is not visible via LCP.

This parameter contains the profile identification. Byte 1 contains the profile number. Byte 2 contains the number of the profile.

9-67 Control Word 1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	False

This parameter accepts the control word from a master class 2 in the same format as PCD 1.

9-68 Status Word 1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	True

This parameter delivers the status word for a master class 2 in the same format as PCD 2.

9-70 Programming Set-up

Default value:	[9] Active set-up 1	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the setup to be programmed during operation.

Option	Name	Description
[0]	Factory setup	
[1]	Set-up 1	
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	
[9]*	Active set-up	

9-71 PROFIBUS Save Data Value

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Parameter values changed via RS-485 are not automatically stored in a non-volatile memory. Use this parameter to activate a function that stores parameter values in the EEPROM non-volatile memory, so changed parameter values are retained at power-down.

Option	Name	Description
[0]*	Off	
[1]	Store edit setup	
[2]	Store all setups	

9-72 PROFIBUSDriveReset

Default value:	[0] No action	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: Resets the VLT® PROFIBUS DP-V1 MCA 101 option only.

Option	Name	Description
[0]*	No action	
[1]	Power-on reset	
[2]	Power-on reset prep	
[3]	Comm option reset	

9-80 Defined Parameters (1)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-81 Defined Parameters (2)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-82 Defined Parameters (3)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-83 Defined Parameters (4)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0

Data type:	Uint16	Change during operation:	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-84 Defined Parameters (5)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-85 Defined Parameters (6)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setup	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter shows a list of all the defined drive parameters available for PROFIBUS.

9-90 Changed Parameters (1)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameters shows a list of all the drive parameters deviating from the default setting.

9-91 Changed Parameters (2)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-92 Changed Parameters (3)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Change during operation:	False		

This parameters shows a list of all the drive parameters deviating from default setting.

9-93 Changed Parameters (4)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-94 Changed Parameters (5)

Default value:	0	Parameter type:	Readout, Array [116]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameters shows a list of all the drive parameters deviating from default setting.

9-99 PROFIBUS Revision Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Readout of revision count.

5.12 Parameter Group 10-** CAN Fieldbus

5.12.1 10-0* Common Settings

10-00 CAN Protocol

Default value:	[1] DeviceNet	Parameter type:	Option
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

View the active CAN protocol.

Option	Name	Description
[1]*	DeviceNet	

10-01 Baud Rate Select

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the fieldbus transmission speed. The selection must correspond to the transmission speed of the master and of the other fieldbus nodes.

Option	Name	Description
[16]	10 Kbps	
[17]	20 Kbps	
[18]	50 Kbps	
[19]	100 Kbps	
[20]	125 Kbps	
[21]	250 Kbps	
[22]	500 Kbps	

10-02 MAC ID

Default value:	Size related	Parameter type:	Range, 0 - 63
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Select the station address. Every station connected to the same network must have an unambiguous address.

10-05 Readout Transmit Error Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

View the number of CAN control transmission errors since the last power-up.

10-06 Readout Receive Error Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

View the number of CAN control receipt errors since the last power-up.

10-07 Readout Bus Off Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

View the number of fieldbus off events since the last power-up.

5.12.2 10-1* DeviceNet

10-10 Process Data Type Selection

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the instance (telegram) for data transmission. The instances available depend on the setting of parameter **8-10 Control Word Profile**. When parameter **8-10 Control Word Profile** is set to **[0] FC Profile**, options **[0] INSTANCE 100/150** and **[1] INSTANCE 101/151** in this parameter are available. When parameter **8-10 Control Word Profile** is set to **[5] ODVA**, options **[2] INSTANCE 20/70** and **[3] INSTANCE 21/71** in this parameter are available. Instances 100/150 and 101/151 are specific. Instances 20/70 and 21/71 are ODVA-specific AC motor profiles. For guidelines in telegram selection, refer to the VLT® DeciveNet MCA 104 Installation Guide.



NOTE: A change to this parameter is executed immediately.

Option	Name	Description
[0]	Instance 100/150	
[1]	Instance 101/151	
[2]	Instance 20/70	
[3]	Instance 21/71	
[6]	Instance 102/152	

10-11 Process Data Config Write

Default value:	–	Parameter type:	Option, Array [4]
Setup:	All setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

Select the process write data for I/O Assembly Instances 101/151. Elements [2] and [3] of this array can be selected. Elements [0] and [1] of the array are fixed.

Option	Name	Description
[0]	None	
[177]	Compressor start at max speed [RPM]	
[178]	Compressor start at max speed [Hz]	
[302]	Minimum reference	
[303]	Maximum reference	
[311]	Jog speed [Hz]	
[319]	Jog speed [RPM]	
[341]	Ramp 1 ramp up time	
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	

Option	Name	Description
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Terminal 42 output bus control	
[663]	Terminal X30/8 output bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[890]	Bus jog 1 speed	
[891]	Bus jog 2 speed	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1444]	d-axis reference gain	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	

10-12 Process Data Config Read

Default value:	–	Parameter type:	Option, Array [4]
Setup:	2 setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

Select the process read data for I/O Assembly Instances 101/151. Elements [2] and [3] of this array can be selected. Elements [0] and [1] of the array are fixed.

Option	Name	Description
[0]	None	
[15]	Readout: actual setup	
[177]	Compressor start max speed [RPM]	
[178]	Compressor start max speed [Hz]	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1444]	d-axis reference gain	
[1500]	Operating hours	

Option	Name	Description
[1501]	Running hours	
[1502]	kWh counter	
[1600]	Control word	
[1601]	Reference [unit]	
[1602]	Reference %	
[1603]	Status word	
[1605]	Main actual value [%]	
[1609]	Custom readout	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1615]	Frequency [%]	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1619]	Thermistor sensor temperature	
[1620]	Motor angle	
[1622]	Torque [%]	
[1623]	Motor shaft power [kW]	
[1624]	Calibrated stator resistance	
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	

Option	Name	Description
[1650]	External reference	
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1684]	Comm. option STW	
[1685]	FC port CTW 1	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	

Option	Name	Description
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[1866]	Actual switching frequency	
[1867]	Alarm word 4	
[1868]	Warning word 4	
[2792]	% of total capacity	
[2795]	Advanced cascade relay output [bin]	
[2796]	Extended cascade relay output [bin]	
[2969]	Flow	
[3421]	PCD 1 read from MCO	
[3422]	PCD 2 read from MCO	
[3423]	PCD 3 read from MCO	
[3424]	PCD 4 read from MCO	
[3425]	PCD 5 read from MCO	
[3426]	PCD 6 read from MCO	
[3427]	PCD 7 read from MCO	

Option	Name	Description
[3428]	PCD 8 read from MCO	
[3429]	PCD 9 read from MCO	
[3430]	PCD 10 read from MCO	
[4037]	Motor current	
[4038]	Motor power	
[4039]	Motor torque	
[4521]	Status	
[4523]	Baseline failure	
[4589]	Cavitation [%]	
[4590]	Stator [%]	
[4591]	Load [%]	
[4592]	Sensor 1 [%]	
[4593]	Sensor 1 [unit]	
[4594]	Sensor 2 [%]	
[4595]	Sensor 3 [unit]	
[4596]	Sensor 3 [%]	
[4597]	Sensor 3 [unit]	
[4598]	Sensor 4 [%]	
[4599]	Sensor 4 [unit]	
[4901]	Autonomous status	
[4902]	Autonomous capacitance status	
[4911]	Baseline status	

10-13 Warning Parameter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View a DeviceNet-specific warning word. One bit is assigned to every warning. Refer to the *VLT® DeviceNet MCA 104 Installation Guide* for further information.

Table 37: Warning Bits

Bit	Description
0	Bus not active
1	Explicit connection timeout
2	I/O connection
3	Retry limit reached
4	Actual is not updated
5	CAN bus off

Table 37: Warning Bits - (continued)

Bit	Description
6	I/O send error
7	Initialization error
8	No bus supply
9	Bus off
10	Error passive
11	Error warning
12	Duplicate MAC ID error
13	RX queue overrun
14	TX queue overrun
15	CAN overrun

10-14 Net Reference

Default value:	[0] Off	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the reference source in instances 21/71 and 20/70.

Option	Name	Description
[0]*	Off	
[1]	On	

10-15 Net Control

Default value:	[0] Off	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the control source in instances 21/71 and 20/70.

Option	Name	Description
[0]*	Off	
[1]	On	

5.12.3 10-2* COS Filters

10-20 COS Filter 1

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Sets up the filter mask for the status word. When operating in COS (change-of-state), it is possible to filter out bits in the status word that should not be sent if they change.

10-21 COS Filter 2

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Sets up the filter mask for the main actual value. When operating in COS (change-of-state), it is possible to filter out bits in the main actual value that should not be sent if they change.

10-22 COS Filter 3

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Sets up the filter mask for PCD 3. When operating in COS (change-of-state), it is possible to filter out bits in PCD 3 that should not be sent if they change.

10-23 COS Filter 4

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Sets up the filter mask for PCD 4. When operating in COS (change-of-state), it is possible to filter out bits in PCD 4 that should not be sent if they change.

5.12.4 10-3* Parameter Access

This parameter group provides access to indexed parameters and defines programming setup.

10-30 Array Index

Default value:	0	Parameter type:	Range, 0 - 255
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

View array parameters. This parameter is only valid when a VLT® DeviceNet MCA 104 is installed.

10-31 Store Data Value

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is used to activate a function that stores all parameter values in the non-volatile memory. The changed parameter values are retained at power-down.

Option	Name	Description
[0]*	Off	Deactivates the non-volatile storage function.
[1]	Store edit setup	Stores all parameter values from the active setups in the non-volatile memory. The selection returns to [0] Off when all values have been stored.
[2]	Store all setups	Stores all parameter values for all setups in the non-volatile memory. The selection returns to [0] Off when all parameter values have been stored.

10-32 Devicenet Revision

Default value:	0	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The DeviceNet revision number. This parameter is used for EDS file creation.

10-33 Store Always

Default value:	[0] Off	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data value:	Uint8	Change during operation:	True

This parameter is used to select whether parameter data received via the DeviceNet option should always be stored in non-volatile memory.

Option	Name	Description
[0]*	Off	Deactivates non-volatile storage of data.
[1]	On	Stores parameter data received via VLT® DeviceNet MCA 104 in EEPROM non-volatile memory as default.

10-34 DeviceNet Product Code

Default value:	Size related	Parameter type:	Range, 0 - 65535
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Use this parameter for reading out the actual DeviceNet product code.

10-39 Devicenet F Parameters

Default value:	0	Parameter type:	Readout, Array [1000]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Use this parameter to configure the drive via DeviceNet and build the EDS file.

5.13 Parameter Group 12-** Ethernet

5.13.1 12-0* IP Settings

12-00 IP Address Assignment

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type: Uint8	Change during operation: True		

Select the method for assigning the IP address.

Option	Name	Description
[0]	Manual	Set the IP address in parameter 12-01 IP Address .
[1]	DHCP	Assign the IP address via DHCP server.
[2]	BOOTP	Assign the IP address via BOOTP server.
[3]	Disable	
[10]	DCP	Assign the IP address via DCP server.
[20]	From node ID	

12-01 IP Address

Default value:	0	Parameter type:	Range, 0 - 4294967295
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

Configure the IP address of the option. Read-only if parameter **12-00 IP Address Assignment** is set to **[1] DHCP**, **[2] BOOTP**, or via DIP switches.

12-02 Subnet Mask

Default value:	0	Parameter type:	Range, 0 - 4294967295
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

Configure the IP subnet mask of the option. Read-only if parameter **12-00 IP Address Assignment** is set to **[1] DHCP** or **[2] BOOTP**.

12-03 Default Gateway

Default value:	0	Parameter type:	Range, 0 - 4294967295
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

Configure the IP default gateway of the option. Read-only if parameter **12-00 IP Address Assignment** set to **[1] DHCP** or **[2] BOOTP**. In a non-routed network, this address is set to the IP address of the I/O device.

12-04 DHCP Server

Default value:	0	Parameter type:	Range, 0 - 2147483647
Setup:	2 setups	Conversion index:	0

Data type:	OctStr[4]	Change during operation:	True



NOTE: A power cycle is necessary after setting the IP parameters manually.

This parameter is read-only. It shows the IP address of the found DHCP or BOOTP server.

12-05 Lease Expires

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeDifferenceWithDateIndication	Change during operation:	True

This parameter is read-only. It shows the lease time for the current DHCP-assigned IP address.

12-06 Name Servers

Default value:	0	Parameter type:	Array [2]
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

IP addresses of the domain name servers. Can be automatically assigned when using DHCP.

12-07 Domain Name

Default value:	0	Parameter type:	Range, 0 - 48
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[48]	Change during operation:	True

Domain name of the attached network. Can be automatically assigned when using DHCP network.

12-09 Physical Address

Default value:	0	Parameter type:	Range, 0 - 17
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[17]	Change during operation:	True

This parameter is read-only. It shows the physical (MAC) address of the option.

5.13.2 12-1* Ethernet Link Parameters

12-10 Link Status

Default value:	[0] No link	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter is read-only. It shows the link status of the Ethernet ports. Index [0] is used for port 1, and index [1] is used for port 2. For EtherCAT, index [0] is for the in-port, and index [1] is for the out-port.

Index	Description
[0]*	No link
[1]	Link

12-11 Link Duration

Default value:	Size related	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	0
Data type:	TimeDifferenceWithDateIndication	Change during operation:	True

Shows the duration of the present link on each port in dd:hh:mm:ss.

12-12 Auto Negotiation

Default value:	[1] On	Parameter type:	Option, Array [2]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Configures auto negotiation of Ethernet link parameters, for each port: ON or OFF. Link Speed and Link Duplex can be configured in parameter **12-13 Link Speed** and parameter **12-14 Link Duplex**.

Option	Name	Description
[0]	Off	
[1]*	On	

12-13 Link Speed

Default value:	[0] None	Parameter type:	Option, Array [2]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Forces the link speed for each port in 10 Mbps or 100 Mbps. If parameter **12-12 Auto Negotiation** is set to **[0] On**, this parameter is read-only and shows the actual link speed. If no link is present, None is shown.

Option	Name	Description
[0]*	None	
[1]	10 Mbps	
[2]	100 Mbps	

12-14 Link Duplex

Default value:	[1] Full duplex	Parameter type:	Option, Array [2]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Forces the duplex for each port to full or half duplex. If parameter **12-12 Auto Negotiation** is set to **[1] On**, this parameter is read-only.

Option	Name	Description
[0]	Half duplex	
[1]*	Full duplex	

12-18 Supervisor MAC

Default value:	0	Parameter type:	Array [2]
Setup:	2 setups	Conversion index:	0
Data type:	OctStr[6]	Change during operation:	True

MAC addresses of currently active supervisors.

12-19 Supervisor IP Addr.

Default value:	0	Parameter type:	Array [2]
Setup:	2 setups	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

IP addresses of currently active supervisors.

5.13.3 12-2* Process Data

12-20 Control Instance

Default value:	Size related	Parameter type:	Range, 0 - 255
Setup:	1 setup	Conversion index:	0
Data type:	UInt8	Change during operation:	True

This parameter is read-only. It shows the connection to the master.

- In Ethernet/IP: If no CIP connection is present, None is shown.
- In EtherCAT: If no connection is active, None is shown, otherwise it shows the active PDO.

12-21 Process Data Config Write

Default value:	–	Parameter type:	Option, Array [20]
Setup:	All setups	Conversion index:	–
Data type:	UInt16	Change during operation:	True

Option	Name	Description
[0]	None	
[177]	Compressor start max speed [RPM]	
[178]	Compressor start max speed [Hz]	
[302]	Minimum reference	
[303]	Maximum reference	
[311]	Jog speed [Hz]	
[319]	Jog speed [RPM]	
[341]	Ramp 1 ramp up time	

Option	Name	Description
[342]	Ramp 1 ramp down time	
[351]	Ramp 2 ramp up time	
[352]	Ramp 2 ramp down time	
[380]	Jog/homing ramp time jog ramp time	
[381]	Quick stop ramp time	
[411]	Motor speed low limit [RPM]	
[412]	Motor speed low limit [Hz]	
[413]	Motor speed high limit [RPM]	
[414]	Motor speed high limit [Hz]	
[416]	Torque limit motor mode	
[417]	Torque limit generator mode	
[553]	Term. 29 high ref./feedb. value	
[558]	Term. 33 high ref./feedb. value	
[590]	Digital & relay bus control	
[593]	Pulse out #27 bus control	
[595]	Pulse out #29 bus control	
[597]	Pulse out #30/6 bus control	
[615]	Terminal 53 high ref./feedb. value	
[625]	Terminal 54 high ref./feedb. value	
[653]	Term 42 output bus ctrl	
[663]	Terminal X30/8 bus control	
[673]	Terminal X45/1 bus control	
[683]	Terminal X45/3 bus control	
[890]	Bus jog 1speed	
[891]	Bus jog 2 speed	
[894]	Bus feedback 1	
[895]	Bus feedback 2	
[896]	Bus feedback 3	
[1444]	d-axis reference gain	
[1680]	Fieldbus CTW 1	
[1682]	Fieldbus REF 1	
[1685]	FC port CTW 1	
[1686]	FC port REF 1	

12-22 Process Data Config Read

Default value:	–	Parameter type:	Option, Array [20]
Setup:	All setups	Conversion index:	–

Data type:	Uint16	Change during operation:	True
Option	Name	Description	
[0]	None		
[15]	Readout: actual setup		
[177]	Compressor start max speed [RPM]		
[178]	Compressor start max speed [Hz]		
[894]	Bus feedback 1		
[895]	Bus feedback 2		
[896]	Bus feedback 3		
[1397]	Alert alarm word		
[1398]	Alert warning word		
[1399]	Alert status word		
[1444]	d-axis reference gain		
[1500]	Operating hours		
[1501]	Running hours		
[1502]	kWh counter		
[1600]	Control word		
[1601]	Reference [unit]		
[1602]	Reference %		
[1603]	Status word		
[1605]	Main actual value [%]		
[1609]	Custom readout		
[1610]	Power [kW]		
[1611]	Power [hp]		
[1612]	Motor voltage		
[1613]	Frequency		
[1614]	Motor current		
[1615]	Frequency [%]		
[1616]	Torque [Nm]		
[1617]	Speed [RPM]		
[1618]	Motor thermal		
[1619]	Thermistor sensor temperature		
[1620]	Motor angle		
[1622]	Torque [%]		
[1623]	Motor shaft power [kW]		
[1624]	Calibrated stator resistance		
[1626]	Power filtered [kW]		

Option	Name	Description
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1638]	SL controller state	
[1639]	Control card temp.	
[1642]	Service log counter	
[1644]	Speed error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback[unit]	
[1653]	Digi pot reference	
[1654]	Feedback 1 [unit]	
[1655]	Feedback 2 [unit]	
[1656]	Feedback 3 [unit]	
[1660]	Digital input	
[1661]	Terminal 53 switch setting	
[1662]	Analog input 53	
[1663]	Terminal 54 switch setting	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1667]	Freq. input #29 [Hz]	
[1668]	Freq. input #33 [Hz]	
[1669]	Pulse output #27 [Hz]	
[1670]	Pulse output #29 [Hz]	
[1671]	Relay output [bin]	
[1672]	Counter A	
[1673]	Counter B	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	

Option	Name	Description
[1678]	Analog out X45/1 [mA]	
[1679]	Analog out X45/3 [mA]	
[1684]	Comm. option STW	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Alarm word	
[1693]	Alarm word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1696]	Maintenance word	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1836]	Analog input X48/2[mA]	
[1837]	Temp. input X48/4	
[1838]	Temp. input X48/7	
[1839]	Temp. input X48/10	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 Digital output [bin]	
[1847]	Last warning	
[1848]	Last warning count	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[1866]	Actual switching frequency	

Option	Name	Description
[1867]	Alarm word 4	
[1868]	Warning word 4	
[4589]	Cavitation [%]	
[4901]	Autonomous status	
[4902]	Autonomous capacitance value	
[4911]	Baseline status	

12-27 Primary Master

Default value:	0	Parameter type:	Array [2]
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	False

This parameter contains the valid IP addresses for the masters allowed to control this follower. If both indexes are set to 0.0.0.0, all masters have access.

12-28 Store Data Values

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter activates a function that stores all parameter values in the non-volatile memory (EEPROM) thus retaining parameter values at power-down. The parameter returns to **[0] Off**.

Option	Name	Description
[0]*	Off	
[1]	Store edit setup	
[2]	Store all setups	

12-29 Store Always

Default value:	[0] Off	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Activates a function that always stores received parameter data in the non-volatile memory (EEPROM).

Option	Name	Description
[0]*	Off	
[1]	On	

5.13.4 12-3* EtherNet/IP

12-30 Warning Parameter

Default value:	0	Parameter type:	Readout

Setup:	All setups	Conversion index:	0
Data type	Uint32	Change during operation:	True

This parameter is read-only. It shows the EtherNet/IP-specific 16-bit status word.

Table 38: 16-Bit Status Word, EtherNet/IP

Bit	Description
0	Owned
1	Not used
2	Configured
3	Not used
4	Not used
5	Not used
6	Not used
7	Not used
8	Minor recoverable fault
9	Minor unrecoverable fault
10	Major recoverable fault
11	Major unrecoverable fault
12	Not used
13	Not used
14	Not used
15	Not used

12-31 Net Reference

Default value:	[0] Off	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Shows the reference source in instance 21/71.

Option	Name	Description
[0]*	Off	
[1]	On	

12-32 Net Control

Default value:	[0] Off	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uin8	Change during operation:	True

Shows the control source in instance 21/71.

Option	Name	Description
[0]*	Off	
[1]	On	

12-33 CIP Revision

Default value:	Size related	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter is read-only. It shows the CIP version of the option software.

12-34 CIP Product Code

Default value:	Size related	Parameter type:	Range, 0 - 65535
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter is read-only. It shows the CIP product code.

12-35 EDS Parameter

Default value:	0	Parameter type:	Readout, Array [1000]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter is used to configure the drive via DeviceNet and build the EDS-file.

12-37 COS Inhibit Timer

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Read-only change-of-state inhibit timer. If the option is configured for COS operation, this inhibit timer can be configured in the forward open telegram to prevent the continuously changing PCD data from generating extensive network traffic. The inhibit time is in ms. 0 = disabled.

12-38 COS Filter

Default value:	0	Parameter type:	Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Change-of-state PCD filters. Sets up a filter mask for each word of process data when operating in COS mode. Single bits in the PCDs can be filtered in/out.

5.13.5 12-4* Modbus TCP

12-40 Status Parameter

Default value:	0	Parameter type:	Readout

Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter is read-only. It shows the Modbus TCP-specific 16-bit status word.

Table 39: 16-Bit Status Word, Modbus TCP

Bit	Description	Bit = [0]	Bit = [1]
0	Link status port 1	Disconnected	Connected
1	Link status port 2	Disconnected	Connected
2	Link speed	0/10 Mbps	100 Mbps
3	Link duplex	Half	Full
4	Port 502 communication	No	Yes
5	UNUSED	–	–
6	Valid IP address	No	Yes
7	Modbus timeout (30 s)	No	Yes
8	Duplicate IP	No	Yes
9	Register 7 error	No	Yes
10	FTP server	Disabled	Enabled
11	HTTP server	Disabled	Enabled
12	SMTP server	Disabled	Enabled
13	Cable diagnosis	Disabled	Enabled
14	Auto crossover	Disabled	Enabled
15	IPMG	Disabled	Enabled

12-41 Slave Message Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter is read-only. It shows the number of Modbus messages received and processed by the follower drive.

12-42 Slave Exception Message Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter is read-only. It shows the number of Modbus messages for which the follower has sent an exception response.

5.13.6 12-4* Fieldbus Extension

12-49 Ethernet Extended Status

Default value:	0hex	Parameter type:	Array [8]
Setup:	1 setup	Conversion index:	0

Data type:	UInt32	Change during operation:	True

This parameter provides extra information from Ethernet-based communication.

5.13.7 12-7* BACnet

12-70 BACnet Status

Default value:	0hex	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter shows the status of the BACnet IP option.

12-71 BACnet Datalink

Default value:	[1] BACnet/IP	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select which interface BACnet/IP should use. If [0] *All datalinks* is selected, the BACnet/IP automatically detects which BACnet layer to use.

Option	Name	Description
[0]	All datalinks	
[1]*	BACnet/IP	
[2]	BACnet Ethernet	

12-72 BACnet UDP Port

Default value:	47808	Parameter type:	Range, 1 - 65535
Setup:	2 setups	Conversion index:	0
Data type:	UInt16	Change during operation:	False

Set the port number used for the UDP connection. The recommended port number is within the ranges 47808–47823 and 49152–65535.

12-75 BBMD IP Address

Default value:	0	Parameter type:	Range, 0 - 2147483647
Setup:	1 setup	Conversion index:	0
Data type:	OctStr[4]	Change during operation:	True

Set the IP address if the remote BBMD management device. If set to 0.0.0.0, the Foreign Device function is disabled.

12-76 BBMD Port

Default value:	47808	Parameter type:	Range, 1 - 65535
Setup:	2 setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Set the port number of the BBMD management device that handles the broadcast messages.

12-77 BBMD Reg. Interval

Default value:	10 s	Parameter type:	Range, 1 - 65535 s
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Sets the registration interval at which the drive re-registers itself in the remote BBMD. The interval is set in seconds.

12-78 Device ID Conflict Detection

Default value:	0 min	Parameter type:	Range, 0 - 525600 min
Setup:	2 setups	Conversion index:	70
Data type:	Uint32	Change during operation:	True

Set the time in minutes that should pass between a device ID conflict and the logging of the conflict. If the parameter is set to 0, logging is disabled.

12-79 Message Counter

Default value:	0	Parameter type:	Readout, Array [6]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Index	Description
[0]	Total number of received and sent messages
[1]	Total number of received bus messages
[2]	Total number of sent messages
[3]	Total number of error messages
[4]	Total number of retired (timed out) messages
[5]	Total number of control word timeout error messages on an object.

5.13.8 12-8* Other Ethernet Services

12-80 FTP Server

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables/disables the built-in FTP server.

Option	Name	Description
[0]*	Disabled	Disable the built-in FTP server.
[1]	Enabled	Enable the built-in FTP server.
[2]	Enabled with TLS	

12-81 HTTP Server

Default value:	[0] Disabled	Parameter type:	Option

Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables/disables the built-in HTTP (web) server.

Option	Name	Description
[0]*	Disabled	Disable the built-in HTTP (web) server.
[1]	Enabled	Enable the built-in HTTP (web) server.

12-82 SMTP Service

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables/disables the built-in SMTP (e-mail) service on the option.

Option	Name	Description
[0]*	Disabled	Disable the SMTP (e-mail) service on the option.
[1]	Enabled	Enable the SMTP (e-mail) service on the option.

12-83 SNMP Agent

Default value:	[1] Enabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to either enable or disable the SNMP agent.

Option	Name	Description
[0]	Disabled	Disable the SNMP agent.
[1]*	Enabled	Enable the SNMP agent.

12-84 Address Conflict Detection

Default value:	[1] Enabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to detect and resolve IP address conflict.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

12-85 ACD Last Conflict

Default value:	0	Parameter type:	Range, 0 - 2147483647
Setup:	2 setups	Conversion index:	0

Data type:	OctStr[35]	Change during operation:	True

The name of the IP address causing the most recent address conflict.

12-86 NTP Host Server

Default value:	0	Parameter type:	Range, 0 - 48
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[48]	Change during operation:	True

Enter the IPv4/IPv6 address, the FQDN, or the hostname of the NTP server.

12-87 SNTP Time Sync

Default value:	60 min	Parameter type:	Range, 1 - 65535 min
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Synchronize the clock via NTP at a defined interval.

12-89 Transparent Socket Channel Port

Default value:	4000	Parameter type:	Range, 0 - 65535
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Use this parameter for configuring the TCP port number for the transparent socket channel. Configuring the TCP port number enables transparent sending of FC telegrams on Ethernet via TCP. If the parameter is set to 0 (default value), the function is disabled.

5.13.9 12-9* Advanced Ethernet Services

12-90 Cable Diagnostics

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Enables/disables advanced cable diagnosis function. If enabled, the distance to cable errors can be read out in parameter **12-93 Cable Error Length**. The parameter resumes to the default setting **[0] Disable** after the diagnostics have finished.



NOTE: The cable diagnostics function is only issued on ports where there is no link (see parameter **12-10 Link Status**).

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

12-91 MDI-X

Default value:	[1] Enabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–

Data type: Uint8 **Change during operation:** True



NOTE: Disabling of the auto-crossover function requires crossed Ethernet cables for daisy-chaining the options.

Option	Name	Description
[0]	Disabled	Disables the automatic cross-over function.
[1]*	Enabled	Enables the automatic cross-over function.

12-92 IGMP Snooping

Default value: [1] Enabled **Parameter type:** Option
Setup: 2 setups **Conversion index:** –
Data type: Uint8 **Change during operation:** True

Enabling the IGMP snooping function prevents flooding of the Ethernet protocol stack. Multicast packets are only forwarded to ports that are a member of the multicast group.

Option	Name	Description
[0]	Disabled	The IGMP snooping function is disabled.
[1]*	Enabled	The IGMP snooping function is enabled.

12-93 Cable Error Length

Default value: 0 **Parameter type:** Array [2]
Setup: 1 setup **Conversion index:** 0
Data type: Uint16 **Change during operation:** True

If cable diagnostics is enabled in parameter **12-90 Cable Diagnostic**, the built-in switch is possible via time domain reflectometry (TDR). This is a measurement technique which detects common cabling problems such as open circuits, short circuits, and impedance mismatches or breaks in transmission cables. The distance from the option to the error is shown in meters with an accuracy of ± 2 m (6.6 ft). The value 0 means no errors detected.

12-96 Port Config

Default value: [0] Disable **Parameter type:** Option
Setup: 2 setups **Conversion index:** –
Data type: Uint8 **Change during operation:** True

Enable or disable the port-mirroring function. The function is used for troubleshooting with a network analyzer tool.

Option	Name	Description
[0]*	Disable	
[1]	Mirror port 1 to 2	
[2]	Mirror port 2 to 1	
[10]	Port 1 disabled	
[11]	Port 2 disabled	

12-97 QoS Priority

Default value:	Size related	Parameter type:	Array [7]
Setup:	2 setups	Conversion index:	0
Data type:	Int8	Change during operation:	True

Each index sets the DSCP value of different types of QoS prioritized messages.

12-98 Interface Counters

Default value:	0	Parameter type:	Readout, Array [11]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter is read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

12-99 Media Counters

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	True

This parameter is read-only. Advanced interface counters from a built-in switch can be used for low-level troubleshooting. The parameter shows a sum of port 1 + port 2.

5.14 Parameter Group 13-** Smart Logic

5.14.1 Introduction to Smart Logic Control

With SLC, it is possible to run up to 4 sequences in parallel. Link between the sequences to create customer- and application-specific behaviors by using logic rules. In active fire mode/emergency mode, operation related to the motor control is disabled.

Smart logic control (SLC) is a sequence of user-defined actions (see parameter **13-52 SL Controller 1 Action**) executed by the SLC when the associated user-defined event (see parameter **13-51 SL Controller 1 Event**) is evaluated as true by the SLC. The condition for an event can be a particular status, or that the output from a logic rule or a comparator operand becomes true. That leads to an associated action as illustrated:

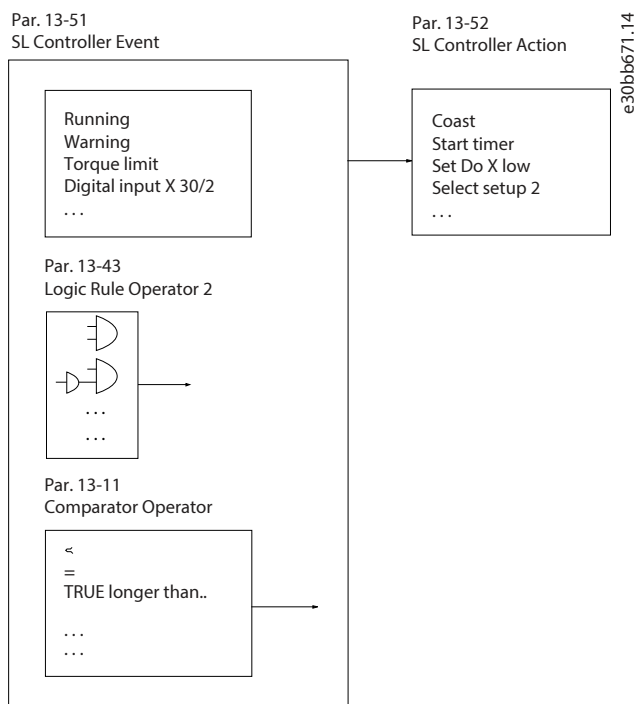


Figure 73: Smart Logic Control (SLC)

Events and actions are each numbered and linked in pairs (states). This means that when the 1st event is fulfilled (becomes true), the 1st action is executed. After this, the conditions of the 2nd event are evaluated and if evaluated true, the 2nd action is executed, and so on. Only 1 event is evaluated at any time. If an event is evaluated as false, nothing happens (in the SLC) during the current scan interval and no other events are evaluated. This means that when the SLC starts, it evaluates the 1st event (and only the 1st event) in each scan interval. Only when the 1st event is evaluated as true, the SLC executes the 1st action and starts evaluating the 2nd event. It is possible to program 1–20 events and actions. When the last event/action has been executed, the sequence starts over again from the 1st event/action.

Four concurring sequences can be defined with each up to 20 event and action pairs. The sequences are executed at the same time but operate separately. For example, sequence 1 may have executed 3 actions, while sequence 2 still waits for its 1st event to occur. In this example, parameter **13-00 SL Controller Mode [0]**, parameter **13-01 Start Event [1]**, and parameter **13-02 Stop Event [2]** correspond to sequence 1, sequence 2, sequence 3.



NOTE: Comparators, flip-flops, timers, and logic rules are shared between sequences.

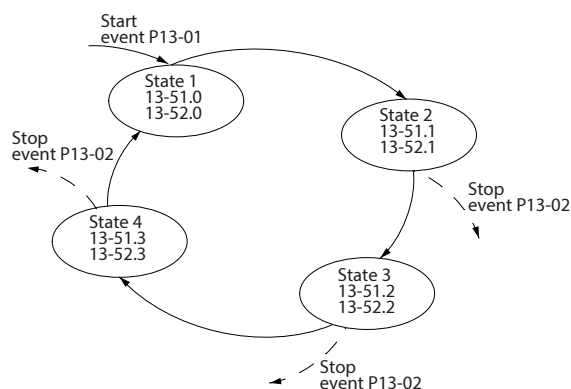


Figure 74: Example of Events and Actions

Starting and stopping the SLC

Start and stop the SLC by selecting **[1] On** or **[0] Off** in parameter **13-00 SL Controller Mode**. The SLC always starts in state 0 (where it evaluates event [0]). The SLC starts when the start event (defined in parameter **13-01 Start Event**) is evaluated as true (provided that **[1] On** is selected in parameter **13-00 SL Controller Mode**). The SLC stops when the stop event (parameter **13-02 Stop Event**) is true. **13-03 Reset SLC** resets all SLC parameters and starts programming from scratch.



NOTE: SLC is only active in auto-on mode, not in hand-on mode.

5.14.2 13-0* SLC Settings

Use the SLC settings to activate, deactivate, and reset the smart logic control sequence. The logic functions and comparators are always running in the background, which opens for separate control of digital inputs and outputs.

13-00 SL Controller Mode

Default value:	–	Parameter type:	Option, Array [4]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

An array with 4 elements [0]–[3] is shown in the display.

Option	Name	Description
[0]	Off	Disables the smart logic controller.
[1]	On	Enables the smart logic controller.

13-01 Start Event

Default value:	–	Parameter type:	Option, Array [4]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the boolean (true or false) input to activate smart logic control.

Option	Name	Description
[0]	False	Select the boolean (true or false) input to activate smart logic control. Enters the fixed value <i>False</i> .
[1]	True	Enters the fixed value <i>True</i> .
[2]	Running	The motor runs.
[3]	In range	The motor runs within the programmed current and speed ranges set in parameter 4-50 Warning Current Low to parameter 4-53 Warning Speed High .
[4]	On reference	The motor runs on reference.
[5]	Torque limit	The torque limit set in parameter 4-16 Torque Limit Motor Mode or parameter 4-17 Torque Limit Generator Mode is exceeded.
[6]	Current limit	The motor current limit set in parameter 4-18 Current Limit is exceeded.

Option	Name	Description
[7]	Out of current range	The motor current is outside the range set in parameter 4-18 Current Limit .
[8]	Below I_{low}	The motor current is lower than set in parameter 4-50 Warning Current Low .
[9]	Above I_{high}	The motor current is higher than set in parameter 4-51 Warning Current High .
[10]	Out of speed range	The speed is outside the range set in parameter 4-52 Warning Speed Low and parameter 4-53 Warning Speed High .
[11]	Below speed low	The output speed is lower than the setting in parameter 4-52 Warning Speed Low .
[12]	Above speed high	The output speed is higher than the setting in parameter 4-53 Warning Speed High .
[13]	Out of feedb. range	The feedback is outside the range set in parameter 4-56 Warning Feedback Low and parameter 4-57 Warning Feedback High .
[14]	Below feedb. low	The feedback is below the limit set in parameter 4-56 Warning Feedback Low .
[15]	Above feedb. high	The feedback is above the limit set in parameter 4-57 Warning Feedback High .
[16]	Thermal warning	The thermal warning turns on when the temperature exceeds the limit in the motor, the drive, the brake resistor, or the thermistor.
[17]	Mains out of range	The mains voltage is outside the specified voltage range.
[18]	Reversing	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[19]	Warning	A warning is active.
[20]	Alarm (trip)	A (trip) alarm is active.
[21]	Alarm (trip lock)	A (trip lock) alarm is active.
[22]	Comparator 0	Use the result of comparator 0.
[23]	Comparator 1	Use the result of comparator 1.
[24]	Comparator 2	Use the result of comparator 2.
[25]	Comparator 3	Use the result of comparator 3.
[26]	Logic rule 0	Use the result of logic rule 0.
[27]	Logic rule 1	Use the result of logic rule 1.
[28]	Logic rule 2	Use the result of logic rule 2.
[29]	Logic rule 3	Use the result of logic rule 3.
[33]	Digital input DI18	Use the result of digital input 18.
[34]	Digital input DI19	Use the result of digital input 19.
[35]	Digital input DI27	Use the result of digital input 27.
[36]	Digital input DI29	Use the result of digital input 29.
[37]	Digital input DI32	Use the result of digital input 32.
[38]	Digital input DI33	Use the result of digital input 33.

Option	Name	Description
[39]	Start command	A start command is issued. This is the default option.
[40]	Drive stopped	A stop command (jog, stop, quick stop, coast) is issued - and not from SLC itself.
[41]	Reset trip	A reset is issued.
[42]	Auto-reset trip	An auto reset is performed.
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[76]	Digital input X30/2	Use the value of X30/2 (VLT® General Purpose I/O MCB 101).
[77]	Digital input X30/3	Use the value of X30/3 (VLT® General Purpose I/O MCB 101).
[78]	Digital input X30/4	Use the value of X30/4 (VLT® General Purpose I/O MCB 101).
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* Comparators .
[95]	RS Flipflop 1	See parameter group 13-1* Comparators .
[96]	RS Flipflop 2	See parameter group 13-1* Comparators .
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	

Option	Name	Description
[131]	Digital input X46/13	
[228]	Comparator 6	Use the result of comparator 6.
[229]	Comparator 7	Use the result of comparator 7.
[230]	Comparator 8	Use the result of comparator 8.
[231]	Comparator 9	Use the result of comparator 9.
[232]	Logic rule 6	Use the result of logic rule 6.
[233]	Logic rule 7	Use the result of logic rule 7.
[234]	Logic rule 8	Use the result of logic rule 8.
[235]	Logic rule 9	Use the result of logic rule 9.
[238]	RS flipflop 8	See parameter group 13-1* Comparators .
[239]	RS flipflop 9	See parameter group 13-1* Comparators .

13-02 Stop Event

Default value:	–	Parameter type:	Option, Array [4]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the boolean (true or false) input to deactivate smart logic control.

Option	Name	Description
[0]	False	Enter the fixed value of false in the logic rule.
[1]	True	Enter the fixed value of true in the logic rule.
[2]	Running	See parameter group 5-3* Digital Outputs for further description.
[3]	In range	See parameter group 5-3* Digital Outputs for further description.
[4]	On reference	See parameter group 5-3* Digital Outputs for further description.
[5]	Torque limit	See parameter group 5-3* Digital Outputs for further description.
[6]	Current limit	See parameter group 5-3* Digital Outputs for further description.
[7]	Out of current range	See parameter group 5-3* Digital Outputs for further description.
[8]	Below I_{low}	See parameter group 5-3* Digital Outputs for further description.
[9]	Above I_{high}	See parameter group 5-3* Digital Outputs for further description.
[10]	Out of speed range	
[11]	Below speed low	See parameter group 5-3* Digital Outputs for further description.
[12]	Above speed high	See parameter group 5-3* Digital Outputs for further description.
[13]	Out of feedb. range	See parameter group 5-3* Digital Outputs for further description.
[14]	Below feedb. low	See parameter group 5-3* Digital Outputs for further description.
[15]	Above feedb. high	See parameter group 5-3* Digital Outputs for further description.
[16]	Thermal warning	See parameter group 5-3* Digital Outputs for further description.
[17]	Mains out of range	See parameter group 5-3* Digital Outputs for further description.

Option	Name	Description
[18]	Reversing	See parameter group 5-3* Digital Outputs for further description.
[19]	Warning	See parameter group 5-3* Digital Outputs for further description.
[20]	Alarm (trip)	See parameter group 5-3* Digital Outputs for further description.
[21]	Alarm (trip lock)	See parameter group 5-3* Digital Outputs for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL timeout 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (high=true).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (high=true).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (high=true).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (high=true).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (high=true).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (high=true).
[39]	Start command	This event is true if the drive is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is true if the drive is stopped or coasted (either via digital input, fieldbus, or other).
[41]	Reset trip	This event is true if the drive is tripped (but not trip locked) and [Reset] is pressed.
[42]	Auto-reset trip	This event is true if the drive is tripped (but not trip locked) and an automatic reset is issued.
[43]	OK key	This event is true if [OK] is pressed.
[44]	Reset key	This event is true if [Reset] is pressed.
[45]	Left key	This event is true [◀]
[46]	Right key	[▶]
[47]	Up key	[▲]
[48]	Down key	[▼]
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.

Option	Name	Description
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL time-out 3	Smart logic controller time 3 is timed out.
[71]	SL time-out 4	Smart logic controller time 4 is timed out.
[72]	SL time-out 5	Smart logic controller time 5 is timed out.
[73]	SL time-out 6	Smart logic controller time 6 is timed out.
[74]	SL time-out 7	Smart logic controller time 7 is timed out.
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS flipflop 0	See parameter group 13-1* Comparators .
[95]	RS flipflop 1	See parameter group 13-1* Comparators .
[96]	RS flipflop 2	See parameter group 13-1* Comparators .
[97]	RS flipflop 3	See parameter group 13-1* Comparators .
[98]	RS flipflop 4	See parameter group 13-1* Comparators .
[99]	RS flipflop 5	See parameter group 13-1* Comparators .
[100]	RS flipflop 6	See parameter group 13-1* Comparators .
[101]	RS flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	

Option	Name	Description
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	Use the result of comparator 6 in the logic rule.
[229]	Comparator 7	Use the result of comparator 7 in the logic rule.
[230]	Comparator 8	Use the result of comparator 8 in the logic rule.
[231]	Comparator 9	Use the result of comparator 9 in the logic rule.
[232]	Logic rule 6	Use the result of logic rule 6 in the logic rule.
[233]	Logic rule 7	Use the result of logic rule 7 in the logic rule.
[234]	Logic rule 8	Use the result of logic rule 8 in the logic rule.
[235]	Logic rule 9	Use the result of logic rule 9 in the logic rule.
[236]	SL time-out 8	Smart logic controller time 8 is timed out.
[237]	SL time-out 9	Smart logic controller time 9 is timed out.
[238]	RS flipflop 8	See parameter group 13-1* Comparators .
[239]	RS flipflop 9	See parameter group 13-1* Comparators .
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-03 Reset SLC

Default value:	[0] Do not reset SLC	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]*	Do not reset SLC	Retain programmed settings in parameter group 13-** Smart Logic .
[1]	Reset SLC	Reset all parameters in parameter group 13-** Smart Logic .

5.14.3 13-1* Comparators

Comparators are used for comparing continuous variables (that is output frequency, output current, analog input, and so on) to fixed preset values.

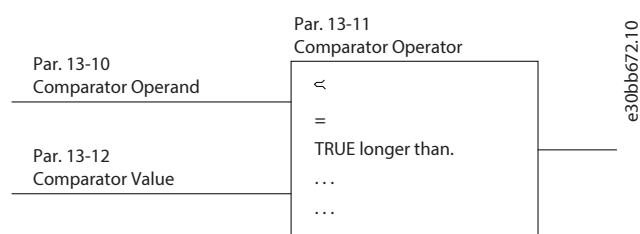


Figure 75: Comparators

There are digital values that are compared to fixed time values. See the explanation in parameter **13-10 Comparator Operand**. Comparators are evaluated once in each scan interval. Use the result (true or false) directly. All parameters in this parameter group are array parameters with index 0–9. Select index 0 to program comparator 0, select index 1 to program comparator 1, and so on.

13-10 Comparator Operand

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Options **[1] Reference %** to **[31] Counter B** are variables, which are compared based on their values. Options **[50] FALSE** to **[186] Drive in auto mode** are digital values (true/false) where the comparison is based on the amount of time during which they are set to true or false. See parameter **13-11 Comparator Operator**.

Option	Name	Description
[0]	DISABLED	The comparator is disabled.
[1]	Reference %	The resulting remote reference in %.
[2]	Feedback %	[RPM] or [Hz], as set in parameter 0-02 Motor Speed Unit .
[3]	Motor speed	[RPM] or [Hz], as set in parameter 0-02 Motor Speed Unit .
[4]	Motor current	
[5]	Motor torque	
[6]	Motor power	
[7]	Motor voltage	

Option	Name	Description
[8]	DC-link voltage	
[9]	Motor thermal	The value is in %.
[10]	Drive thermal	The value is in %.
[11]	Heat sink temp.	The value is in %.
[12]	Analog input AI53	The value is in %.
[13]	Analog input AI54	The value is in %.
[14]	Analog input AIFB10	AIFB10 is internal 10 V supply.
[15]	Analog input AIS24V	AIS24V is a 24 V switch mode power supply.
[17]	Analog input AICCT	Value is in [°]. AICCT is control card temperature.
[18]	Pulse input FI29	The value is in %.
[19]	Pulse input FI33	The value is in %.
[20]	Alarm number	Shows the actual alarm number.  NOTE: With this selection, it is not possible to use < and > as comparator operators.
		 NOTE: Several alarms/warnings can be present at the same time. As the alarm/warning numbers are not grouped in a predefined order, defining a range is not relevant.
[21]	Warning number	Shows the actual warning number.  NOTE: With this selection, it is not possible to use < and > as comparator operators.
		 NOTE: Several alarms/warnings can be present at the same time. As the alarm/warning numbers are not grouped in a predefined order, defining a range is not relevant.
[22]	Analog input X30/11	
[23]	Analog input X30/12	
[24]	Sensorless flow	
[25]	Sensorless pressure	
[26]	Flow totalized volume	
[27]	Flow actual volume	
[28]	Flow	
[29]	Number of pump running	
[30]	Counter A	
[31]	Counter B	
[34]	Analog input X48/2	
[35]	Temp input X48/4	

Option	Name	Description
[36]	Temp input X48/7	
[37]	Temp input X48/10	
[38]	Derag counter	
[40]	Analog input X42/1	
[41]	Analog input X42/3	
[42]	Analog input X42/5	
[43]	Analog input X49/1	
[44]	Analog input X49/3	
[45]	Analog input X49/5	
[46]	AI53 scaled	
[47]	AI54 scaled	
[48]	AI53 unit	
[49]	AI55 unit	
[50]	FALSE	Use to enter the fixed value <i>False</i> in the comparator.
[51]	TRUE	Use to enter <i>True</i> in the comparator.
[52]	Control ready	The control board receives supply voltage.
[53]	Drive ready	The drive is ready for operation and applies a signal on the control board.
[54]	Running	The motor runs.
[55]	Reversing	The output is active when the drive runs counterclockwise (the logical product of the status bits running AND reverse).
[56]	In range	The motor runs within the programmed current and speed ranges set in parameter 4-50 Warning Current Low to parameter 4-53 Warning Speed High .
[60]	On reference	The motor runs on reference.
[61]	Below reference, low	The motor runs at a reference which is less than the value in parameter 4-54 Warning Reference Low .
[62]	Above ref, high	The motor runs at a reference which exceeds the value in parameter 4-55 Warning Reference High .
[65]	Torque limit	The torque exceeds the value in parameter 4-16 Torque Limit Motor Mode or parameter 4-17 Torque Limit Generator Mode .
[66]	Current limit	The motor current exceeds the value in parameter 4-18 Current Limit .
[67]	Out of current range	The motor current is outside the range set in parameter 4-18 Current Limit .
[68]	Below I low	The motor current is lower than the value in parameter 4-50 Warning Current Low .
[69]	Above I high	The motor current is higher than the value in parameter 4-51 Warning Current High .

Option	Name	Description
[70]	Out of speed range	The speed is outside the range set in parameter 4-52 Warning Speed Low and parameter 4-53 Warning Speed High .
[71]	Below speed low	The output speed is lower than the value in parameter 4-52 Warning Speed Low .
[72]	Above speed high	The output speed is higher than the value in parameter 4-53 Warning Speed High .
[75]	Out of feedback range	The feedback is outside the range set in parameter 4-56 Warning Feedback Low and parameter 4-57 Warning Feedback High .
[76]	Below feedback low	The feedback is lower than the limit set in parameter 4-56 Warning Feedback Low .
[77]	Above feedback high	The feedback exceeds the limit set in parameter 4-57 Warning Feedback High .
[80]	Thermal warning	This operand becomes true when the drive detects any thermal warning, for instance when the temperature exceeds the limit in the motor, the drive, the brake resistor, or thermistor.
[82]	Mains out of range	The mains voltage is outside the specified voltage range.
[85]	Warning	If a warning is triggered, this operand gets the warning number.
[86]	Alarm (trip)	A trip alarm is active.
[87]	Alarm (trip lock)	A trip lock alarm is active.
[90]	Bus OK	Active communication (no timeout) via the serial communication port.
[91]	Torque limit and stop	If the drive has received a stop signal and is at the torque limit, the signal is logic 0.
[92]	Brake fault (IGBT)	The brake IGBT is short-circuited.
[94]	Safe stop active	
[100]	Comparator 0	The result of comparator 0.
[101]	Comparator 1	The result of comparator 1.
[102]	Comparator 2	The result of comparator 2.
[103]	Comparator 3	The result of comparator 3.
[104]	Comparator 4	The result of comparator 4.
[105]	Comparator 5	The result of comparator 5.
[106]	Comparator 6	The result of comparator 6.
[107]	Comparator 7	The result of comparator 7.
[108]	Comparator 8	The result of comparator 8.
[109]	Comparator 9	The result of comparator 9.
[110]	Logic rule 0	The result of logic rule 0.
[111]	Logic rule 1	The result of logic rule 1.
[112]	Logic rule 2	The result of logic rule 2.
[113]	Logic rule 3	The result of logic rule 3.
[114]	Logic rule 4	The result of logic rule 4.

Option	Name	Description
[115]	Logic rule 5	The result of logic rule 5.
[116]	Logic rule 6	The result of logic rule 6.
[117]	Logic rule 7	The result of logic rule 7.
[118]	Logic rule 8	The result of logic rule 8.
[119]	Logic rule 9	The result of logic rule 9.
[120]	SL time-out 0	The result of the SLC timer 0.
[121]	SL time-out 1	The result of the SLC timer 1.
[122]	SL time-out 2	The result of the SLC timer 2.
[123]	SL time-out 3	The result of the SLC timer 3.
[124]	SL time-out 4	The result of the SLC timer 4.
[125]	SL time-out 5	The result of the SLC timer 5.
[126]	SL time-out 6	The result of the SLC timer 6.
[127]	SL time-out 7	The result of the SLC timer 7.
[128]	SL time-out 8	The result of the SLC timer 8.
[129]	SL time-out 9	The result of the SLC timer 9.
[130]	Digital input DI18	Digital input 18 (high=true).
[131]	Digital input DI19	Digital input 19 (high=true).
[132]	Digital input DI27	Digital input 27 (high=true).
[133]	Digital input DI29	Digital input 29 (high=true)
[134]	Digital input DI32	Digital input 32 (high=true).
[135]	Digital input DI33	Digital input 33 (high=true).
[136]	RS flipflop 0	
[137]	RS flipflop 1	
[138]	RS flipflop 2	
[139]	RS flipflop 3	
[140]	RS flipflop 4	
[141]	RS flipflop 5	
[142]	RS flipflop 6	
[143]	RS flipflop 7	
[144]	RS flipflop 8	
[145]	RS flipflop 9	
[150]	SL digital output A	Use the result of the SLC output A.
[151]	SL digital output B	Use the result of the SLC output B.
[152]	SL digital output C	Use the result of the SLC output C.
[153]	SL digital output D	Use the result of the SLC output D.
[154]	SL digital output E	Use the result of the SLC output E.
[155]	SL digital output F	Use the result of the SLC output F.

Option	Name	Description
[160]	Relay 1	Relay 1 is active.
[161]	Relay 2	Relay 2 is active.
[162]	Relay 3	Relay 3 is active.
[163]	Relay 4	Relay 4 is active.
[164]	Relay 5	Relay 5 is active.
[165]	Relay 6	Relay 6 is active.
[166]	Relay 7	Relay 7 is active.
[167]	Relay 8	Relay 8 is active.
[168]	Relay 9	Relay 9 is active.
[180]	Local reference active	Active when parameter 3-13 Reference Site is [2] Local or when parameter 3-13 Reference Site is [0] Linked to hand/auto , at the same time as the LCP is in hand-on mode.
[181]	Remote reference active	Active when parameter 3-13 Reference Site is [1] Remote or [0] Linked to hand/auto , while the LCP is in auto-on mode.
[182]	Start command	Active when there is an active start command and no stop command.
[183]	Drive stopped	A stop command (jog, stop, qstop, coast) is issued – and not from the SLC itself.
[185]	Drive in hand mode	Active when the drive is in hand-on mode.
[186]	Drive in auto mode	Active when the drive is in auto-on mode.
[187]	Start command given	
[190]	Digital input X30/2	
[191]	Digital input X30/3	
[192]	Digital input X30/4	
[193]	Digital input X46/1	
[194]	Digital input X46/3	
[195]	Digital input X46/5	
[196]	Digital input X46/7	
[197]	Digital input X46/9	
[198]	Digital input X46/11	
[199]	Digital input X46/13	
[204]	System on ref	
[205]	No flow	
[206]	Dry pump	
[207]	End of curve	
[208]	Broken belt	
[209]	ECB drive mode	
[210]	ECB bypass mode	

Option	Name	Description
[211]	ECB test mode	
[212]	Emergency mode	
[240]	Totalized vol in thousands	
[241]	Totalized vol in millions	
[242]	Totalized vol in billions	
[243]	Totalized vol in trillions	
[245]	Actual vol in thousands	
[246]	Actual vol in millions	
[247]	Actual vol in billions	
[248]	Actual vol in trillions	
[249]	Therm. sensor temp.	

13-11 Comparator Operator

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the operator to be used in the comparison. This is an array parameter containing comparator operators 0–5.

Option	Name	Description
[0]	<	 NOTE: If [20] <i>Alarm number</i> or [21] <i>Warning number</i> is selected in parameter 13-10 Comparator Operand, [0] < cannot be selected in this parameter. The result of the evaluation is true when the variable selected in parameter 13-10 Comparator Operand is smaller than the fixed value in parameter 13-12 Comparator Value. The result is false if the variable selected in parameter 13-10 Comparator Operand is greater than the fixed value in parameter 13-12 Comparator Value.
[1]	≈ (equal)	The result of the evaluation is true when the variable selected in parameter 13-10 Comparator Operand is approximately equal to the fixed value in parameter 13-12 Comparator Value.
[2]	>	 NOTE: If [20] <i>Alarm number</i> or [21] <i>Warning number</i> is selected in parameter 13-10 Comparator Operand, [2] > cannot be selected in this parameter. Inverse logic of option [0] <.
[5]	TRUE longer than..	
[6]	FALSE longerthan..	
[7]	TRUE shorter than..	
[8]	FALSE shorter than..	

13-12 Comparator Value

Default value:	Size related	Parameter type:	Array [10]
Setup:	2 setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the trigger level for the variable that is monitored by this comparator. This is an array parameter containing comparator values 0–9.

5.14.4 13-1* RS Flip Flops

The reset/set flip flops hold the signal until set/reset.

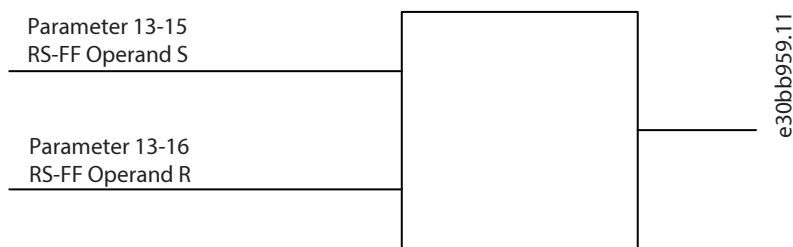


Figure 76: Reset/Set Flip Flops

Two parameters are used and the output can be used in the logic rules and as events.

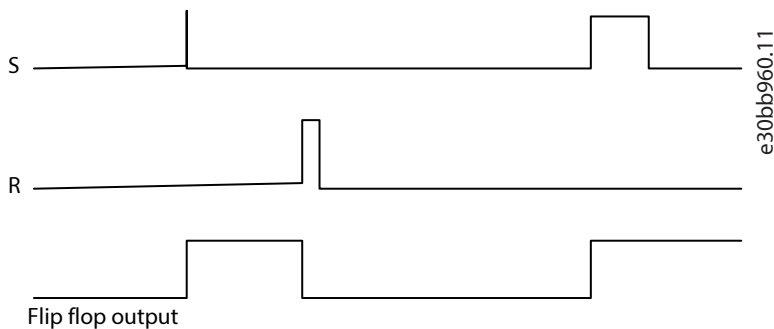


Figure 77: Flip Flop Outputs

The 2 operators can be selected from a long list. As a special case, the same digital input can be used as both set and reset, making it possible to use the same digital input as start/stop. The following settings can be used to set up the same digital input (for example, DI32) as start/stop.

Table 40: Operators

Parameter	Setting	Notes
Parameter 13-00 SL Controller Mode	[1] On	–
Parameter 13-01 Start Event[0]	True	–
Parameter 13-02 Stop Event [0]	False	–
Parameter 13-40 Logic Rule Boolean 1 [0]	[37] Digital input DI32	–
Parameter 13-42 Logic Rule Boolean 2 [0]	[2] Running	–
Parameter 13-41 Logic Rule Operator 1 [0]	[3] AND NOT	–
Parameter 13-40 Logic Rule Boolean 1 [1]	[37] Digital input DI32	–
Parameter 13-42 Logic Rule Boolean 2 [1]	[2] Running	–

Table 40: Operators - (continued)

Parameter	Setting	Notes
Parameter 13-41 <i>Logic Rule Operator 1</i> [1]	[1] <i>AND</i>	–
Parameter 13-15 <i>RS-FF Operand S</i> [0]	[26] <i>Logic rule 0</i>	Output from parameter 13-41 <i>Logic Rule Operator 1</i> [0].
Parameter 13-16 <i>RS-FF Operand R</i> [0]	[27] <i>Logic rule 1</i>	Output from parameter 13-41 <i>Logic Rule Operator 1</i> [1].
Parameter 13-51 <i>SL Controller 1 Event</i> [0]	[94] <i>RS Flipflop 0</i>	Output from parameter 13-15 <i>RSFF Operand S</i> and parameter 13-16 <i>RSFF Operand R</i> .
Parameter 13-52 <i>SL Controller 1 Action</i> [0]	[22] <i>Run</i>	–
Parameter 13-51 <i>SL Controller 1 Event</i> [1]	[27] <i>Logic rule 1</i>	–
Parameter 13-52 <i>SL Controller 1 Action</i> [1]	[24] <i>Stop</i>	–

13-15 RS-FF Operand S

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the boolean (true or false) input to deactivate smart logic control.

Option	Name	Description
[0]	False	Enter the fixed value of false in the logic rule.
[1]	True	Enter the fixed value of true in the logic rule.
[2]	Running	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[3]	In range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[4]	On reference	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[5]	Torque limit	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[6]	Current limit	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[7]	Out of current range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[8]	Below I_{low}	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[9]	Above I_{high}	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[10]	Out of speed range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[11]	Below speed low	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[12]	Above speed high	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[13]	Out of feedb. range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[14]	Below feedb. low	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[15]	Above feedb. high	See parameter group 5-3* <i>Digital Outputs</i> for further description.

Option	Name	Description
[16]	Thermal warning	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[17]	Mains out of range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[18]	Reversing	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[19]	Warning	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[20]	Alarm (trip)	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[21]	Alarm (trip lock)	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL time-out 0	Use the result of timer 0 in the logic rule.
[31]	SL time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL timeout 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (high=true).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (high=true).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (high=true).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (high=true).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (high=true).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (high=true).
[39]	Start command	This event is true if the drive is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is true if the drive is stopped or coasted (either via digital input, fieldbus, or other).
[41]	Reset trip	This event is true if the drive is tripped (but not trip locked) and [Reset] is pressed.
[42]	Auto-reset trip	This event is true if the drive is tripped (but not trip locked) and an automatic reset is issued.
[43]	OK key	This event is true if [OK] is pressed.
[44]	Reset key	This event is true if [Reset] is pressed.
[45]	Left key	This event is true if [◀] is pressed.
[46]	Right key	The event is true if [▶] is pressed.
[47]	Up key	The event is true if [▲] is pressed.
[48]	Down key	The event is true if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.

Option	Name	Description
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL time-out 3	Smart logic controller time 3 is timed out.
[71]	SL time-out 4	Smart logic controller time 4 is timed out.
[72]	SL time-out 5	Smart logic controller time 5 is timed out.
[73]	SL time-out 6	Smart logic controller time 6 is timed out.
[74]	SL time-out 7	Smart logic controller time 7 is timed out.
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS flipflop 0	See parameter group 13-1* Comparators .
[95]	RS flipflop 1	See parameter group 13-1* Comparators .
[96]	RS flipflop 2	See parameter group 13-1* Comparators .
[97]	RS flipflop 3	See parameter group 13-1* Comparators .
[98]	RS flipflop 4	See parameter group 13-1* Comparators .
[99]	RS flipflop 5	See parameter group 13-1* Comparators .
[100]	RS flipflop 6	See parameter group 13-1* Comparators .
[101]	RS flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.

Option	Name	Description
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input x46/1	
[126]	Digital input x46/3	
[127]	Digital input x46/5	
[128]	Digital input x46/7	
[129]	Digital input x46/9	
[130]	Digital input x46/11	
[131]	Digital input x46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If the <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	Use the result of comparator 6 in the logic rule.
[229]	Comparator 7	Use the result of comparator 7 in the logic rule.
[230]	Comparator 8	Use the result of comparator 8 in the logic rule.
[231]	Comparator 9	Use the result of comparator 9 in the logic rule.
[232]	Logic rule 6	Use the result of logic rule 6 in the logic rule.
[233]	Logic rule 7	Use the result of logic rule 7 in the logic rule.
[234]	Logic rule 8	Use the result of logic rule 8 in the logic rule.
[235]	Logic rule 9	Use the result of logic rule 9 in the logic rule.
[236]	SL time-out 8	Smart logic controller time 8 is timed out.
[237]	SL time-out 9	Smart logic controller time 9 is timed out.
[238]	RS flipflop 8	See parameter group 13-1* Comparators .
[239]	RS flipflop 9	See parameter group 13-1* Comparators .
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-16 RS-FF Operand R

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the boolean (true or false) input to deactivate smart logic control. The Operand R inputs have priority over the Operand S inputs.

Option	Name	Description
[0]	False	Enter the fixed value of false in the logic rule.
[1]	True	Enter the fixed value of true in the logic rule.
[2]	Running	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[3]	In range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[4]	On reference	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[5]	Torque limit	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[6]	Current limit	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[7]	Out of current range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[8]	Below I_{low}	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[9]	Above I_{high}	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[10]	Out of speed range	
[11]	Below speed low	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[12]	Above speed high	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[13]	Out of feedb. range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[14]	Below feedb. low	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[15]	Above feedb. high	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[16]	Thermal warning	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[17]	Mains out of range	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[18]	Reversing	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[19]	Warning	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[20]	Alarm (trip)	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[21]	Alarm (trip lock)	See parameter group 5-3* <i>Digital Outputs</i> for further description.
[22]	Comparator 0	Use the result of comparator 0 in the logic rule.
[23]	Comparator 1	Use the result of comparator 1 in the logic rule.
[24]	Comparator 2	Use the result of comparator 2 in the logic rule.
[25]	Comparator 3	Use the result of comparator 3 in the logic rule.
[26]	Logic rule 0	Use the result of logic rule 0 in the logic rule.
[27]	Logic rule 1	Use the result of logic rule 1 in the logic rule.
[28]	Logic rule 2	Use the result of logic rule 2 in the logic rule.
[29]	Logic rule 3	Use the result of logic rule 3 in the logic rule.
[30]	SL time-out 0	Use the result of timer 0 in the logic rule.

Option	Name	Description
[31]	SL time-out 1	Use the result of timer 1 in the logic rule.
[32]	SL timeout 2	Use the result of timer 2 in the logic rule.
[33]	Digital input DI18	Use the value of DI18 in the logic rule (high=true).
[34]	Digital input DI19	Use the value of DI19 in the logic rule (high=true).
[35]	Digital input DI27	Use the value of DI27 in the logic rule (high=true).
[36]	Digital input DI29	Use the value of DI29 in the logic rule (high=true).
[37]	Digital input DI32	Use the value of DI32 in the logic rule (high=true).
[38]	Digital input DI33	Use the value of DI33 in the logic rule (high=true).
[39]	Start command	This event is true if the drive is started (either via digital input, fieldbus, or other).
[40]	Drive stopped	This event is true if the drive is stopped or coasted (either via digital input, fieldbus, or other).
[41]	Reset trip	This event is true if the drive is tripped (but not trip locked) and [Reset] is pressed.
[42]	Auto-reset trip	This event is true if the drive is tripped (but not trip locked) and an automatic reset is issued.
[43]	OK key	This event is true if [OK] is pressed.
[44]	Reset key	This event is true if [Reset] is pressed.
[45]	Left key	This event is true if [◀] is pressed.
[46]	Right key	The event is true if [▶] is pressed.
[47]	Up key	The event is true if [▲] is pressed.
[48]	Down key	The event is true if [▼] is pressed.
[50]	Comparator 4	Use the result of comparator 4 in the logic rule.
[51]	Comparator 5	Use the result of comparator 5 in the logic rule.
[60]	Logic rule 4	Use the result of logic rule 4 in the logic rule.
[61]	Logic rule 5	Use the result of logic rule 5 in the logic rule.
[70]	SL time-out 3	Smart logic controller time 3 is timed out.
[71]	SL time-out 4	Smart logic controller time 4 is timed out.
[72]	SL time-out 5	Smart logic controller time 5 is timed out.
[73]	SL time-out 6	Smart logic controller time 6 is timed out.
[74]	SL time-out 7	Smart logic controller time 7 is timed out.
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	

Option	Name	Description
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS flipflop 0	See parameter group 13-1* Comparators .
[95]	RS flipflop 1	See parameter group 13-1* Comparators .
[96]	RS flipflop 2	See parameter group 13-1* Comparators .
[97]	RS flipflop 3	See parameter group 13-1* Comparators .
[98]	RS flipflop 4	See parameter group 13-1* Comparators .
[99]	RS flipflop 5	See parameter group 13-1* Comparators .
[100]	RS flipflop 6	See parameter group 13-1* Comparators .
[101]	RS flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input x46/1	
[126]	Digital input x46/3	
[127]	Digital input x46/5	
[128]	Digital input x46/7	
[129]	Digital input x46/9	
[130]	Digital input x46/11	
[131]	Digital input x46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If the <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.

Option	Name	Description
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	Use the result of comparator 6 in the logic rule.
[229]	Comparator 7	Use the result of comparator 7 in the logic rule.
[230]	Comparator 8	Use the result of comparator 8 in the logic rule.
[231]	Comparator 9	Use the result of comparator 9 in the logic rule.
[232]	Logic rule 6	Use the result of logic rule 6 in the logic rule.
[233]	Logic rule 7	Use the result of logic rule 7 in the logic rule.
[234]	Logic rule 8	Use the result of logic rule 8 in the logic rule.
[235]	Logic rule 9	Use the result of logic rule 9 in the logic rule.
[236]	SL time-out 8	Smart logic controller time 8 is timed out.
[237]	SL time-out 9	Smart logic controller time 9 is timed out.
[238]	RS flipflop 8	See parameter group 13-1* Comparators .
[239]	RS flipflop 9	See parameter group 13-1* Comparators .
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

5.14.5 13-2* Timers

Use the result (true or false) from timers directly to define an event (see parameter **13-51 SL Controller Event**), or as boolean input in a logic rule (see parameter **13-40 Logic Rule Boolean 1**, parameter **13-42 Logic Rule Boolean 2**, or parameter **13-43 Logic Rule Boolean 3**). A timer is only false when started by an action, for example **[29] Start timer 1**, until the timer value entered in this parameter has elapsed. Then the timer becomes true again. All parameters in this parameter group are array parameters with index 0–2. Each index programs the equivalent timer, for example, index 0 programs timer 0.

13-20 SL Controller Timer

Default value:	Size related	Parameter type:	Array [10]
Setup:	1 setup	Conversion index:	-3
Data type:	Timediff w/o DatelD	Change during operation:	True

Enter the value to define the duration of the false output from the programmed timer. A timer is only false if it is started by an action (that is **[29] Start timer 1**) and until the given timer value has elapsed.

5.14.6 13-4* Logic Rules

Combine up to 3 boolean inputs (true/false inputs) from timers, comparators, digital inputs, status bits, and events using the logical operators AND, OR, and NOT. Select boolean inputs for the calculation in parameter **13-40 Logic Rule Boolean 1**, parameter **13-42 Logic Rule Boolean 2**, and parameter **13-44 Logic Rule Boolean 3**. Define the operators used to logically combine the selected inputs in parameter **13-41 Logic Rule Operator 1** and parameter **13-43 Logic Rule Operator 2**.

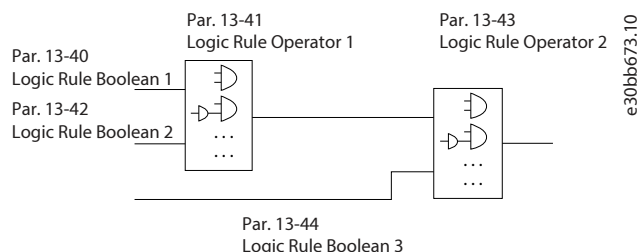


Figure 78: Logic Rules

Priority of calculation

The results of parameter **13-40 Logic Rule Boolean 1**, parameter **13-41 Logic Rule Operator 1**, and parameter **13-42 Logic Rule Boolean 2** are calculated first. The outcome (true/false) of this calculation is combined with the settings of parameter **13-43 Logic Rule Operator 2** and parameter **13-44 Logic Rule Boolean 3**, yielding the final result (true/false) of the logic rule.

13-40 Logic Rule Boolean 1

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	False	Select the 1st boolean (true or false) input for the selected logic rule. See parameter <i>13-01 Start Event</i> and parameter <i>13-02 Stop Event</i> for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	

Option	Name	Description
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.

Option	Name	Description
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* Comparators .
[95]	RS Flipflop 1	See parameter group 13-1* Comparators .
[96]	RS Flipflop 2	See parameter group 13-1* Comparators .
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	

Option	Name	Description
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-41 Logic Rule Operator 1

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the 1st logical operator to use on the boolean inputs from parameter **13-40 Logic Rule Boolean 1** and parameter **13-42 Logic Rule Boolean 2**. Parameter numbers in square brackets stand for the boolean inputs of parameters in parameter group **13-** Smart Logic Control**.

Option	Name	Description
[0]	DISABLED	Ignores - Parameter 13-42 Logic Rule Boolean 2. - Parameter 13-43 Logic Rule Operator 2. - Parameter 13-44 Logic Rule Boolean 3.
[1]	AND	Evaluates the expression [13-40] AND [13-42].
[2]	OR	Evaluates the expression [13-40] OR [13-42].
[3]	AND NOT	Evaluates the expression [13-40] AND NOT [13-42].
[4]	OR NOT	Evaluates the expression [13-40] OR NOT [13-42].
[5]	NOT AND	Evaluates the expression NOT [13-40] AND [13-42].
[6]	NOT OR	Evaluates the expression NOT [13-40] OR [13-42].
[7]	NOT AND NOT	Evaluates the expression NOT [13-40] AND NOT [13-42].
[8]	NOT OR NOT	Evaluates the expression NOT [13-40] OR NOT [13-42].

13-42 Logic Rule Boolean 2

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	False	Select the 2nd boolean (true or false) input for the selected logic rule. See parameter 13-01 Start Event and parameter 13-02 Stop Event for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	

Option	Name	Description
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.

Option	Name	Description
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* Comparators .
[95]	RS Flipflop 1	See parameter group 13-1* Comparators .
[96]	RS Flipflop 2	See parameter group 13-1* Comparators .
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	

Option	Name	Description
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	

Option	Name	Description
[244]	SL digital output E	
[245]	SL digital output F	

13-43 Logic Rule Operator 2

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the 2nd logical operator to be used on the boolean input calculated in:

- Parameter **13-40 Logic Rule Boolean 1**.
- Parameter **13-41 Logic Rule Operator 1**.
- Parameter **13-42 Logic Rule Boolean 2**.

[13-44] signifies the boolean input of parameter **13-44 Logic Rule Boolean 3**. [13-40/13-42] signifies the boolean input calculated in:

- Parameter **13-40 Logic Rule Boolean 1**.
- Parameter **13-41 Logic Rule Operator 1**.
- Parameter **13-42 Logic Rule Boolean 2**.

Option	Name	Description
[0]	DISABLED	
[1]	AND	
[2]	OR	
[3]	AND NOT	
[4]	OR NOT	
[5]	NOT AND	
[6]	NOT OR	
[7]	NOT AND NOT	
[8]	NOT OR NOT	

13-44 Logic Rule Boolean 3

Default value:	–	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	False	Select the 3rd boolean (true or false) input for the selected logic rule. See parameter 13-01 Start Event and parameter 13-02 Stop Event for more information.
[1]	True	
[2]	Running	
[3]	In range	

Option	Name	Description
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	

Option	Name	Description
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group <i>13-1* Comparators</i> .
[95]	RS Flipflop 1	See parameter group <i>13-1* Comparators</i> .
[96]	RS Flipflop 2	See parameter group <i>13-1* Comparators</i> .
[97]	RS Flipflop 3	See parameter group <i>13-1* Comparators</i> .
[98]	RS Flipflop 4	See parameter group <i>13-1* Comparators</i> .
[99]	RS Flipflop 5	See parameter group <i>13-1* Comparators</i> .
[100]	RS Flipflop 6	See parameter group <i>13-1* Comparators</i> .
[101]	RS Flipflop 7	See parameter group <i>13-1* Comparators</i> .

Option	Name	Description
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	

Option	Name	Description
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

5.14.7 13-5* States

13-51 SL Controller 1 Event

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See parameter 13-02 Stop Event for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	

Option	Name	Description
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	

Option	Name	Description
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* Comparators .
[95]	RS Flipflop 1	See parameter group 13-1* Comparators .
[96]	RS Flipflop 2	See parameter group 13-1* Comparators .
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	

Option	Name	Description
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 164 , ATEX ETR <i>cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 166 , ATEX ETR <i>freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 163 , ATEX ETR <i>cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If warning 165 , ATEX ETR <i>freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-52 SL Controller 1 Action

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in parameter **13-51 SL Controller 1 Event**) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see parameter 13-20 SL Controller Timer for further description.
[30]	Start timer 1	Start timer 1, see parameter 13-20 SL Controller Timer for further description.
[31]	Start timer 2	Start timer 2, see parameter 13-20 SL Controller Timer for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)

Option	Name	Description
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in parameter 4-55 Warning Reference High .
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see parameter 13-20 SL Controller Timer for further description.
[71]	Start timer 4	Starts timer 4, see parameter 13-20 SL Controller Timer for further description.
[72]	Start timer 5	Starts timer 5, see parameter 13-20 SL Controller Timer for further description.
[73]	Start timer 6	Starts timer 6, see parameter 13-20 SL Controller Timer for further description.
[74]	Start timer 7	Starts timer 7, see parameter 13-20 SL Controller Timer for further description.
[75]	Start timer 8	Starts timer 8, see parameter 13-20 SL Controller Timer for further description.
[76]	Start timer 9	Starts timer 9, see parameter 13-20 SL Controller Timer for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

13-53 SL Controller 2 Event

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See parameter 13-02 Stop Event for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	

Option	Name	Description
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* <i>Comparators</i> .
[95]	RS Flipflop 1	See parameter group 13-1* <i>Comparators</i> .
[96]	RS Flipflop 2	See parameter group 13-1* <i>Comparators</i> .

Option	Name	Description
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 164, ATEX ETR cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166, ATEX ETR freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163, ATEX ETR cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165, ATEX ETR freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	

Option	Name	Description
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-54 SL Controller 2 Action

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in parameter **13-53 SL Controller 2 Event**) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.

Option	Name	Description
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see parameter 13-20 SL Controller Timer for further description.
[30]	Start timer 1	Start timer 1, see parameter 13-20 SL Controller Timer for further description.
[31]	Start timer 2	Start timer 2, see parameter 13-20 SL Controller Timer for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in parameter 4-55 Warning Reference High .
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see parameter 13-20 SL Controller Timer for further description.

Option	Name	Description
[71]	Start timer 4	Starts timer 4, see parameter 13-20 SL Controller Timer for further description.
[72]	Start timer 5	Starts timer 5, see parameter 13-20 SL Controller Timer for further description.
[73]	Start timer 6	Starts timer 6, see parameter 13-20 SL Controller Timer for further description.
[74]	Start timer 7	Starts timer 7, see parameter 13-20 SL Controller Timer for further description.
[75]	Start timer 8	Starts timer 8, see parameter 13-20 SL Controller Timer for further description.
[76]	Start timer 9	Starts timer 9, see parameter 13-20 SL Controller Timer for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

13-55 SL Controller 3 Event

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See parameter 13-02 Stop Event for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	

Option	Name	Description
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.

Option	Name	Description
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* Comparators .
[95]	RS Flipflop 1	See parameter group 13-1* Comparators .
[96]	RS Flipflop 2	See parameter group 13-1* Comparators .
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.

Option	Name	Description
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 164, ATEX ETR <i>cur.lim.alarm</i> is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 166, ATEX ETR <i>freq.lim.alarm</i> is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 163, ATEX ETR <i>cur.lim.warning</i> is active, the output is 1.
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If warning 165, ATEX ETR <i>freq.lim.warning</i> is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-56 SL Controller 3 Action

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in parameter **13-55 SL Controller 3 Event**) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see parameter 13-20 SL Controller Timer for further description.
[30]	Start timer 1	Start timer 1, see parameter 13-20 SL Controller Timer for further description.
[31]	Start timer 2	Start timer 2, see parameter 13-20 SL Controller Timer for further description.

Option	Name	Description
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in parameter 4-55 Warning Reference High .
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see parameter 13-20 SL Controller Timer for further description.
[71]	Start timer 4	Starts timer 4, see parameter 13-20 SL Controller Timer for further description.
[72]	Start timer 5	Starts timer 5, see parameter 13-20 SL Controller Timer for further description.
[73]	Start timer 6	Starts timer 6, see parameter 13-20 SL Controller Timer for further description.
[74]	Start timer 7	Starts timer 7, see parameter 13-20 SL Controller Timer for further description.
[75]	Start timer 8	Starts timer 8, see parameter 13-20 SL Controller Timer for further description.
[76]	Start timer 9	Starts timer 9, see parameter 13-20 SL Controller Timer for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

13-57 SL Controller 4 Event

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	False	Select the boolean (true or false) input for the selected logic rule. See parameter 13-02 Stop Event for more information.
[1]	True	
[2]	Running	
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	

Option	Name	Description
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[39]	Start command	
[40]	Drive stopped	
[41]	Reset trip	
[42]	Auto-reset trip	
[43]	OK key	[OK] is pressed. Only available on the graphical LCP.
[44]	Reset key	[Reset] is pressed. Only available on the graphical LCP.
[45]	Left key	[◀] is pressed. Only available on the graphical LCP.
[46]	Right key	[▶] is pressed. Only available on the graphical LCP.
[47]	Up key	[▲] is pressed. Only available on the graphical LCP.
[48]	Down key	[▼] is pressed. Only available on the graphical LCP.
[50]	Comparator 4	Use the result of comparator 4.
[51]	Comparator 5	Use the result of comparator 5.
[60]	Logic rule 4	Use the result of logic rule 4.
[61]	Logic rule 5	Use the result of logic rule 5.
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[75]	Start command given	
[76]	Digital input X30/2	
[77]	Digital input X30/3	
[78]	Digital input X30/4	
[80]	No flow	
[81]	Dry pump	
[82]	End of curve	
[83]	Broken belt	
[90]	ECB drive mode	
[91]	ECB bypass mode	

Option	Name	Description
[92]	ECB test mode	
[93]	Emergency mode	
[94]	RS Flipflop 0	See parameter group 13-1* Comparators .
[95]	RS Flipflop 1	See parameter group 13-1* Comparators .
[96]	RS Flipflop 2	See parameter group 13-1* Comparators .
[97]	RS Flipflop 3	See parameter group 13-1* Comparators .
[98]	RS Flipflop 4	See parameter group 13-1* Comparators .
[99]	RS Flipflop 5	See parameter group 13-1* Comparators .
[100]	RS Flipflop 6	See parameter group 13-1* Comparators .
[101]	RS Flipflop 7	See parameter group 13-1* Comparators .
[102]	Verifying flow	
[103]	Relay 1	
[104]	Relay 2	
[105]	Relay 3	
[106]	Relay 4	
[107]	Relay 5	
[108]	Relay 6	
[109]	Relay 7	X34/VLT® Relay Card MCB 105.
[110]	Relay 8	X34/VLT® Relay Card MCB 105.
[111]	Relay 9	X34/VLT® Relay Card MCB 105.
[112]	System on ref	
[125]	Digital input X46/1	
[126]	Digital input X46/3	
[127]	Digital input X46/5	
[128]	Digital input X46/7	
[129]	Digital input X46/9	
[130]	Digital input X46/11	
[131]	Digital input X46/13	
[140]	ATEX ETR cur. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 164, ATEX ETR cur.lim.alarm is active, the output is 1.
[141]	ATEX ETR cur. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 166, ATEX ETR freq.lim.alarm is active, the output is 1.
[142]	ATEX ETR freq. warning	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If alarm 163, ATEX ETR cur.lim.warning is active, the output is 1.

Option	Name	Description
[143]	ATEX ETR freq. alarm	Available if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If warning 165, ATEX ETR freq.lim.warning is active, the output is 1.
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

13-58 SL Controller 4 Action

Default value:	–	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the action corresponding to the SLC event. Actions are executed when the corresponding event (defined in parameter **13-57 SL Controller 4 Event**) is evaluated as true. The following actions are available:

Option	Name	Description
[0]	Disabled	
[1]	No action	No action is taken if the SLC event is evaluated as true.
[2]	Select set-up 1	Changes the active setup to setup 1.
[3]	Select set-up 2	Changes the active setup to setup 2.
[4]	Select set-up 3	Changes the active setup to setup 3.
[5]	Select set-up 4	Changes the active setup to setup 4. If the setup is changed, it merges with other setup commands coming from either the digital inputs or via fieldbus.
[10]	Select preset ref 0	Select preset reference 0.

Option	Name	Description
[11]	Select preset ref 1	Select preset reference 1.
[12]	Select preset ref 2	Select preset reference 2.
[13]	Select preset ref 3	Select preset reference 3.
[14]	Select preset ref 4	Select preset reference 4.
[15]	Select preset ref 5	Select preset reference 5.
[16]	Select preset ref 6	Select preset reference 6.
[17]	Select preset ref 7	Select preset reference 7. If the active preset reference is changed, it merges with other preset reference commands coming from either digital inputs or via fieldbus.
[18]	Select ramp 1	The value is in %.
[19]	Select ramp 2	The value is in %.
[22]	Run	Issues a start command to the drive.
[23]	Run reverse	Issues a start reverse command to the drive.
[24]	Stop	Issues a stop command to the drive.
[26]	DC brake	Issues a DC stop command to the drive.
[27]	Coast	The drive coasts immediately. All stop commands including the coast command stop the SLC.
[28]	Freeze output	Freezes the output frequency of the drive.
[29]	Start timer 0	Start timer 0, see parameter 13-20 SL Controller Timer for further description.
[30]	Start timer 1	Start timer 1, see parameter 13-20 SL Controller Timer for further description.
[31]	Start timer 2	Start timer 2, see parameter 13-20 SL Controller Timer for further description.
[32]	Set digital out A low	Any output with digital output 1 selected is low (off)
[33]	Set digital out B low	Any output with digital output 2 selected is low (off)
[34]	Set digital out C low	Any output with digital output 3 selected is low (off)
[35]	Set digital out D low	Any output with digital output 4 selected is low (off)
[36]	Set digital out E low	Any output with digital output 5 selected is low (off)
[37]	Set digital out F low	Any output with digital output 6 selected is low (off)
[38]	Set digital out A high	Any output with digital output 1 selected is high (closed).
[39]	Set digital out B high	Any output with digital output 2 selected is high (closed).
[40]	Set digital out C high	Any output with digital output 3 selected is high (closed).
[41]	Set digital out D high	Any output with digital output 4 selected is high (closed).
[42]	Set digital out E high	Any output with digital output 5 selected is high (closed).
[43]	Set digital out F high	Any output with digital output 6 selected is high (closed).
[60]	Reset counter A	Resets counter A to 0.
[61]	Reset counter B	Resets counter B to 0.

Option	Name	Description
[62]	Counter A (up)	The motor runs at a reference which exceeds the value in parameter 4-55 Warning Reference High .
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	Starts timer 3, see parameter 13-20 SL Controller Timer for further description.
[71]	Start timer 4	Starts timer 4, see parameter 13-20 SL Controller Timer for further description.
[72]	Start timer 5	Starts timer 5, see parameter 13-20 SL Controller Timer for further description.
[73]	Start timer 6	Starts timer 6, see parameter 13-20 SL Controller Timer for further description.
[74]	Start timer 7	Starts timer 7, see parameter 13-20 SL Controller Timer for further description.
[75]	Start timer 8	Starts timer 8, see parameter 13-20 SL Controller Timer for further description.
[76]	Start timer 9	Starts timer 9, see parameter 13-20 SL Controller Timer for further description.
[80]	Sleep mode	Starts the sleep mode.
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

5.14.8 13-9* User-defined Alerts and Readouts

Parameters in this group allow the configuration of application-specific triggers for triggering the drive to perform a certain action, show the status on the LCP, and represent it accordingly in parameter **13-97 Alert Alarm Word**, parameter **13-98 Alert Warning Word**, and parameter **13-99 Alert Status Word**. In parameter **13-91 Alert Action**, it is possible to select drive functionalities such as *info only*, *stop*, *running to max*, and *force drive to trip*.

Use the following parameters to configure the drive to show a message and perform an action when a specific event occurs:

- Parameter **13-90 Alert Trigger** – the event that triggers the user-defined action and message.
- Parameter **13-91 Alert Action** – the action that the drive performs when the event defined in parameter **13-90 Alert Trigger** occurs.
- Parameter **13-92 Alert Text** – the text that the drive shows in the display when the event defined in parameter **13-90 Alert Trigger** occurs.

For example, consider the following use case: If there is an active signal on digital input 32, the drive shows the message *Valve 5 open* and ramps down to a stop. To achieve this configuration, make the following settings:

- Parameter **13-90 Alert Trigger** = **[37] Digital input DI32**.
- Parameter **13-91 Alert Action** = **[5] Stop & warning**.
- Parameter **13-92 Alert Text** = *Valve 5 open*.

Actions reflected in parameter 16-03 Status Word and alert parameters

When an action containing trip is selected and triggered, the drive trips, bit 3 in the basic status word is set, and the corresponding hex value is shown in parameter 13-97 Alert Alarm Word.

The alarm for *User Alert* is logged as alarm value = 124 in parameter 15-30 Fault Log: Error Code, index [0]–[9].

When an action containing warning info is selected and triggered, bit 7 in the basic status word is set, and the corresponding hex value is shown in parameter 13-98 Alert Warning Word.

Other actions selected are not indicated in the basic status word, but the corresponding hex value is shown in parameter 13-99 Alert Status Word.

Example of setting up digital inputs as triggers, actions, and readouts

Refer to the following table to understand the 3 examples in this section.

Table 41: Example of Setting up Triggers, Actions, and Readouts

ID	Name	Setup 1
1390.0	Alert Trigger	[34] Digital input DI19
1390.1	Alert Trigger	[37] Digital input DI32
1390.2	Alert Trigger	[0] False
1390.3	Alert Trigger	[0] False
1390.4	Alert Trigger	[0] False
1390.5	Alert Trigger	[0] False
1390.6	Alert Trigger	[0] False
1390.7	Alert Trigger	[0] False
1390.8	Alert Trigger	[38] Digital input DI33
1390.9	Alert Trigger	[0] False
1391.0	Alert Action	[0] Info
1391.1	Alert Action	[1] Warning
1391.2	Alert Action	[0] Info
1391.3	Alert Action	[0] Info
1391.4	Alert Action	[0] Info
1391.5	Alert Action	[0] Info
1391.6	Alert Action	[0] Info
1391.7	Alert Action	[0] Info
1391.8	Alert Action	[12] Trip
1391.9	Alert Action	[0] Info
1392.0	Alert Text	Dig In 19
1392.1	Alert Text	Dig In 32
1392.2	Alert Text	User Alert
1392.3	Alert Text	User Alert
1392.4	Alert Text	User Alert
1392.5	Alert Text	User Alert

Table 41: Example of Setting up Triggers, Actions, and Readouts - (continued)

ID	Name	Setup 1
1392.6	Alert Text	User Alert
1392.7	Alert Text	User Alert
1392.8	Alert Text	Dig In 33
1392.9	Alert Text	User Alert

Example 1: In parameter **13-90 Alert Trigger**, index [0], DI19 is selected as trigger. The digital value is 0000 0001. The corresponding action, Info, is set in parameter **13-91 Alert Action**, index [0] and is shown as 1 hex in parameter **13-99 Alert Status Word**.

Example 2: In parameter **13-90 Alert Trigger**, index [1], DI32 is selected as trigger. The digital value is 0000 0010. The corresponding action, Warning, is set in parameter **13-91 Alert Action**, index [1] and is shown as 2 hex in parameter **13-98 Alert Warning Word**.

Example 3: In parameter **13-90 Alert Trigger**, index [8], DI33 is selected as trigger. The digital value is 0001 0000 0000. The corresponding action, Trip, is set in parameter **13-91 Alert Action**, index [8] and is shown as 100 hex in parameter **13-97 Alert Alarm Word**.

When 1 of the 3 digital inputs shown in this example is activated, the text shown in the LCP is the one defined in parameter **13-92 Alert Text**, index [0], [1], and [8].



NOTE: The action setting of an active trigger cannot be changed. For example, if DI19 is selected as trigger and the input is high, the action cannot be changed from *Stop* to *Jog*.

13-90 Alert Trigger

Default value:	[0] False	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the event that triggers the user-defined action and message.

Option	Name	Description
[0]*	False	
[1]	True	
[18]	Reversing	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	

Option	Name	Description
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[94]	RS flipflop 0	
[95]	RS flipflop 1	
[96]	RS flipflop 2	
[97]	RS flipflop 3	
[98]	RS flipflop 4	
[99]	RS flipflop 5	
[100]	RS flipflop 6	
[101]	RS flipflop 7	
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	

13-91 Alert Action

Default value:	[0] Info	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: For safety reasons, this parameter cannot be changed when there is an active alarm.

Select the action that the drive performs when the event defined in parameter **13-90 Alert Trigger** occurs.

Option	Name	Description
[0]*	Info	
[1]	Warning	
[2]	Freeze output	
[3]	Freeze output & warn	
[4]	Stop	
[5]	Stop & warning	
[6]	Jogging	
[7]	Jogging & warning	
[8]	Max speed	
[9]	Max speed & warn	
[10]	Stop and trip	
[11]	Stop and trip w manual reset	
[12]	Trip	
[13]	Trip w manual reset	
[14]	Trip lock	

13-92 Alert Text

Default value:	Size related	Parameter type:	Array [10]
Setup:	2 setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	True

Enter the text that the drive shows in the display when the event defined in parameter **13-90 Alert Trigger** occurs.

13-97 Alert Alarm Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	False

Shows the alarm word of a user-defined alarm in hex code.

13-98 Alert Warning Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the warning word of a user-defined alarm in hex code.

13-99 Alert Status Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the status word of a user-defined alarm in hex code.

5.15 Parameter Group 14-** Special Functions

5.15.1 14-0* Inverter Switching

14-00 Switching Pattern

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the switching pattern: 60° AVM or SFAVM.



NOTE: The drive may adjust the switching pattern automatically to avoid a trip.

Option	Name	Description
[0]	60 AVM	
[1]	SFAVM	

14-01 Switching Frequency

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the drive switching frequency. Changing the switching frequency reduces acoustic noise from the motor. Default values depend on power size.



NOTE: The output frequency value of the drive must never exceed 10% of the switching frequency. When the motor is running, adjust the switching frequency in parameter **14-01 Switching Frequency** to minimize motor noise.



NOTE: To avoid a trip, the drive can adjust the switching frequency automatically.

Option	Name	Description
[0]	1.0 kHz	
[1]	1.5 kHz	
[2]	2.0 kHz	
[3]	2.5 kHz	
[4]	3.0 kHz	
[5]	3.5 kHz	
[6]	4.0 kHz	
[7]	5.0 kHz	
[8]	6.0 kHz	
[9]	7.0 kHz	
[10]	8.0 kHz	
[11]	10.0 kHz	
[12]	12.0 kHz	
[13]	14.0 kHz	
[14]	16.0 kHz	

14-02 Switching Pattern Shift Frequency

Default value:	Size related	Parameter type:	Range, 15 - 590 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Set the frequency where the switching pattern shifts between SFAVM and 60° AVM. Set a value to keep high-speed motors in SFAVM mode during ramp-up and during low-speed operation. The value to set is motor-dependent. The pattern shift frequency can be set when parameter **14-00 Switching Pattern** is set to **[0] 60 AVM**.

14-03 Overmodulation

Default value:	[1] On	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: Overmodulation leads to increased torque ripple as the harmonics increase.

Option	Name	Description
[0]	Off	Select [0] Off for no overmodulation of the output voltage to avoid torque ripple on the motor shaft. This feature may be useful for applications such as grinding machines.
[1]*	On	Select [1] On to enable the overmodulation function for the output voltage. This is the right option when it is required that the output voltage is higher than 95% of the input voltage (typically when running over-synchronously). The output voltage is increased according to the degree of overmodulation. Control in flux control principle provides an output current of up to 98% of the input current, regardless of parameter 14-03 Overmodulation .
[2]	User defined	Modulation index refers to the relation between motor voltage and DC-link voltage. High overmodulation increases the motor voltage and optimizes the motor torque and efficiency by reducing the motor current. A high modulation index increases the risk of torque ripple on the motor shaft. In applications where the torque ripple occur, it can be beneficial to disable the overmodulation. It is possible to configure the setup in the range defined in parameter 40-55 Modulation Index .
[3]	Limit output voltage	

14-04 Acoustic Noise Reduction

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True
Option	Name	Description	
[0]*	Off	No change of the acoustic motor switching noise.	
[1]	On	Select to reduce the acoustic noise from the motor.	

14-05 PWM Generation

Default value:	[0] Standard	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter in VVC+ and U/f mode only. When running with low ratio between switch frequency and output frequency (especially close to or <10:1), it is possible to improve the resolution of the PWM modulation and optimize the output voltage.

Option	Name	Description
[0]*	Standard	Use this setting for standard motors.
[1]	Double update	Updates the PWM pattern twice per switch period. Select this option to achieve a more optimal sinus-wave and a slight increase of the output voltage.

5.15.2 14-1* Mains On/Off

These parameters are for configuring mains failure monitoring and handling.

14-10 Mains Failure

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

When parameter **1-00 Configuration Mode** is set to **[2] Torque**, the following options are inactive:

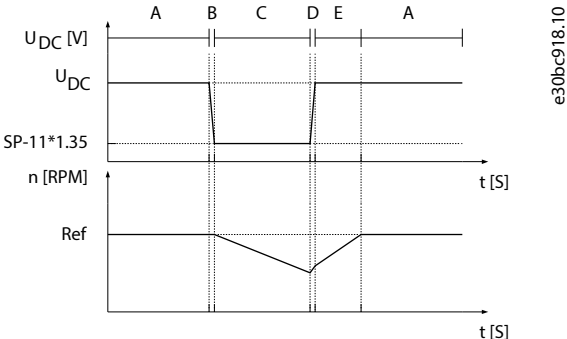
- **[1] Ctrl. ramp-down**
- **[5] Kinetic back-up, trip**
- **[7] Kin. back-up, trip w recovery**



NOTE: This parameter cannot be changed while the motor is running.

Parameter **14-10 Mains Failure** is typically used where short mains interruptions (voltage dips) are present. At 100% load and a short voltage interruption, the DC voltage on the main capacitors drops quickly. For larger drives, it only takes a few milliseconds before the DC level drops to about 373 V DC, and the IGBTs cut off and lose the control of the motor. When mains is restored, and the IGBTs start again, the output frequency and voltage vector do not correspond to the speed/frequency of the motor, and the result is normally an overvoltage or overcurrent, mostly resulting in a trip lock. Parameter **14-10 Mains Failure** can be programmed to avoid this situation. Select the function according to which the drive must act when the threshold in parameter **14-11 Mains Fault Voltage Level** is reached.

Option	Name	Description
[0]*	No function	The drive does not compensate for a mains interruption. The voltage on the DC link drops quickly and motor control is lost within milliseconds to seconds. This situation results in a trip lock.
[1]	Ctrl. ramp-down	Control of the motor remains with the drive, and the drive performs a controlled ramp down from parameter 14-11 Mains Fault Voltage Level . If parameter 2-10 Brake Function is [0] Off or [2] AC brake , the ramp follows the overvoltage ramping. If parameter 2-10 Brake Function is [1] Resistor Brake , the ramp follows the setting in parameter 3-81 Quick Stop Ramp Time . This selection is useful in pump applications, where the inertia is low and the friction is high. When mains is restored, the output frequency ramps the motor up to the reference speed. If the mains interruption is prolonged, the controlled ramp down may bring the output frequency down to 0 RPM, and when the mains is restored, the application is ramped up from 0 RPM to the previous reference speed via the normal ramp-up. If the energy in the DC link disappears before the motor is ramped to 0, the motor is coasted. Limitation: See the introduction text in this parameter.
[3]	Coasting	The inverter turns off and the capacitor bank backs up the control card. Backing up the control card ensures a faster restart when mains is reconnected (at short power curves).
[4]	Kinetic back-up	Kinetic back-up ensures that the drive keeps running as long as there is energy in the system due to the inertia from motor and load. This is done by converting the mechanical energy to the DC link and maintaining control of the drive and motor. This can extend the controlled operation, depending on the inertia in the system. For fans, it is typically several seconds; for pumps up to 2 s; and for compressors only a fraction of a second. Many industry

Option	Name	Description						
		applications can extend controlled operation for many seconds, which is often enough time for the mains to return.  Figure 79: Kinetic Back-up <table><tr><td>A Normal operation</td><td>B Mains failure</td></tr><tr><td>C Kinetic backup</td><td>D Mains return</td></tr><tr><td>E Normal operation: Ramping</td><td></td></tr></table>	A Normal operation	B Mains failure	C Kinetic backup	D Mains return	E Normal operation: Ramping	
A Normal operation	B Mains failure							
C Kinetic backup	D Mains return							
E Normal operation: Ramping								
		The DC level during [4] <i>Kinetic backup</i> equals parameter 14-11 Mains Fault Voltage Level x 1.35. If the mains does not return, U_{DC} is maintained as long as possible by ramping the speed down towards 0 RPM. Finally, the drive coasts. If the mains returns while in kinetic back-up mode, U_{DC} increases above parameter 14-11 Mains Fault Voltage Level x 1.35. This is detected in 1 of the following ways: • If $U_{DC} > \text{parameter } 14-11 \text{ Mains Fault Voltage Level} \times 1.35 \times 1.05$. • If the speed is above the reference. This is relevant if the mains comes back at a lower level than before, for example parameter 14-11 Mains Fault Voltage Level x 1.35 x 1.02. This does not fulfill the criterion in point 1, and the drive tries to reduce U_{DC} to parameter 14-11 Mains Fault Voltage Level x 1.35 by increasing the speed. This cannot be done as the mains cannot be lowered. • If running mechanically. The same mechanism as in point 2 applies, but the inertia prevents the speed from going above the reference speed. This leads to the motor running mechanically until the speed is above the reference speed and the situation in point 2 occurs. Instead of waiting for that criterion, point 3 is introduced.						
[5]	Kinetic back-up, trip	The difference between kinetic back-up with and without trip is that the latter always ramps down to 0 RPM and trips, regardless of whether mains returns or not. The function does not detect if mains returns. This is the reason for the relatively high level on the DC link during ramp-down.						

Option	Name	Description

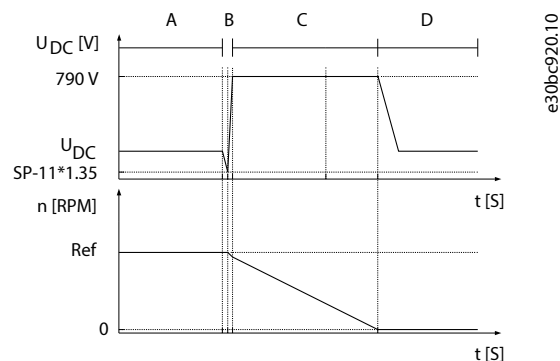


Figure 80: Kinetic Back-up Trip

A	Normal operation	B	Mains failure
C	Kinetic backup	D	Trip

[6]	Alarm
[7]	Kin. back-up, trip w recovery

This option is valid in VVC+ only. Kinetic back-up with recovery combines the features of kinetic back-up and kinetic back-up with trip. This feature makes it possible to select between kinetic back-up and kinetic back-up with trip, based on a recovery speed, configurable in parameter **14-15 Kin. Back-up Trip Recovery Level**. If mains does not return, the drive ramps down to 0 RPM and trips. If mains returns while in kinetic back-up at a speed above the value in parameter **14-15 Kin. Back-up Trip Recovery Level**, normal operation is resumed. This is equal to **[4] Kinetic Back-up**. The DC level during **[7] Kin. back-up, trip w recovery** is parameter **14-11 Mains Fault Voltage Level** x 1.35.

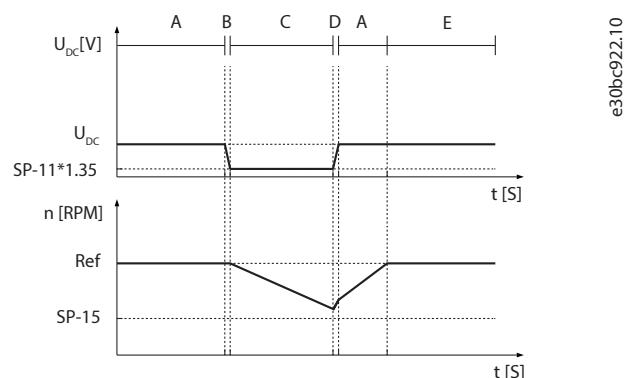


Figure 81: Kinetic Back-up Trip w/Recovery, Mains Returns Above Parameter 14-15 Kin. Back-up Trip Recovery Level

A	Normal operation	B	Mains Failure
C	Kinetic backup	D	Mains return
E	Normal operation: Ramping		

If mains returns while in kinetic back-up at a speed below parameter **14-15 Kin. Back-up Trip Recovery Level**, the drive ramps down to 0 RPM using the ramp and then trips. If the ramp is

Option	Name	Description

slower than the system ramping down on its own, the ramping is done mechanically and U_{DC} is at the normal level ($U_{DC,m} \times 1.35$).

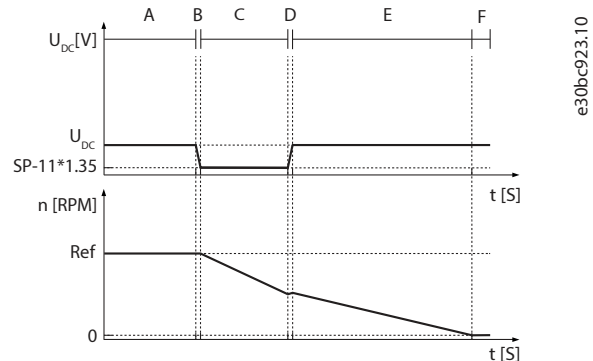


Figure 82: Kinetic Back-up Trip w/Recovery, Slow Ramp, Mains Returns Below Parameter 14-15 Kin. Back-up Trip Recovery Level

A Normal operation	B Mains failure
C Kinetic backup	D Mains return
E Kinetic backup, ramping to trip	F Trip

If the ramp is quicker than the ramp-down speed of the application, the ramping generates current. This results in a higher U_{DC} , which is limited using the brake chopper/resistor brake.

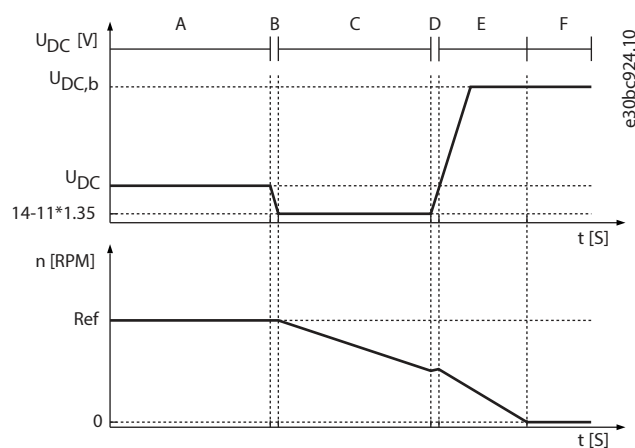


Figure 83: Kinetic Back-up Trip w/Recovery, Quick Ramp, Mains Returns Below Parameter 14-15 Kin. Back-up Trip Recovery Level

A Normal operation	B Mains failure
C Kinetic backup	D Mains return
E Kinetic backup ramping to trip	F Trip

NOTICE

For best performance of controlled ramp down and kinetic backup, set **parameter 1-03 Torque Characteristics** to **[0] Compressor** or **[1] Variable torque** (no automatic energy optimization should be active).

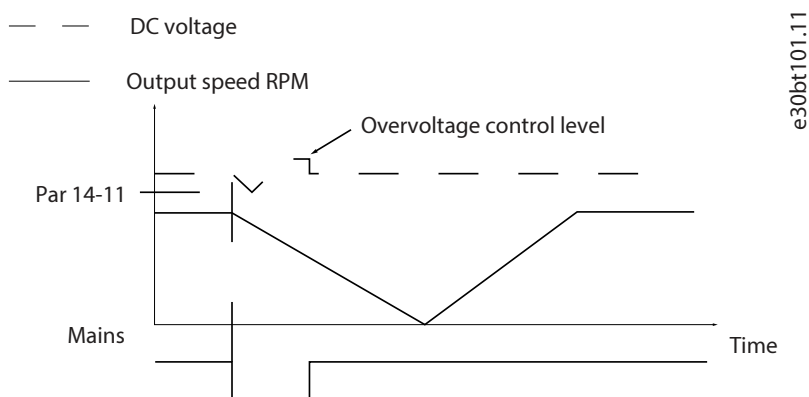


Figure 84: Controlled Ramp Down, Short Mains Failure

[Figure 84](#) shows ramping down to a stop followed by ramping up to the reference.

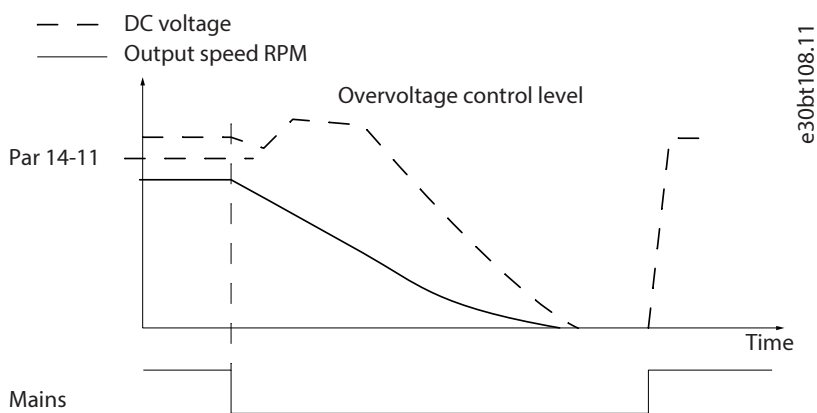


Figure 85: Controlled Ramp Down, Longer Mains Failure

[Figure 85](#) shows ramping down as long as the energy in the system allows it, then the motor coasts.

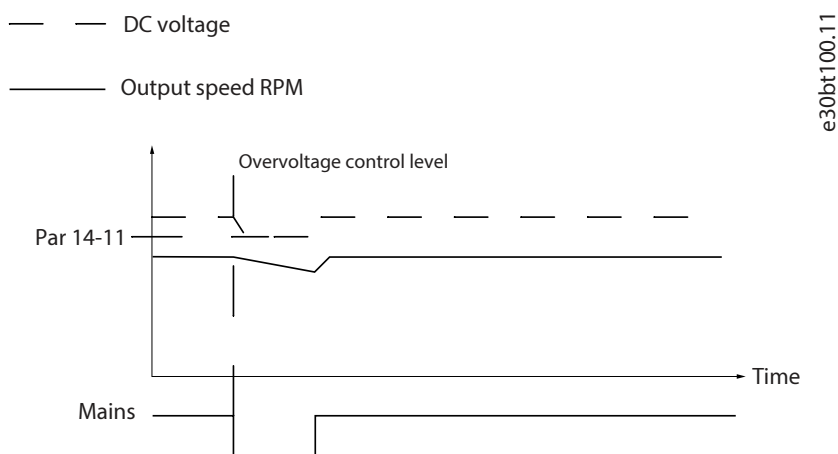


Figure 86: Kinetic Backup, Short Mains Failure

[Figure 86](#) shows riding through as long as the energy in the system allows it.

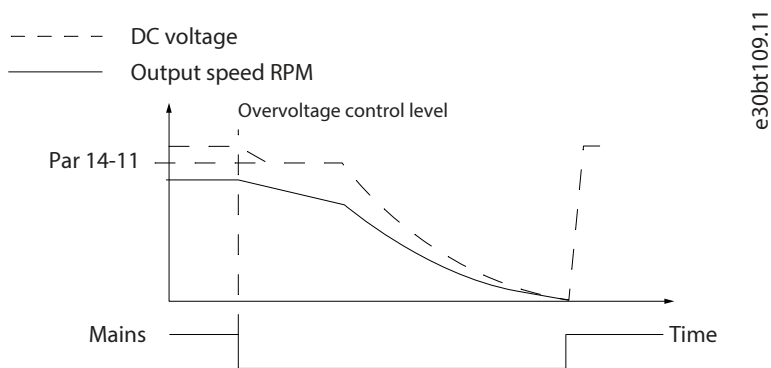


Figure 87: Kinetic Backup, Longer Mains Failure

Figure 87 shows the motor coasting when the energy in the system is too low.

14-11 Mains Fault Voltage Level

Default type:	Size related	Parameter type:	Range, 140 - 600 V
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter defines the threshold voltage at which the function in parameter **14-10 Mains Failure** is activated. Select the detection level depending on the supply quality. For a supply of 380 V, set parameter **14-11 Mains Fault Voltage Level** to 342 V. This results in a DC detection level of 462 V (parameter **14-11 Mains Fault Voltage Level** x 1.35).

14-12 Response to Mains Imbalance

Default value:	[3] Derate	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Make sure that the setting in parameter **0-03 Regional Setting** matches the actual grid.

Operation under severe mains imbalance conditions reduces the lifetime of the motor. Conditions are considered severe if the motor is operated continuously near nominal load (for example, a pump or a fan running near full speed). Select the level of operation when mains imbalance conditions occur. Options **[5] Fast trip lock** to **[7] Fast warning** are based on a principle which ensures detection of a missing mains phase within 2 s and responds according to the selection. See parameter **14-17 Fast Mains Phase Loss** and parameter **14-18 Fast Mains Phase Loss Min Power**. A minimum load on the drive of 2% nominal power is required for detection of missing mains phase.

Option	Name	Description
[0]	Trip Lock	A trip lock is triggered upon a mains phase imbalance.
[1]	Warning	A warning is issued upon a mains phase imbalance.
[2]	Disabled	Mains failure detection is disabled.
[3]*	Derate	The drive derates upon a mains phase imbalance.
[4]	Trip	The drive trips.
[5]	Fast Trip Lock	A trip lock occurs when a mains input phase is missing.

Option	Name	Description
[6]	Fast Trip	The drive trips when a mains input phase is missing.
[7]	Fast Warning	A warning occurs when a mains input phase is missing.

14-14 Kin. Back-up Time-up

Default value:	60 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

This parameter defines the kinetic backup timeout in flux mode when running on low voltage grids. If the supply voltage does not exceed the value defined in parameter **14-11 Mains Fault Voltage Level** +5% within the specified time, the drive automatically runs a controlled ramp-down profile before stop.

14-15 Kin. Back-up Trip Recovery Level

Default value:	Size related	Parameter type:	Range, 0 - 60000.000 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Uint32	Change during operation:	True

This parameter specifies the kinetic backup trip recovery level. The unit is defined in parameter **0-02 Motor Speed Unit**.

14-16 Kin. Back-up Gain

Default value:	100%	Parameter type:	Range, 0 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Enter the kinetic backup gain value in percent.

14-17 Fast Mains Phase Loss Level

Default value:	100%	Parameter type:	Range, 0 - 500%
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the level at which the functions Fast Mains Phase Loss Trip or Fast Mains Phase Loss Warning (see parameter **14-12 Response to Mains Imbalance**) should be activated.



NOTE: A lower level than the default might cause false alarms as it increases sensitivity.

14-18 Fast Mains Phase Loss Min Power

Default value:	2%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the minimum power level (% of nominal power) at which the functions Fast Mains Phase Loss Trip or Fast Mains Phase Loss Warning (see parameter **14-12 Response to Mains Imbalance**) should be activated.



NOTE: A minimum power level of 2% is a prerequisite for the Fast Mains Phase Loss function to work.

5.15.3 14-2* Trip Reset

Parameters for configuring auto reset handling, special trip handling, and control card self-test or initialization.

14-20 Reset Mode

Default value:	[10] Automatic reset x 10	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the reset function after tripping. Once reset, the drive can be restarted.



NOTE: The motor may start without warning. If the specified number of automatic resets is reached within 10 minutes, the drive enters **[0] Manual reset** mode. After the manual reset is performed, the setting of parameter **14-20 Reset Mode** returns to the original selection. If the number of automatic resets are not reached within 10 minutes, or when a manual reset is performed, the internal automatic reset counter returns to 0.

Option	Name	Description
[0]	Manual reset	Select [0] Manual reset to perform a reset via [Reset] or via the digital inputs.
[1]	Automatic reset x 1	Select [1] - [12] Automatic reset x 1... x20 to perform 1–20 automatic resets after tripping.
[2]	Automatic reset x 2	
[3]	Automatic reset x 3	
[4]	Automatic reset x 4	
[5]	Automatic reset x 5	
[6]	Automatic reset x 6	
[7]	Automatic reset x 7	
[8]	Automatic reset x 8	
[9]	Automatic reset x 9	
[10]*	Automatic reset x 10	
[11]	Automatic reset x 15	
[12]	Automatic reset x 20	
[13]	Infinite auto reset	Select this option for continuous resetting after tripping.

14-21 Automatic Restart Time

Default value:	10 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the time interval from trip to start of the automatic reset function. This parameter is active when parameter **14-20 Reset Mode** is set to **[1]–[13] Automatic reset**.

14-22 Operation Mode

Default value:	[0] Normal operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to specify normal operation, to perform tests, or to initialize all parameters except parameter **15-03 Power Up's**, parameter **15-04 Over Temp's**, and parameter **15-05 Over Volt's**. This function is active only when the power is cycled to the drive. Select **[0] Normal operation** for normal operation of the drive with the motor in the selected application. Select **[1] Control card test** to test the analog and digital inputs and outputs and the +10 V control voltage. The test requires a test connector with internal connections. Use the following procedure for the control card test:

- Select **[1] Control card test**.
- Disconnect the mains supply and wait for the indicator light in the display to go out.
- Set switches S201 (A53) and S202 (A54) to ON/I.
- Insert the test plug.
- Connect to mains supply.
- Carry out various tests.
- The results are shown on the LCP and the drive moved into an infinite loop.
- Parameter **14-22 Operation Mode** is automatically set to normal operation. Carry out a power cycle to start up in normal operation after a control card test.

If the test is OK

LCP readout: Control card OK.

Disconnect the mains supply and remove the test plug. The green indicator light on the control card lights up.

If the test fails

LCP readout: Control card I/O failure.

Replace the drive or control card. The red indicator light on the control card is turned on. Test plugs (connect the following terminals to each other): 18 - 27 - 32; 19 - 29 - 33; 42 - 53 - 54.

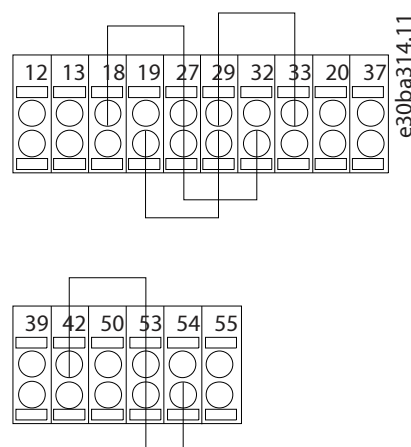


Figure 88: Test Plugs

Select **[2] Initialisation** to reset all parameter values to default settings, except for: Parameter **15-03 Power Up's**, parameter **15-04 Over Temp's**, and parameter **15-05 Over Volt's**. The drive resets during the next power-up. Parameter **14-22 Operation Mode** also returns to the default setting **[0] Normal operation**.

Option	Name	Description
[0]*	Normal operation	Normal operation of the drive with the motor in the selected application.
[1]	Control card test	Remember to set switches S201 (A53) and S202 (A54) as specified in the parameter description when performing a control card test. Otherwise, the test fails.
[2]	Initialisation	Select this option to perform initialization. The drive resets during the next power-up. This option does not clear the service logs.
[3]	Boot mode	
[5]	Clear service logs	 NOTE: Save the log information using VLT® Motion Control Tool MCT 10 before clearing the service logs. Select this option and perform a power cycle to clear the log.
[6]	Clear param. log	

14-24 Trip Delay at Current Limit

Default value:	60 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Enter the current limit trip delay in s. When the output current reaches the current limit (parameter **4-18 Current Limit**), a warning is triggered. When the current limit warning has been continuously present for the period specified in this parameter, the drive trips. To run continuously in current limit without tripping, set the parameter to 60 s. Thermal monitoring of the drive remains active.

14-25 Trip Delay at Torque Limit

Default value:	60 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Enter the torque limit trip delay in s. When the output torque reaches the torque limits (parameter **4-16 Torque Limit Motor Mode** and parameter **4-17 Torque Limit Generator Mode**), a warning is triggered. When the torque limit warning has been continuously present for the period specified in this parameter, the drive trips. Disable the trip delay by setting the parameter to 60 s. Thermal monitoring of the drive remains active.

14-26 Trip Delay at Inverter Fault

Default value:	Size related	Parameter type:	Range, 0 - 35 s
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

When the drive detects an overvoltage in the set time, a trip is effected after the set time. If the value is 0, protection mode is disabled.

5.15.4 14-3* Current Limit Control

The drive features an integral current limit controller, which is activated when the motor current, and thus the torque, is higher than the torque limits set in parameter **4-16 Torque Limit Motor Mode** and parameter **4-17 Torque Limit Generator Mode**. When the current limit is reached during motor operation or regenerative operation, the drive tries to reduce torque below the preset torque limits as quickly as possible without losing control of the motor. While the current control is active, the drive can only be stopped by setting a digital input to **[2] Coast inverse** or **[3] Coast and reset inv.** Any signals on terminals 18–33 are not active until the drive is no longer near the current limit. By using a digital input set to **[2] Coast inverse** or **[3] Coast and reset inv.**, the motor does not use the ramp-down time, since the drive is coasted. If a quick stop is necessary, use the mechanical brake control function along with an external electro-mechanical brake attached to the application.

14-30 Current Lim Ctrl, Proportional Gain

Default value:	100%	Parameter type:	Range, 5 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Enter the proportional gain value for the current limit controller. Selection of a high value makes the controller react faster. Too high a value leads to controller instability.

14-31 Current Lim Ctrl, Integration Time

Default value:	Size related	Parameter type:	Range, 0.002 - 2 s
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	False

Controls the current limit control integration time. Selection of a low value makes it react faster. Too low a value leads to controller instability.

14-32 Current Lim Ctrl, Filter Time

Default value:	Size related	Parameter type:	Range, 1 - 100 ms
Setup:	All setups	Conversion index:	-4
Data type:	Uint16	Change during operation:	False

Controls the current limit control low-pass filter. This makes it possible to react to peak values or to average values. When selecting average values, it is sometimes possible to run with higher output current and instead trip on the hardware limit for current. However, the control reacts slower as it does not react on immediate values.

14-35 Stall Protection

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter is active in flux mode only.

Option	Name	Description
[0]	Disabled	Disables stall protection in field weakening flux mode and may cause loss of motor control.
[1]*	Enabled	Enables stall protection in field weakening flux mode.

5.15.5 14-4* Energy Optimizing

Parameters for adjusting the energy optimization level in both variable torque (VT) and automatic energy optimization (AEO) mode.

Automatic energy optimization is only active if parameter **1-03 Torque Characteristics** is set to either **[2] Auto energy optim. CT** or **[3] Auto energy optim. VT**.

14-40 VT Level

Default value:	66%	Parameter type:	Range, 40 - 90%
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False

NOTE: This parameter cannot be adjusted while the motor is running.

NOTE: This parameter is not active when parameter **1-10 Motor Construction** is set to **[1] PM non-salient SPM**.

Enter the level of motor magnetization at low speed. Selection of a low value reduces energy loss in the motor but also reduces load capability.

14-41 AEO Minimum Magnetization

Default value:	Size related	Parameter type:	Range, 30 - 200%
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

NOTE: This parameter is not active when parameter **1-10 Motor Construction** is set to **[1] PM non-salient SPM**.

Enter the minimum allowable magnetization for AEO. Selection of a low value reduces energy loss in the motor but can also reduce resistance to sudden load changes.

14-42 Minimum AEO Frequency

Default value:	Size related	Parameter type:	Range, 0 - 255 Hz
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

NOTE: This parameter is not active when parameter **1-10 Motor Construction** is set to **[1] PM non-salient SPM**.

Enter the minimum frequency at which the automatic energy optimization (AEO) is to be active.

14-43 Motor Cosphi

Default value:	Size related	Parameter type:	Range, 0.40 - 0.95
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The Cos(phi) setpoint is automatically set for optimum AEO performance. This parameter should normally not be altered. However, in some situations it may be necessary to enter a new value to fine-tune.

14-44 d-axis Reference Gain

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Adjustment parameter for the d-axis current. 100% indicates maximum torque per ampere value based on the motor parameters. Increasing the maximum torque can improve the power factor of the machine, which may increase the current consumption. The adjustment parameter allows to:

- Adjust minimum current consumption, allowing for tolerances in the motor parameters.
- Obtain the optimal balance between current consumption and power factor of the machine at a given point of operation.

5.15.6 14-5* Environment



NOTE: Perform a power-cycle after changing any of the parameters in parameter group **14-5* Environment**.

These parameters support the drive when operating under special environmental conditions.

14-50 RFI Filter

Default value:	[1] On	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Turn the RFI filter on or off. The RFI filter ensures that the drive complies with EMC standards. Select **[0] Off** only when the drive is connected to an isolated mains source (IT mains).

Option	Name	Description
[0]	Off	
[1]*	On	

14-51 DC-link Compensation

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The rectified AC-DC voltage in the DC link of the drive is associated with voltage ripples. Voltage ripples can increase in magnitude with increased load and are undesirable because they can generate current and torque ripples. A compensation method is used to reduce these voltage ripples in the DC link. In general, DC-link compensation is recommended for most applications, but pay attention when operating in field weakening as it can generate speed oscillations at the motor shaft. In field weakening, turn off DC-link compensation.

Option	Name	Description
[0]	Off	Disables DC-link compensation.
[1]	On	Enables DC-link compensation.
[2]	Advanced	Improved compensation of DC-link ripple caused by mains frequency and phase imbalance.


NOTE: Parameter *0-03 Regional Setting* must be set correctly according to the actual mains grid.

14-52 Fan Control

Default value:	[0] Auto	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the minimum speed of the main fan.

Option	Name	Description
[0]*	Auto	Select [0] Auto to run fan only when internal temperature in the drive is in the range from 35 °C (95 °F) to approximately 55 °C (131 °F). The fan runs at low speed below 35 °C (95 °F), and at full speed at approximately 55 °C (131 °F).
[1]	On 50%	The fan always runs at 50% speed or above. The fan runs at 50% speed at 35 °C (95 °F), and at full speed at approximately 55 °C (131 °F).
[2]	On 75%	The fan always runs at 75% speed or above. The fan runs at 75% speed at 35 °C (95 °F), and at full speed at approximately 55 °C (131 °F).
[3]	On 100%	The fan always runs at 100% speed.
[4]	Auto (Low temp env.)	This option is the same as [0] Auto , but with special considerations around and below 0 °C (32 °F). In option [0] Auto there is a risk that the fan starts running around 0 °C as the drive detects a sensor fault and thus protects the drive while reporting <i>warning 66, Heat sink Temperature Low</i> . Option [4] Auto (Low temp env.) can be used in very cold environments and prevents the negative effects of this further cooling and avoids <i>warning 66, Heat sink Temperature Low</i> .

14-53 Fan Monitor

Default value:	[1] Warning	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the drive action if a fan fault is detected.

Option	Name	Description
[0]	Disabled	
[1]*	Warning	
[2]	Trip	

14-55 Output Filter

Default value:	[0] No filter	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

CAUTION

OVERHEATING OF FILTER OR AC DRIVE

Incorrect setting of parameter **14-55 Output Filter** can lead to overheating and cause equipment damage and personal injury.

- Always set parameter **14-55 Output Filter** to **[2] Sine-wave fixed** when using a sine-wave filter.



NOTE: This parameter cannot be adjusted while the motor is running.



NOTE: Reset the drive after selecting **[2] Sine-wave filter fixed**.

Select the type of output filter connected.

Option	Name	Description
[0]*	No filter	Set the parameter when VLT® MCC 102 dU/dt filters or VLT® MCC 105 high-frequency common-mode filters are connected to the drive.
[1]	Sine-wave filter	Use the setting for backward compatibility purposes. Set parameter 14-56 Capacitance Output Filter and parameter 14-57 Inductance Output Filter . Setting the parameter does not limit the range of the switching frequency.

Option	Name	Description
[2]	Sine-Wave Filter Fixed	NOTICE SINE-WAVE FILTER FIXED SETTING Ensures that the filter is operated within the safe range of switching frequencies. Use the setting only for VLT® MCC 101 Sine-wave Filters. When setting the option for VLT® MCC 101 Sine-wave filters, the parameter sets a minimum allowed limit to the switching frequency and ensures the filter is operated within the safe range of switching frequencies. The option supports all control principle operations of the filter. Set parameter 14-56 Capacitance Output Filter and parameter 14-57 Inductance Output Filter. Setting the option allows the modulation pattern to be set to stator flux asynchronous vector modulation (SFAVM), which reduces the acoustic switching noise from the filter.
[5]	All-mode Filter	NOTICE ALL-MODE FILTERING Enables all-mode filter operating condition and ensures that the filter is operated within the safe range of switching frequencies. Use this setting only for VLT® MCC 201 All-Mode Filters. When setting the option for VLT® MCC 201 All-mode Filter, the parameter enables all-mode filter operating conditions, which include settings for a minimum allowed limit to the switching frequency and ensure the filter is operated within the safe range of switching frequencies. The option supports all control principle operations of the filter. Set parameter 14-56 Capacitance Output Filter and parameter 14-57 Inductance Output Filter. Setting the option allows the modulation pattern to be set to stator flux asynchronous vector modulation (SFAVM), which reduces the acoustic switching noise from the filter.

14-56 Capacitance Output Filter

Default value:	Size related	Parameter type:	Range, 0.1 - 6500 uF
Setup:	All setups	Conversion index:	-7
Data type:	Uint16	Change during operation:	False

Set the C_y (capacitance) value of the output filter in uF, when using VLT® MCC 101 Sine-wave filter and VLT® MCC 201 All-mode filter. See the filter product label for the capacitance value. The value is the equivalent star-connected capacitance of the filter. When the filters are installed in parallel, enter the combined capacitance value of the paralleled filter. The value is the equivalent star-connected capacitance (C_y) of the filter multiplied by the number of installed paralleled filters.

NOTICE

SETTING FOR VLT® MCC 101 SINE-WAVE FILTER AND VLT® MCC 201 ALL-MODE FILTER

Enables accurate flux compensation when option [2] *Flux sensorless* or option [3] *Flux w/motor feedback* is selected in parameter *1-01 Motor Control Principle*.

- Enter the correct capacitance value of the connected filter.

14-57 Inductance Output Filter

Default value:	Size related	Parameter type:	Range, 0.001 - 65 mH
Setup:	All setups	Conversion index:	-6
Data type:	Uint16	Change during operation:	False

Set the inductance of the output filter in mH, when using VLT® MCC 101 Sine-wave Filter and VLT® MCC 201 All-mode Filter. See the product label of the filter for the value of inductance. When filters are installed in parallel, enter the combined inductance value of the installed paralleled filters. The inductance value in the parameter is the inductance value of the filter divided by the number of paralleled filters.

NOTICE

SETTING FOR VLT® MCC 201 ALL-MODE AND VLT® MCC 101 SINE-WAVE FILTERS

Enables accurate flux control compensation when option [2] *Flux Sensorless* or option [3] *Flux w/Motor Feedback* is selected in parameter *1-01 Motor Control Principle*.

- Enter the correct inductance value of the connected filter.

14-59 Actual Number of Inverter Units

Default value:	Size related	Parameter type:	Range, 1 - 1
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	False

Set the actual number of power units.

5.15.7 14-6* Auto Derate

This parameter group contains parameters for derating the drive if there is a high temperature.

No trip at inverter overload

In some systems, the drive has not been sized properly to yield the current needed in all points of the operational flow-head characteristic. At these points, the motor needs a current higher than the rated current of the drive. The drive can yield 110% of the rated current continuously for 60 s. If still overloaded, the drive normally trips (causing the motor to stop by coasting) and issues an alarm.

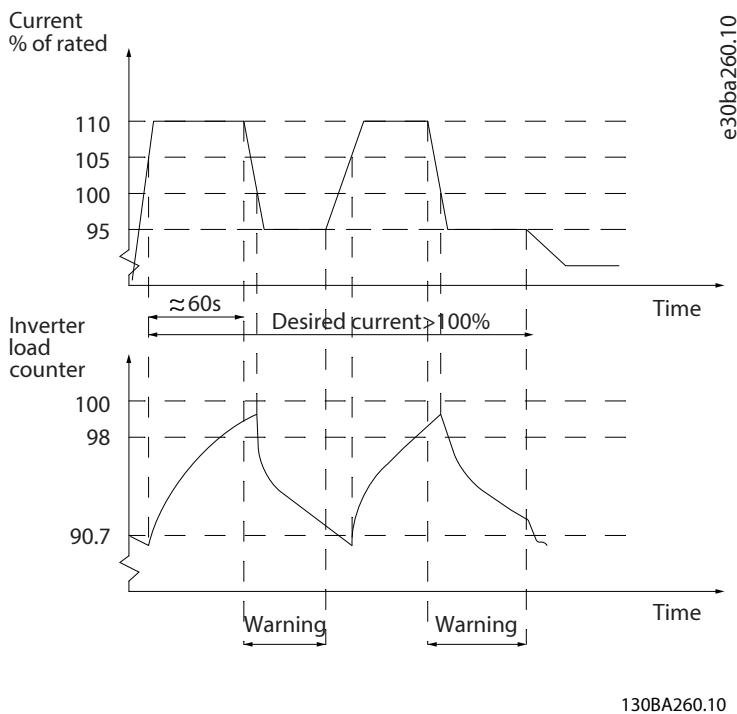


Figure 89: Output Current in Overload Condition

If the motor is unable to run continuously with the demanded capacity, run it at reduced speed for a while.

Select parameter **14-61 Function at Inverter Overload** to automatically reduce motor speed until the output current is below 100% of the rated current (set in parameter **14-62 Inv. Overload Derate Current**). Parameter **14-61 Function at Inverter Overload** is an alternative to letting the drive trip.

The drive estimates the load on the power section with an inverter load counter, which causes a warning at 98% and a reset of the warning at 90%. At the value 100%, the drive trips and issues an alarm. Status for the counter can be read in parameter **16-35 Inverter Thermal**.

If parameter **14-61 Function at Inverter Overload** is set to **[3] Derate**, the motor speed is reduced when the counter exceeds 98%, and stays reduced until the counter has dropped below 90.7%. If parameter **14-62 Inv. Overload Derate Current** is set to for example 95%, a steady overload causes the pump speed to fluctuate between values corresponding to 110% and 95% of rated output current for the drive.

14-60 Function at Over Temperature

Default value:	[1] Derate	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

If either heat sink or control card temperature exceeds a factory-programmed temperature limit, a warning is activated. If the temperature increases further, select whether the drive should trip (trip lock) or derate the output current.

Option	Name	Description
[0]	Trip	The drive trips (trip lock) and generates an alarm. Cycle power to reset the alarm. The motor restarts when the heat sink temperature has dropped below the alarm limit.
[1]*	Derate	If the critical temperature is exceeded, the output current is reduced until the allowable temperature has been reached.

14-61 Function at Inverter Overload

Default value:	[1] Derate	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter if there is a steady overload beyond the thermal limits (110% for 60 s).

Option	Name	Description
[0]	Trip	Select [0] Trip to make the drive trip and issue an alarm.
[1]*	Derate	Reduces the motor speed to decrease the load on the power section and allowing it to cool down.

14-62 Inv. Overload Derate Current

Default value:	95%	Parameter type:	Range, 50 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the current level (in % of rated output current for the drive) when running with reduced motor speed after load on the drive has exceeded the allowable limit (110% for 60 s).

5.15.8 14-8* Options

14-80 Option Supplied by External 24VDC

Default value:	[0] No	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: To make the parameter change function, perform a power cycle.

Option	Name	Description
[0]*	No	Select this option to use the 24 V DC supply of the drive.
[1]	Yes	Select this option if a 24 V DC external supply is used to power the option. Inputs/outputs are galvanically isolated from the drive when operated from an external supply.

14-88 Option Data Storage

Default value:	0	Parameter type:	Array [24]
Setup:	2 setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter stores information about options over a power cycle.

5.15.9 14-9* Fault Settings

14-90 Fault Level

Default value:	–	Parameter type:	Array [29]
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This is an array parameter with 26 elements. Each of the bits can be configured to any of the following options. Use this parameter to customize fault levels.

Option	Name	Description
[0]	Off	Use [0] Off with caution as it ignores all warnings and alarms for the selected source.
[1]	Warning	
[2]	Trip	Changing a fault level from default option [3] Trip Lock to [2] Trip leads to the automatic reset of the alarm. For alarms involving overcurrent, the drive has a hardware protection that issues a 3-minute recovery after 2 consecutive overcurrent incidents. This hardware protection cannot be overruled.
[3]	Trip lock	
[4]	Trip w. delayed reset	This option adds a delay between automatic resets, otherwise it is the same as option [2] Trip . The delay prevents a situation where reset is attempted repeatedly for an overcurrent situation. Hardware protection of the drive forces the 3-minute recovery time after 2 consecutive overcurrents (within a short time window).

Table 42: Possible Actions when Selected Alarms Appear

Failure	Parameter	Alarm	Off	Warning	Trip	Trip lock	Trip with delayed reset
10 V low	1490.0	1	X ⁽¹⁾	D ⁽²⁾	–	–	–
24 V low	1490.1	47	X	–	–	D	–
1.8 V low	1490.2	48	X	–	–	D	–
Voltage limit	1490.3	64	X	D	–	–	–
Ground fault	1490.4 ⁽³⁾	14	–	–	D	X	–
Ground fault 2	1490.5 ⁽³⁾	45	–	–	D	X	–
Torque limit	1490.6	12	X	D	–	–	–
Overcurrent	1490.7	13	–	–	–	D	X
Short circuit	1490.8	16	–	–	X	D	–
Heat sink temp.	1490.9	29	–	–	X	D	–
Heat sink sensor	1490.10	39	–	–	X	D	–
Control card temp.	1490.11	65	–	–	X	D	–

Table 42: Possible Actions when Selected Alarms Appear - (continued)

Failure	Parameter	Alarm	Off	Warning	Trip	Trip lock	Trip with delayed reset
Power card temp.	1490.12	69	–	–	X	D	–
Heat sink temp.	1490.13 ⁽⁴⁾	244	–	–	X	D	–
Heat sink sensor	1490.14 ⁽⁴⁾	245	–	–	X	D	–
Power card temp.	1490.15 ⁽⁴⁾	247	–	–	X	D	–
Derag limit fault	1490.16 ^{(3), (5)}	100	–	–	D	X	–

1) X = Possible selection

2) D = Default value

3) Only these faults are configurable on the FC 202. Due to a software limitation with array parameters, all other faults are shown in the VLT® Motion Control Tool MCT 10. For the other parameter indices, writing any other value than its current value (the default value) returns a value-out-of-range error. Thus, it is not allowed to change the fault level for the non-configurable ones.

4) Alarm 244, Heat sink temp., alarm 245, Heat sink sensor, and alarm 247 Power card temp. are used for multiple power cards.

5) This parameter has been 1490.6 in all firmware versions up to 1.86.

5.16 Parameter Group 15-** Drive Information

5.16.1 15-0* Operating Data

15-00 Operating Hours

Default value:	0 h	Parameter type:	Readout
Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	False

View for how many hours the drive has run. The value is saved when the drive is turned off.

15-01 Running Hours

Default value:	0 h	Parameter type:	Readout
Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	False

View how many hours the motor has run. Reset the counter in parameter **15-07 Reset Running Hours Counter**. The value is saved when the drive is turned off.

15-02 kWh Counter

Default value:	0 kWh	Parameter type:	Readout
Setup:	All setups	Conversion index:	75
Data type:	Uint32	Change during operation:	False

Register the power consumption of the motor as an average value over 1 hour. Reset the counter in parameter **15-06 Reset kWh Counter**.

15-03 Power Up's

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

View the number of times the drive has been powered up.

15-04 Over Temp's

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

View the number of drive temperature faults.

15-05 Over Volt's

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

View the number of drive overvoltage events.

15-06 Reset kWh Counter

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Do not reset	No reset of the kWh counter is required.
[1]	Reset counter	Press [OK] to reset the kWh counter to 0 (see parameter 15-02 kWh Counter). The reset date is stored in parameter 15-28 kWh Counter Reset Time .

15-07 Reset Running Hours Counter

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Do not reset	No reset of the running hours and the number of starts counter is required.
[1]	Reset counter	To reset the running hours and the number of starts counter to 0, select [1] Reset and press [OK] (see parameter 15-01 Running Hours and parameter 15-08 Number of starts). The reset date is stored in parameter 15-29 Running Hour Reset Time .

15-08 Number of Starts

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

View the number of times the motor has been started. The counter can be reset in parameter **15-07 Reset Running Hours Counter**. The value is saved when the drive is turned off.

5.16.2 15-1* Data Log Settings

The data log enables continuous logging of up to 4 data sources (parameter **15-10 Logging Source**) at individual rates (parameter **15-11 Logging Interval**). A trigger event (parameter **15-12 Trigger Event**) and window (parameter **15-14 Samples Before Trigger**) are used to start and stop the logging conditionally.

15-10 Logging Source

Default value:	[0] None	Parameter type:	Option, Array [4]
Setup:	2 setups	Conversion index:	–
Data type:	Uint16	Change during operation:	True

Select the variables to be logged.

Option	Name	Description
[0]*	None	
[15]	Readout: Actual setup	
[17]	Active emergency mode setup	
[1397]	Alert alarm word	
[1398]	Alert warning word	
[1399]	Alert status word	
[1600]	Control word	
[1601]	Reference [Unit]	
[1602]	Reference [%]	
[1603]	Status word	
[1610]	Power [kW]	
[1611]	Power [hp]	
[1612]	Motor voltage	
[1613]	Frequency	
[1614]	Motor current	
[1616]	Torque [Nm]	
[1617]	Speed [RPM]	
[1618]	Motor thermal	
[1620]	Motor angle	
[1622]	Torque [%]	
[1624]	Calibrated Stator Resistance	

Option	Name	Description
[1626]	Power filtered [kW]	
[1627]	Power filtered [hp]	
[1630]	DC link voltage	
[1632]	Brake energy /s	
[1633]	Brake energy average	
[1634]	Heatsink temp.	
[1635]	Inverter thermal	
[1644]	Speed Error [RPM]	
[1645]	Motor phase U current	
[1646]	Motor phase V current	
[1647]	Motor phase W current	
[1648]	Speed ref. after ramp [RPM]	
[1650]	External reference	
[1652]	Feedback [Unit]	
[1654]	Feedback 1 [Unit]	
[1655]	Feedback 2 [Unit]	
[1656]	Feedback 3 [Unit]	
[1659]	Adjusted setpoint	
[1660]	Digital input	
[1662]	Analog input 53	
[1664]	Analog input 54	
[1665]	Analog output 42 [mA]	
[1666]	Digital output [bin]	
[1675]	Analog in X30/11	
[1676]	Analog in X30/12	
[1677]	Analog out X30/8 [mA]	
[1687]	Bus readout alarm/warning	
[1689]	Configurable alarm/warning word	
[1690]	Alarm word	
[1691]	Alarm word 2	
[1692]	Warning word	
[1693]	Warning word 2	
[1694]	Ext. status word	
[1695]	Ext. status word 2	
[1697]	Alarm word 3	
[1698]	Warning word 3	
[1699]	Ext. status word 3	

Option	Name	Description
[1830]	Analog input X42/1	
[1831]	Analog input X42/3	
[1832]	Analog input X42/5	
[1833]	Analog out X42/7 [V]	
[1834]	Analog out X42/9 [V]	
[1835]	Analog out X42/11 [V]	
[1840]	Analog input X49/1	
[1841]	Analog input X49/3	
[1842]	Analog input X49/5	
[1843]	Analog out X49/7	
[1844]	Analog out X49/9	
[1845]	Analog out X49/11	
[1846]	X49 digital output [bin]	
[1850]	Sensorless readout [unit]	
[1860]	Digital input 2	
[1866]	Actual switching frequency	
[1867]	Alarm word 4	
[1868]	Warning word 4	
[2791]	Cascade reference	
[3110]	Bypass status word	

15-11 Logging Interval

Default value:	Size related	Parameter type:	Range, 0 - 0, Array [4]
Setup:	2 setups	Conversion index:	-3
Data type:	Time diff wo DateID[4]	Change during operation:	True

Enter the interval in ms between each sampling of the variables to be logged.

15-12 Trigger Event

Default value:	[0] False	Parameter type:	Option
Setup:	1 setup	Conversion index:	-
Data type:	UInt8	Change during operation:	True

Select the trigger event. When the trigger event occurs, a window is applied to freeze the log. The log then retains a specified percentage of samples before the occurrence of the trigger event (parameter *15-14 Samples Before Trigger*).

Option	Name	Description
[0]*	False	
[1]	True	
[2]	Running	

Option	Name	Description
[3]	In range	
[4]	On reference	
[5]	Torque limit	
[6]	Current limit	
[7]	Out of current range	
[8]	Below I low	
[9]	Above I high	
[10]	Out of speed range	
[11]	Below speed low	
[12]	Above speed high	
[13]	Out of feedb. range	
[14]	Below feedb. low	
[15]	Above feedb. high	
[16]	Thermal warning	
[17]	Mains out of range	
[18]	Reversing	
[19]	Warning	
[20]	Alarm (trip)	
[21]	Alarm (trip lock)	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	

15-13 Logging Mode

Default value:	[0] Log always	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Log always	Select [0] Log always for continuous logging.
[1]	Log once on trigger	Select [1] Log once on trigger to start and stop logging conditionally using parameter 15-12 Trigger Event and parameter 15-14 Samples Before Trigger .

15-14 Samples Before Trigger

Default value:	50	Parameter type:	Range, 0 - 100
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Before a trigger event, enter the percentage of all samples which should be retained in the log. See also parameter **15-12 Trigger Event** and parameter **15-13 Logging Mode**.

15-15 Info Message: "Service Log Full"

Default value:	[0] Disabled	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

See Service log. By enabling this parameter, a text message is shown in the drive when the service log runs full: *Clear logs, Service log full: 28 [M26]*. The message recommends to clear the log.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	Enable message.

15-17 Service Log Trigger Alarm

Default value:	0	Parameter type:	Range, 0=Off - 9999
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True

Enter alarm number that triggers the Service Log write to flash. By default Service Log will log motor specific data during motor related alarms. Using Displayline parameters **0-20 Display Line 1.1 Small**, **0-21 Display Line 1.2 Small**, and **0-22 Display Line 1.3 small** with current parameter, the Service Log can be configured for custom data logging events.

15-18 Service Log Trigger SLC

Default value:	[0] False	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The service log can be used for troubleshooting. The SLC operands trigger the service log when an event occurs. The maximum numbers of service logs is 24. To clear the service logs, use parameter **14-22 Operation Mode** followed by a power cycle.

Option	Name	Description
[0]*	False	
[18]	Reversing	
[19]	Warning	
[22]	Comparator 0	
[23]	Comparator 1	
[24]	Comparator 2	
[25]	Comparator 3	
[26]	Logic rule 0	
[27]	Logic rule 1	
[28]	Logic rule 2	
[29]	Logic rule 3	
[30]	SL time-out 0	
[31]	SL time-out 1	
[32]	SL time-out 2	
[33]	Digital input DI18	
[34]	Digital input DI19	
[35]	Digital input DI27	
[36]	Digital input DI29	
[37]	Digital input DI32	
[38]	Digital input DI33	
[50]	Comparator 4	
[51]	Comparator 5	
[60]	Logic rule 4	
[61]	Logic rule 5	
[70]	SL time-out 3	
[71]	SL time-out 4	
[72]	SL time-out 5	
[73]	SL time-out 6	
[74]	SL time-out 7	
[90]	ECB drive mode	
[91]	ECB bypass mode	
[94]	RS flipflop 0	
[95]	RS flipflop 1	
[96]	RS flipflop 2	
[97]	RS flipflop 3	

Option	Name	Description
[98]	RS flipflop 4	
[99]	RS flipflop 5	
[100]	RS flipflop 6	
[101]	RS flipflop 7	
[228]	Comparator 6	
[229]	Comparator 7	
[230]	Comparator 8	
[231]	Comparator 9	
[232]	Logic rule 6	
[233]	Logic rule 7	
[234]	Logic rule 8	
[235]	Logic rule 9	
[236]	SL time-out 8	
[237]	SL time-out 9	
[238]	RS flipflop 8	
[239]	RS flipflop 9	
[240]	SL digital output A	
[241]	SL digital output B	
[242]	SL digital output C	
[243]	SL digital output D	
[244]	SL digital output E	
[245]	SL digital output F	

5.16.3 Service Log

The service log function saves detailed log information of a 5-second interval when alarms occur. Service technicians can analyze this information to troubleshoot and optimize the drive.

The drive can save up to 24 service log records in the flash memory. To receive a warning when the service log is full, set parameter **15-15 Info Message: "Service Log Full"** to **[1] Enable**. To read the current number of records in the memory, check parameter **16-42 Service Log Counter**.

Sampling rate

There are 2 periods with different sampling rates:

- Slow samples: 20 samples at a rate of 250 ms resulting in 5 s of history before the trip.
- Fast samples: 50 samples at a rate of 5 ms resulting in 250 ms of detailed history before the trip.



NOTE: To enable the real-time clock (RTC) stamp, use the real-time clock module. If real-time clock is not available, the operating time in parameter **15-32 Fault Log: Time** is recorded.

Table 43: Logged Channels

Polling	Color	Name
CH 1	Light gray	Frequency
CH 2	Dark gray	Speed [RPM]
CH 3	Red	Reference [%]
CH 4	Orange	DC-link voltage
CH 5	Yellow	Motor current
CH 6	Khaki	Motor voltage
CH 7	Light green	Control word
CH 8	Light blue	Status word
CH 9	Dark blue	[20] Operating hours
CH 10	Purple	[21] Running hours
CH 11	Magenta	[22] kWh counter

Channels 1–8 are fixed channels with unfiltered signals and cannot be changed. Channels 9–11 are filtered and refer to parameters **0–20** to **0–22**, which are reflected in the 3 upper lines in the LCP.

5.16.4 Clearing the Service Log

The flash memory stores up to 24 records. To save new logs, clear the service log memory.

Save the service log records using the VLT® Motion Control Tool MCT 10 before clearing the service log.

The service log is stored in EEPROM in the control card and will be erased by initialization, that is when changing the power card. Before changing the power card:

1. Click the Service Log icon to read the service log from the drive.
2. Copy parameters to a project in MCT 10.
3. Save the parameters including the service log in the project.
 - a. When loading the parameters back into the drive, the service log is not included.
4. Clear the service log after a commissioning to remove any alarms that occurred during testing.

Procedure

1. Select option **[5] Clear Service Log** in parameter **14-22 Operation Mode**.
2. Power cycle the drive. Clearing the service log extends the power-up time by approximately 1 s.

5.16.5 Service Log Indication

Parameter **16-42 Service Log Counter** shows the number of service logs stored in the memory.

The drive indicates a full service log memory in 1 of the following ways:

- The LCP shows the message: *Clear logs Service log full: 28 [M26]*.
- Bit 25 is set high in parameter **16-96 Maintenance Word** (0x2000000).

Performing the drive initialization does not clear the service log memory.

5.16.6 Reading the Service Log Information

See the VLT® Motion Control Tool MCT 10 to read the service log information.

Procedure

1. Open the MCT 10 software.
2. Select a drive.
3. Select the Service Log plug-in.
4. Click *Read from drive*.

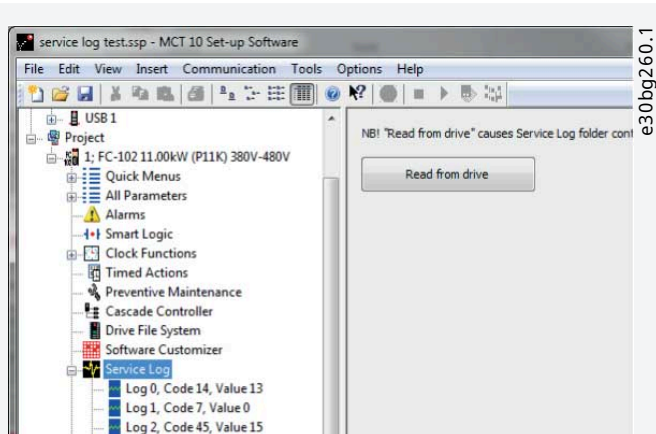


Figure 90: MCT 10, Read From Drive

The service log view in MCT 10 looks as shown in [Figure 91](#). Use the cursor to view the detailed readings at a specific time.

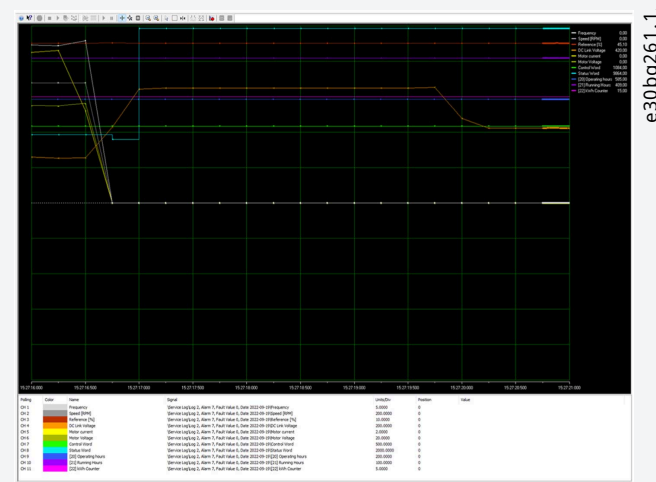


Figure 91: Service Log View, 5 s

Use the zoom function to focus on the last 250 ms before the fault.

5.16.7 Alarms that Trigger a Service Log Record

Table 44: Alarms Triggering a Service Log Record

#	Alarm title
4	Mains phase loss
5	DC voltage high
6	DC voltage low

Table 44: Alarms Triggering a Service Log Record - (continued)

#	Alarm title
7	DC overvoltage
8	DC undervoltage
9	Inverter overld.
10	Motor ETR over
12	Torque limit
13	Over current
14	Earth (ground) fault
16	Short circuit
18	Start failed
25	Brake resistor
26	Brake overload
27	Brake IGBT
28	Brake check
30	U phase loss
31	V phase loss
32	W phase loss
36	Mains failure
37	Phase imbalance
44	Earth (ground) fault AL44
45	Earth (ground) fault 2
59	Current



NOTE: If an alarm has 2 states (warning/alarm), it only triggers a service log record when going into the alarm state.

5.16.8 15-2* Historic Log

View up to 50 logged data items via the array parameters in this parameter group. Data is logged every time an event occurs (not to be confused with SLC events). Events in this context are defined as a change in 1 of the following areas:

- Digital inputs
- Digital outputs
- Warning word
- Alarm word
- Status word
- Control word
- Extended status word

Events are logged with value and time stamp in ms. The time interval between 2 events depends on how often events occur (maximum once every scan time). Data logging is continuous, but if an alarm occurs, the log is saved and the values can be viewed on the display. This feature is useful, for example when carrying out service following a trip. View the historic log contained in this parameter via the serial communication port or via the display.

15-20 Historic Log: Event

Default value:	0	Parameter type:	Readout, Array [50]
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False

View the event type of the logged events.

Index	Description
[0]*	No event
[1]	Digital input
[2]	Digital output
[3]	Warning word
[4]	Alarm word
[5]	Status word
[6]	Control word
[7]	Extended status word
[8]	Warning word 2
[9]	Alarm word 2
[10]	Extended status word 2
[11]	Warning word 3
[12]	Alarm word 3
[13]	Extended status word 3
[14]	Alarm word 4
[15]	Warning word 4

15-21 Historic Log: Value

Default value:	0	Parameter type:	Readout, Array [50]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	False

View the value of the logged event. Interpret the event values as below:

Digital input	Decimal value. See parameter 16-60 Digital Input for a description after converting to binary value.
Digital output (not monitored in this SW release)	Decimal value. See parameter 16-66 Digital Output [bin] for a description after converting to binary value.
Warning word	Decimal value. See parameter 16-92 Warning Word for a description.

Alarm word	Decimal value. See parameter 16-90 Alarm Word for a description.
Status word	Decimal value. See parameter 16-03 Status Word for a description after converting to binary value.
Control word	Decimal value. See parameter 16-00 Control Word for a description.
Extended status word	Decimal value. See parameter 16-94 Ext. Status Word for a description.

15-22 Historic log: Time

Default value:	0 ms	Parameter type:	Readout, Array [50]
Setup:	All setups	Conversion index:	-3
Data type:	UInt32	Change during operation:	False

View the time at which the logged event occurred. Time is measured in ms since drive start. This is an array parameter containing event times 0-49.

15-23 Historic Log: Date and Time

Default value:	Size related	Parameter type:	Readout, Array [50]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

Array parameter; Date & Time 0 – 49. This parameter shows which time the logged event occurred.

5.16.9 15-2* Operating Data Log

15-28 kWh Counter Reset Time

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

View the date and time for the last kWh counter reset.

15-29 Running Hour Reset Time

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

View the date and time for the last running hour counter reset.

5.16.10 15-3* Alarm Log

Parameters in this group are array parameters where up to 10 fault logs can be viewed. 0 is the most recently logged data and 9 is the oldest. Fault codes, values, and time stamps can be viewed for all logged data.

15-30 Alarm Log: Error Code

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0

Data type:	UInt16	Change during operation:	False

View the error code and look up its meaning in [6.1.2 Alarm/Warning Code List](#) in the chapter *Troubleshooting*.

15-31 Alarm Log: Value

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	False

View an extra description of the error. This parameter is mostly used with *alarm 38, internal fault*.

15-32 Alarm Log: Time

Default value:	0 s	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	False

View the time when the logged event occurred. Time is measured in seconds from the start-up of the drive.

15-33 Alarm Log: Date and Time

Default value:	Size related	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

Array parameter; Date & Time [0]–[9]: This parameter shows when the logged event occurred.

15-34 Alarm Log: Setpoint

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

This parameter shows the status of the alarm:

- 0 = Alarm inactive
- 1 = Alarm active

15-35 Alarm Log: Feedback

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

This parameter shows at which time the logged event occurred. Time is measured in seconds from the start-up of the drive.

15-36 Alarm Log: Current Demand

Default value:	0%	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False

View an extra description of an error. This parameter is mostly used in combination with *alarm 38, Internal Fault*.

15-37 Alarm Log: Current Demand

Default value:	[0]	Parameter type:	Option, Array [10]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

Option	Name	Description
[0]*		
[1]	%	
[5]	PPM	
[10]	l/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm HG	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	

Option	Name	Description
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	HP	

15-38 Alarm Log: Speed

Default value:	0 RPM	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	67
Data type:	Int32	Change during operation:	False

View the actual motor speed value when the logged event occurred.

5.16.11 15-4* Drive Identification

Parameters containing read-only information about the hardware and software configuration in the drive.

15-40 FC Type

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[6]	Change during operation:	False

View the drive type. The readout is identical to the drive power field of the type code definition, characters 1–6.

15-41 Power Section

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	VisStr[20]	Change during operation:	False

View the power section. The readout is identical to the drive power field of the type code definition, characters 7–10.

15-42 Voltage

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the voltage. The readout is identical to the drive power field of the type code definition, characters 11-12.

15-43 Software Version

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[5]	Change during operation:	False

View the combined SW version (or package version) consisting of power SW and control SW.

15-44 Ordered Typecode String

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[40]	Change during operation:	False

View the type code string used for reordering the drive in its original configuration.

15-45 Actual Typecode String

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[40]	Change during operation:	False

View the actual type code string.

15-46 Frequency Converter Ordering No

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[8]	Change during operation:	False

View the 8-digit code number used for reordering the drive in its original configuration. To restore the order number after the power card exchange, see parameter **14-29 Service Code**.

15-47 Power Card Ordering No

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[8]	Change during operation:	False

View the power card code number.

15-48 LCP ID No

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the LCP ID number.

15-49 SW ID Control Card

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the control card software version number.

15-50 SW ID Power Card

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the power card software version number.

15-51 Frequency Converter Serial Number

Default value:	0	Parameter type:	Range, 0 - 10
Setup:	All setups	Conversion index:	0
Data type:	VisStr[10]	Change during operation:	False

View the drive serial number.

15-53 Power Card Serial Number

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[19]	Change during operation:	False

View the power card serial number.

15-54 Config File Name

Default value:	Size related	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[16]	Change during operation:	False

Shows the special configuration file names.

15-58 Smart Setup Filename

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	VisStr[16]	Change during operation:	True

Shows the Smart Setup file name.

15-59 Filename

Default:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[16]	Change during operation:	False

Shows the currently used customer-specific initial values (CSIV) file name.

5.16.12 15-6* Option Ident.

This read-only parameter group contains information about the hardware and software configuration of the options installed in slots A, B, C0, and C1.

15-60 Option Mounted

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[30]	Change during operation:	False

View the type of installed option.

15-61 Option SW Version

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the installed option software version.

15-62 Option Ordering No

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[8]	Change during operation:	False

View the code number for the installed options.

15-63 Option Serial No

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[18]	Change during operation:	False

View the installed option serial number.

15-64 Application Version

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0

Data type:	VisStr[30]	Change during operation:	False

View application version that is running in options installed in slots A, B, C0, and C1.

15-70 Option in Slot A

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[30]	Change during operation:	False

View the type code string for the option installed in slot A and a translation of the type code string. For example, for type code string *AX*, the translation is *No option*.

15-71 Slot A Option SW Version

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the software version for the option installed in slot A.

15-72 Option in Slot B

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[30]	Change during operation:	False

View the type code string for the option installed in slot B and a translation of the type code string. For example, for type code string *BX*, the translation is *No option*.

15-73 Slot B SW Version

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the software version for the option installed in slot B.

15-74 Option in Slot C0/E0

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[30]	Change during operation:	False

View the type code string for the option installed in slot C and a translation of the type code string. For example, for type code string *CXXXX*, the translation is *No option*.

15-75 Slot C0/E0 Option SW Version

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the software version for the option installed in slot C.

15-76 Option in Slot C1/E1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[30]	Change during operation:	False

View the type code string for the option installed in slot C1 and a translation of the type code string. For example, for type code string CXXXX, the translation is *No option*.

15-77 Slot C1/E1 Option SW Version

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	False

View the software version for the installed option in option slot C.

15-80 Fan Running Hours

Default value:	0 h	Parameter type:	Readout
Setup:	All setups	Conversion index:	74
Data type:	UInt32	Change during operation:	True

View for how many hours the heat sink fan has run (increments for every hour). The value is saved when the drive is turned off.

15-81 Preset Fan Running Hours

Default value:	0 h	Parameter type:	Range, 0 - 99999 h
Setup:	All setups	Conversion index:	74
Data type:	UInt32	Change during operation:	True

Enter the preset fan running hours counter, see parameter *15-80 Fan Running Hours*. This parameter cannot be selected via the serial port RS-485.

15-87 kWh Counter Hires

Default value:	0 kWh	Parameter type:	Readout
Setup:	All setups	Conversion index:	75
Data type:	UInt32	Change during operation:	False

Register the power consumption of the motor as an average value over 1 hour. Reset the counter in parameter *15-06 Reset kWh Counter*. The decimal places are reset at power-up.

5.16.13 15-9* Parameter Info

15-92 Defined Parameters

Default value:	0	Parameter type:	Readout, Array [2000]
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	False

View a list of all defined parameters in the drive. The list ends with 0.

15-93 Modified Parameters

Default value:	0	Parameter type:	Readout, Array [1000]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

View a list of the parameters that have been changed from their default setting. The list ends with 0. Changes may not be visible until up to 30 s after implementation.

15-94 Extended Version

Default value:	Size related	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[65]	Change during operation:	True

View a list of SW build IDs in the drive. In a service case, Hotline can ask for SW build IDs.

15-98 Drive Identification

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[53]	Change during operation:	False

This parameter contains data used by the VLT® Motion Control Tool MCT 10.

15-99 Parameter Metadata

Default value:	0	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter contains data used by the VLT® Motion Control Tool MCT 10.

5.17 Parameter Group 16-** Data Readouts

5.17.1 16-0* General Status

16-00 Control Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	True

View the control word sent to the drive via the serial communication port in hex code.

16-01 Reference [Unit]

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the present reference value applied on impulse or analog basis in the unit resulting from the configuration selected in parameter **1-00 Configuration Mode** (Hz, Nm, or RPM).

16-02 Reference %

Default value:	0%	Parameter type:	Range, -200 - 200%
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	True

View the total reference. The total reference is the sum of digital, analog, preset, bus, and freeze references plus catch up and slow down.

16-03 Status Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	True

View the status word sent from the drive via the serial communication port in hex code.

16-05 Main Actual Value [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

View the 2-byte word sent with the status word to the fieldbus master reporting the main actual value.

16-09 Custom Readout

Default value:	0 CustomReadoutUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

View the value of custom readout from parameter **0-30 Unit for Userdefined Readout** to parameter **0-32 Custom Readout Max Value**.

5.17.2 16-1* Motor Status

16-10 Power [kW]

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	1
Data type:	Int32	Change during operation:	True

Shows motor power in kW. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 1.3 s may pass from when an input value changes to when the data readout values change. The resolution of a readout value on fieldbus is in 10 W steps. The base unit is in W.

16-11 Power [hp]

Default value:	0 hp	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

Shows motor power in hp. The value shown is calculated based on the actual motor voltage and motor current. The value is filtered, and therefore approximately 1.3 ms may pass from when an input value changes to when the data readout values change.

16-12 Motor Voltage

Default value:	0 V	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

View the motor voltage as a calculated value used for controlling the motor.

16-13 Frequency

Default value:	0 Hz	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

View the motor frequency without resonance damping.

16-14 Motor Current

Default value:	0 A	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

View the motor current measured as an average value, I_{RMS} . The value is filtered, and therefore approximately 1.3 s may pass from when an input value changes to when the data readout values change.

16-15 Frequency [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

View a 2-byte word reporting the actual motor frequency (without resonance damping) as a percentage (scale 0000–4000 hex) of parameter **4-19 Max Output Frequency**. Set parameter **9-16 PCD Read Configuration** index 1 to send it with the status word instead of the MAV.

16-16 Torque [Nm]

Default value:	0 Nm	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Int32	Change during operation:	True

View the torque value with sign, applied to the motor shaft. Linearity is not exact between 160% motor current and torque in relation to the rated torque. Some motors supply more than 160% torque. Therefore, the minimum value and the maximum value depend on the maximum motor current and the motor used. The value is filtered, and therefore approximately 30 ms may pass from when an input changes value to when the data readout values change. In flux control principle, this readout is compensated for in parameter **1-68 Motor Inertia** for improved accuracy.

16-17 Speed [RPM]

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Int32	Change during operation:	True

View the actual motor RPM. In open-loop or closed-loop process control, the motor RPM is estimated. In speed closed-loop modes, the motor RPM is measured.

16-18 Motor Thermal

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

View the calculated thermal load on the motor. The cutout limit is 100%. The basis for calculation is the ETR function selected in parameter *1-90 Motor Thermal Protection*.

16-19 Thermistor Sensor Temperature

Default value:	0 °C	Parameter type:	Readout
Setup:	All setups	Conversion index:	100
Data type:	Int16	Change during operation:	True

Returning the actual temperature on KTY sensor built into the motor. See parameter group *1-9* Motor Temperature*.

16-20 Motor Angle

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

View the current encoder/resolver angle offset relative to the index position. The value range of 0–65535 corresponds to 0–2 π (radian).

16-22 Torque [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

The value shown is the torque in percent of nominal torque, with sign, applied to the motor shaft.

16-23 Motor Shaft Power [kW]

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	1
Data type:	Int32	Change during operation:	True

Readout of the mechanical power applied to the motor shaft. The base unit is in W.

16-24 Calibrated Stator Resistance

Default value:	0.0000 Ohm	Parameter type:	Readout
Setup:	All setups	Conversion index:	-4
Data type:	Uint32	Change during operation:	True

Shows the calibrated stator resistance.

16-26 Power Filtered [kW]

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	False

Shows the calibrated stator resistance.

16-27 Power Filtered [hp]

Default value:	0 hp	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

Shows the calibrated stator resistance.

5.17.3 16-3* Drive Status

16-30 DC Link Voltage

Default value:	0 V	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View a measured value. The value is filtered with a 30 ms time constant.

16-31 System Temp.

Default value:	0 °C	Parameter type:	Readout
Setup:	All setups	Conversion index:	100
Data type:	Int8	Change during operation:	True

Shows the highest internal system temperature. In the smaller enclosure sizes (A–C), the system temperature matches the control card temperature measurement in parameter **16-39 Control Card Temp**. In the larger enclosure sizes (D–F), the system temperature is the highest temperature measured on hardware components with temperature sensors, for example, the power card(s).

16-32 Brake Energy/s

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

View the brake power transmitted to an external brake resistor, stated as an instant value.

16-33 Brake Energy Average

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

View the brake power transmitted to an external brake resistor. The mean power is calculated on an average level based on the selected time period within parameter **2-13 Brake Power Monitoring**.

16-34 Heat Sink Temp.

Default value:	0 °C	Parameter type:	Readout
Setup:	All setups	Conversion index:	100
Data type:	Uint8	Change during operation:	True

View the drive heat sink temperature. The cutout limit is 90 ± 5 °C (194 ± 9 °F), and the motor cuts back in at 60 ± 5 °C (140 ± 9 °F).

16-35 Inverter Thermal

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Conversion index:	True

View the percentage load on the inverter.

16-36 Inv. Nom. Current

Default value:	Size related	Parameter type:	Range, 0.01 - 10000 A
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

View the inverter nominal current, which must match the nameplate data on the connected motor. The data is used for calculation of torque, motor overload protection, and so on.

16-37 Inv. Max. Current

Default value:	Size related	Parameter type:	Range, 0.01 - 10000 A
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

View the inverter maximum current, which must match the nameplate data on the connected motor. The data is used for calculation of torque, motor overload protection, and so on.

16-38 SL Controller State

Default value:	0	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

View the state of the event under execution by the SL controller.

16-39 Control Card Temp.

Default value:	0 °C	Parameter type:	Readout
Setup:	All setups	Conversion index:	100
Data type:	UInt8	Change during operation:	True

View the temperature on the control card, stated in °C.

16-40 Logging Buffer Full

Default value:	[0] No	Parameter Type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

View whether the logging buffer is full (see parameter group **15-1* Data Log Settings**). The logging buffer is never full when parameter **15-13 Logging Mode** is set to **[0] Log always**.

Index	Name
[0]*	No
[1]	Yes

16-42 Service Log Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Shows the number of service logs stored in the ServiceLog file. If the ServiceLog file is full, clear the logged data by selecting option **[5] Clear** service logs in parameter **14-22 Operation Mode**. The logged data is deleted on the next power-up.

16-43 Timed Actions Status

Default value:	[0] Timed actions auto	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

View the mode of time-based actions.

Index	Name
[0]*	Timed actions auto
[1]	Timed actions disabled
[2]	Constant on action
[3]	Constant off actions

16-44 Speed Error [RPM]

Default value:	0.000 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Int32	Change during operation:	True

Shows the difference between the speed reference and the actual speed.

16-45 Motor Phase U Current

Default value:	0 A	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

Shows the motor phase U_{RMS} current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in the motor windings.

16-46 Motor Phase V Current

Default value:	0 A	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

Shows the motor phase V_{RMS} current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in the motor windings.

16-47 Motor Phase W Current

Default value:	0 A	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

Shows the motor phase W_{RMS} current. Facilitates monitoring of imbalance in the motor currents, detection of weak motor cables or imbalance in the motor windings.

16-48 Speed Ref. After Ramp [RPM]

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Int32	Change during operation:	False

This parameter specifies the reference given to the drive after the speed ramp.

16-49 Current Fault Source

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Value indicates source of current faults including short circuit, overcurrent, and imbalance of supply voltage (from left):

- 1–4 Inverter
- 5–8 Rectifier
- 0 No fault recorded

5.17.4 16-5* Ref. & Feedb.

16-50 External Reference

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	True

View the total reference, the sum of digital, analog, preset, fieldbus, and freeze references, plus catch up and slow down.

16-52 Feedback[Unit]

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View value of resulting feedback value after processing of feedback 1-3 in parameter **3-00 Reference Range**, parameter **16-54 Feedback 1 [Unit]**, parameter **16-55 Feedback 2 [Unit]**, and parameter **16-56 Feedback 3 [Unit]** in the feedback manager. See parameter group **20-0* Feedback**. The value is limited by settings in parameter **3-02 Minimum Reference** and parameter **3-03 Maximum Reference**. Units are set in parameter **20-12 Reference/Feedback Unit**.

16-53 Digi Pot Reference

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

View the contribution of the digital potentiometer to the actual reference.

16-54 Feedback 1 [Unit]

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout
Setup:	All	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the value of feedback 1, see parameter group **20-0* Feedback**. The value is limited by the settings in parameter **20-13 Minimum Reference/Feedb.** and parameter **20-14 Maximum Reference/Feedb.** Units are as set in parameter **20-12 Reference/Feedback Unit**.

16-55 Feedback 2 [Unit]

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the value of feedback 2, see parameter group **20-0* Feedback**. The value is limited by the settings in parameter **20-13 Minimum Reference/Feedb.** and parameter **20-14 Maximum Reference/Feedb.** Units are as set in parameter **20-12 Reference/Feedback Unit**.

16-56 Feedback 3 [Unit]

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the value of feedback 3, see parameter group **20-0* Feedback**. The value is limited by the settings in parameter **20-13 Minimum Reference/Feedb.** and parameter **20-14 Maximum Reference/Feedb.** Units are as set in parameter **20-12 Reference/Feedback Unit**.

16-58 PID Output [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	True

This parameter returns the drive closed-loop PID controller output value in %.

16-59 Adjusted Setpoint

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter shows the actual operating setpoint after it has been modified by flow compensation.

5.17.5 16-6* Inputs and Outputs

16-60 Digital Input

Default value:	0	Parameter type:	Range, 0 - 65535
Setup:	All setup	Conversion index:	0
Data type:	UInt16	Change during operation:	True

View the signal states from the active digital inputs. Example: Input 18 corresponds to bit number 5, 0 = no signal, 1 = connected signal. Bit 6 works in the opposite way, 0 = on, 1 = off (Safe Torque Off input).

Table 45: Active Digital Inputs

Bit	Input
0	Digital input terminal 33.
1	Digital input terminal 32.
2	Digital input terminal 29.
3	Digital input terminal 27.
4	Digital input terminal 19.
5	Digital input terminal 18.
6	Digital input terminal 37.
7	Digital input VLT® General Purpose I/O MCB 101 terminal X30/4.
8	Digital input VLT® General Purpose I/O MCB 101 terminal X30/3.
9	Digital input VLT® General Purpose I/O MCB 101 terminal X30/2.
Bit 10–63	Reserved for future terminals.

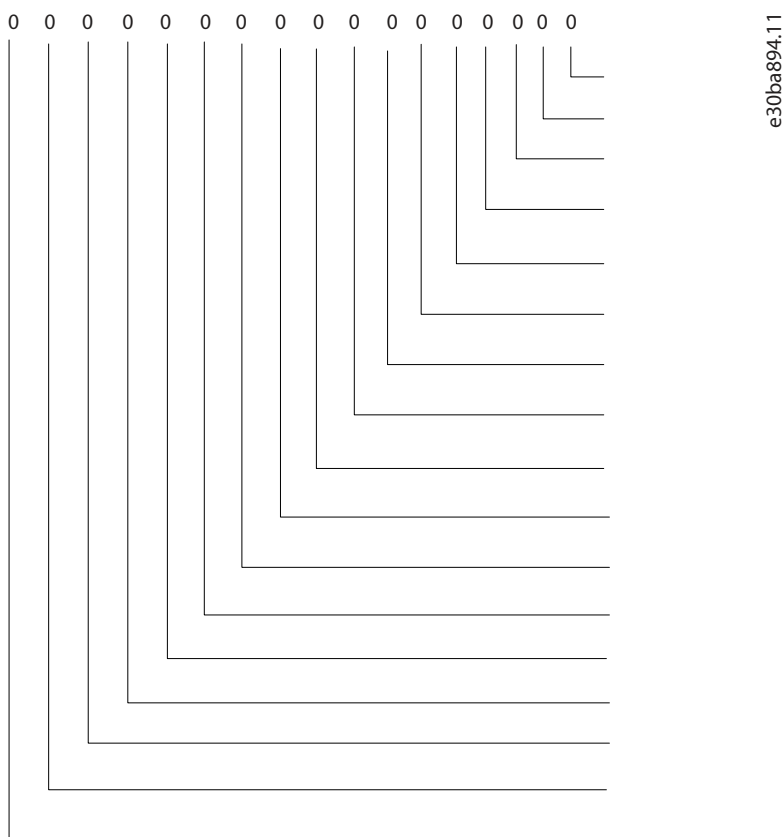


Figure 92: Relay Settings

16-61 Terminal 53 Switch Setting

Default value:	[0] Current	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

View the setting of input terminal 53.

Index	Name
[0]*	Current
[1]	Voltage

16-62 Analog Input 53

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the actual value at input 53.

16-63 Terminal 54 Switch Setting

Default value:	[0] Current	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

View the setting of terminal 54.

Index	Name
[0]*	Current
[1]	Voltage

16-64 Analog Input 54

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Changes during operation:	True

View the actual value at input 54.

16-65 Analog Output 42 [mA]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

View the actual value at output 42 in mA. The value shown reflects the selection in parameter **6-50 Terminal 42 Output**.

16-66 Digital Output [bin]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

View the binary value of all digital outputs.

16-67 Freq. Input #29 [Hz]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the actual frequency rate on terminal 29.

16-68 Freq. Input #33 [Hz]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the actual value of the frequency applied at terminal 33 as an impulse input.

16-69 Pulse Output #27 [Hz]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the actual value of pulses applied to terminal 27 in digital output mode.

16-70 Pulse Output #29 [Hz]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the actual value of pulses at terminal 29 in digital output mode.

16-71 Relay Output [bin]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View the settings of all relays.

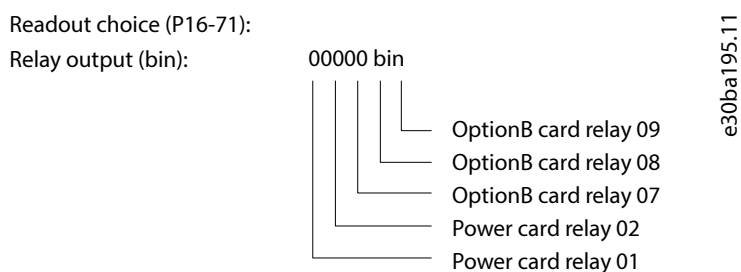


Figure 93: Relay Settings

16-72 Counter A

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the present value of counter A. Counters are useful as comparator operands, see parameter **13-10 Comparator Operand**. Reset or change the value either via digital inputs (parameter group **5-1* Digital Inputs**) or by using an SLC action (parameter **13-52 SL Controller Action**).

16-73 Counter B

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

View the present value of counter B. Counters are useful as comparator operands, see parameter **13-10 Comparator Operand**. Reset or change the value either via digital inputs (parameter group **5-1* Digital Inputs**) or by using an SLC action (parameter **13-52 SL Controller Action**).

16-75 Analog In X30/11

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3

Data type:	Int32	Change during operation:	True

View the actual value at input X30/11 of VLT® General Purpose I/O MCB 101.

16-76 Analog In X30/12

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the actual value at input X30/12 of VLT® General Purpose I/O MCB 101.

16-77 Analog Out X30/8 [mA]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

View the actual value at input X30/8 in mA.

16-78 Analog Out X45/1 [mA]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Shows the actual output value at terminal X45/1. The value shown reflects the selection in parameter **6-70 Terminal X45/1 Output**.

16-79 Analog Out X45/3 [mA]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Shows the actual output value at terminal X45/3. The value shown reflects the selection in parameter **6-80 Terminal X45/3 Output**.

5.17.6 16-8* Fieldbus & FC Port

Parameters for reporting the bus references and control words.

16-80 Fieldbus CTW 1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	True

View the 2-byte control word (CTW) received from the bus-master. Interpretation of the CTW depends on the fieldbus option installed and the CTW profile selected in parameter **8-10 Control Word Profile**. For more information, refer to the relevant fieldbus manual.

16-82 Fieldbus REF 1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	N2	Change during operation:	True

View the 2-byte word sent with the control word from the bus-master to set the reference value. For more information, refer to the relevant fieldbus manual.

16-84 Comm. Option STW

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	True

Shows the status word of the extended fieldbus communication option. For more information, refer to the relevant fieldbus manual.

16-85 FC Port CTW 1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	False

View the 2-byte control word (CTW) received from the fieldbus master. Interpretation of the control word depends on the fieldbus option installed and the control word profile selected in parameter **8-10 Control Word Profile**.

16-86 FC Port REF 1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	N2	Change during operation:	False

View the 2-byte status word (STW) sent to the fieldbus master. Interpretation of the status word depends on the fieldbus option installed and the control word profile selected in parameter **8-10 Control Word Profile**.

16-87 Bus Readout Alarm/Warning

Default value:	0	Parameter type:	Readout, Array [3]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Alarm and warning numbers in hex as shown in the alarm log. The alarm number is the 1st that occurred after the last reset.

Index	Description
[0]	The high byte contains the alarm, the low byte contains the warning.
[1]	Warning number only
[2]	Alarm number only

16-89 Configurable Alarm/Warning Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This alarm/warning word is configured in parameter **8-17 Configurable Alarm and Warningword** to match the actual requirements.

5.17.7 16-9* Diagnosis Readouts



NOTE: When using VLT® Motion Control Tool MCT 10, the readout parameters can only be read online, that is as the actual status. This means that the status is not stored in the MCT 10 setup software file.

16-90 Alarm Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Show the alarm word sent via the serial communication port in hex code.

16-91 Alarm Word 2

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Shows the alarm word sent via the serial communication port in hex code.

16-92 Warning Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Shows the warning word sent via the serial communication port in hex code.

16-93 Warning Word 2

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Show the warning word sent via the serial communication port in hex code.

16-94 Ext. Status Word

Default value:	0	Parameter type:	Range, 0 - 4294967295
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Returns the extended warning word sent via the serial communication port in hex code.

16-95 Ext. Status Word 2

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Returns the extended warning word sent via the serial communication port in hex code.

16-96 Maintenance Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Readout of the preventive maintenance word. The bits reflect the status for the programmed preventive maintenance events in parameter group **23-1* Maintenance**. 13 bits show combinations of all the possible items:

- Bit 0: Motor bearings
- Bit 1: Pump bearings
- Bit 2: Fan bearings
- Bit 3: Valve
- Bit 4: Pressure transmitter
- Bit 5: Flow transmitter
- Bit 6: Temperature transmitter
- Bit 7: Pump seals
- Bit 8: Fan belt
- Bit 9: Filter
- Bit 10: Drive cooling fan
- Bit 11: Drive system health check
- Bit 12: Warranty
- Bit 13: Maintenance text 0
- Bit 14: Maintenance text 1
- Bit 15: Maintenance text 2
- Bit 16: Maintenance text 3
- Bit 17: Maintenance text 4

The following table details the display of the maintenance word.

Table 46: Maintenance Word

Position 4⇒	Valve	Fan bearings	Pump bearings	Motor bearings
Position 3⇒	Pump seals	Temperature transmitter	Flow transmitter	Pressure transmitter
Position 2⇒	Drive system health check	Drive cooling fan	Filter	Fan belt
Position 1⇒	–	–	–	Warranty
0 _{hex}	–	–	–	–
1 _{hex}	–	–	–	+
2 _{hex}	–	–	+	–
3 _{hex}	–	–	+	+
4 _{hex}	–	+	–	–

Table 46: Maintenance Word - (continued)

Position 4⇒	Valve	Fan bearings	Pump bearings	Motor bearings
Position 3⇒	Pump seals	Temperature transmitter	Flow transmitter	Pressure transmitter
Position 2⇒	Drive system health check	Drive cooling fan	Filter	Fan belt
Position 1⇒	–	–	–	Warranty
5 _{hex}	–	+	–	+
6 _{hex}	–	+	+	–
7 _{hex}	–	+	+	+
8 _{hex}	+	–	–	–
9 _{hex}	+	–	–	+
A _{hex}	+	–	+	–
B _{hex}	+	–	+	+
C _{hex}	+	+	–	–
D _{hex}	+	+	–	+
E _{hex}	+	+	+	–
F _{hex}	+	+	+	+

Example: The preventive maintenance word shows 040A_{hex}:

Position	1	2	3	4
Hex value	0	4	0	A

- The 1st digit 0 indicates that no items from the 4th row require maintenance.
- The 2nd digit 4 refers to the 3rd row indicating that the drive cooling fan requires maintenance.
- The 3rd digit 0 indicates that no items for the 2nd row require maintenance.
- The 4th digit A refers to the top row indicating that the valve and the pump bearings require maintenance.

16-97 Alarm Word 3

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the alarm word sent via the serial communication port in hex code.

16-98 Warning Word 3

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the warning word sent via the serial communication port in hex code.

16-99 Ext. Status Word 3

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the extended status word sent via the serial communication port in hex code.

5.18 Parameter Group 18-** Data Readouts 2

5.18.1 18-0* Maintenance Log

This group contains the last 10 preventive maintenance events. Maintenance log 0 is the latest and maintenance log 9 is the oldest.

By selecting 1 of the logs and pressing [OK], the maintenance item, action, and time of the occurrence are shown in parameter **18-0 Maintenance Log: Item** to parameter **18-03 Maintenance Log: Date and Time**.

The alarm log key allows access to both alarm log and maintenance log.

18-00 Maintenance Log: Item

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

Shows the fault code. See the different maintenance items in parameter **23-10 Maintenance Item**.

18-01 Maintenance Log: Action

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

Shows the fault code. See the different maintenance actions in parameter **23-11 Maintenance Action**.

18-02 Maintenance Log: Time

Default value:	0 s	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows when the logged event occurred. Time is measured in s since last power-up.

18-03 Maintenance Log: Date and Time

Default value:	Size related	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

Shows when the logged event occurred.



NOTE: For this parameter to show the time of the logged event, date and time must be programmed in parameter **0-70 Date and Time**.

Date format depends on the setting in parameter **0-71 Date Format**, while the time format depends on the setting in parameter **0-72 Time Format**.



NOTE: The drive has no back-up of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with back-up is installed. In parameter **0-79 Clock Fault**, it is possible to program a warning in case the clock has not been set properly, for example after a power-down. Incorrect setting of the clock affects the time stamps for the maintenance events.



NOTE: When mounting a VLT® Analog I/O MCB 109 option card, a battery back-up of date and time is included.

5.18.2 18-1* Emergency Mode Log

The log covers the latest 10 faults which have been suppressed by the emergency mode function. See parameter group **24-0* Emergency Mode**. The log can be viewed either via the following parameters or by pressing [Alarm Log] on the LCP and selecting *Emergency mode log*. It is not possible to reset the emergency mode log.

18-10 Emergency Mode Log: Event

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

This parameter contains an array with 10 elements. The number read represents a fault code, which corresponds to a specific alarm. Refer to *Alarm/Warning Code List in chapter Troubleshooting*.

18-11 Emergency Mode Log: Time

Default value:	0 s	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

This parameter shows at which time the logged event occurred. Time is measured in seconds since the drive was started.

18-12 Emergency Mode Log: Date and Time

Default value:	Size related	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

This parameter shows at which date and time the logged event occurred. The date and time rely on the internal clock in parameter group **0-7* Clock Settings**.

5.18.3 18-1* Parameter Log

18-13 Parameter Number

Default value:	0 N/A	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Shows the parameter which is most recently changed. Index 0 shows the latest change in the parameter.

18-14 Parameter Index

Default value:	0 N/A	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	–
Data type:	Uint16	Change during operation:	False

This parameter shows the index of the parameter which was changed.

18-15 Change Time

Default value:	Size related	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

Shows the date and time stamp when a parameter was most recently changed. It is recommended to set the time and date in the drive to ensure the right time is logged.

18-16 Operating Hours

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows operating hours of the drive at the instance when the parameter was changed.

18-17 Running Hours

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows running hours of the motor when the parameter is changed.

18-18 Value Before Change as Integer

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	False

Shows the previous value of the parameter as integer, without scaling or unit conversion. The parameter only shows integer data.

18-19 Value Before Change

Default value:	Size related	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[30]	Change during operation:	False

Shows the previous value of the parameter with units. Only applicable for integer values.

5.18.4 18-3* Analog Readouts

18-30 Analog Input X42/1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	False

Readout of the value of the signal applied to terminal X42/1 on the analog I/O card. The units of the value shown in the LCP correspond to the mode selected in parameter **26-00 Terminal X42/1 Mode**.

18-31 Analog Input X42/3

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

Readout of the value of the signal applied to terminal X42/3 on the analog I/O card. The units of the value shown in the LCP correspond to the mode selected in parameter **26-01 Terminal X42/3 Mode**.

18-32 Analog Input X42/5

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

Readout of the value of the signal applied to terminal X42/5 on the analog I/O card. The units of the value shown in the LCP correspond to the mode selected in parameter **26-02 Terminal X42/5 Mode**.

18-33 Analog Input X42/7 [V]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Readout of the value of the signal applied to terminal X42/7 on the analog I/O card. The value shown reflects the selection in parameter **26-40 Terminal X42/7 Output**.

18-34 Analog Input X42/9 [V]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Readout of the value of the signal applied to terminal X42/9 on the analog I/O card. The value reflects the selection in parameter **26-50 Terminal X42/9 Output**.

18-35 Analog Input X42/11 [V]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Readout of the value of the signal applied to terminal X42/11 on the analog I/O card. The value shown reflects the selection in parameter **26-60 Terminal X42/11 Output**.

18-36 Analog Input X48/2 [mA]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

View the actual current measured at input X48/2.

18-37 Temp. Input X48/4

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

View the actual temperature measured at input X48/4. The temperature unit is based on the selection in parameter **35-00 Term. X48/4 Temperature Unit**.

18-38 Temp. Input X48/7

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

View the actual temperature measured at input X48/7. The temperature unit is based on the selection in parameter **35-02 Term. X48/7 Temperature Unit**.

18-39 Temp. Input X48/10

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

View the actual temperature measured at input X48/10. The temperature unit is based on the selection in parameter **35-04 Term. X48/10 Temperature Unit**.

5.18.5 18-4* PGIO Data Readouts

Parameters for configuring the readout of VLT® Programmable I/O MCB 115.

18-40 Analog Input X49/1

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

View the actual value at input X49/1 either as a voltage, current or a temperature value.

18-41 Analog Input X49/3

Default value:	0	Parameter type:	Readout

Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

View the actual value at input X49/3 either as a voltage, current, or a temperature value.

18-42 Analog Input X49/5

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

View the actual value at input X49/5 either as a voltage, current, or a temperature value.

18-43 Analog Input X49/7

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Shows the actual value at output of terminal X49/7 in V or mA. The value reflects the selection in parameter **36-40 Terminal X49/7 Analog Output**.

18-44 Analog Input X49/9

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Shows the actual value at output of terminal X49/9 in V or mA. The value reflects the selection in parameter **36-50 Terminal X49/9 Analog Output**.

18-45 Analog Input X49/11

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	False

Shows the actual value at output of terminal X49/11 in V or mA. The value reflects the selection in parameter **36-60 Terminal X49/11 Analog Output**.

18-46 X49 Digital Output [bin]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	False

Shows the binary value of all programmable I/O digital outputs.

5.18.6 18-4* Last Warning

18-47 Last Warning

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows the last warning.

18-48 Last Warning Count

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows how many times the last warning has been active.

5.18.7 18-5* Ref. & Feedb.

Parameters in this group report the reference and feedback inputs.

18-50 Sensorless Readout [Unit]

Default value:	0 SensorlessUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

This parameter shows a readout of the pressure or flow based on the sensorless calculations. This value is not used for control and will only be updated if sensorless data supports both flow and pressure.

18-55 Active Alarm Numbers

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter contains an array of up to 20 alarms that are currently active. The value 0 means no alarm.

18-56 Active Warning Numbers

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter contains an array of up to 20 warnings that are currently active. The value 0 means no warning.

5.18.8 18-6* Inputs & Outputs 2

18-60 Digital Input 2

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	Uint16	Change during operation:	True

Shows the signal states from the active digital inputs.

- 0 = No signal
- 1 = Connected signal

5.18.9 18-6* Motor Status 2

18-65 AMA Status

Default value:	[0] AMA not performed	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter shows the latest AMA execution status.

Index	Name
[0]*	AMA not performed
[1]	AMA running
[2]	AMA interrupted
[3]	AMA complete

18-66 Actual Switching Frequency

Default value:	0 kHz	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View the actual switching frequency value. The value may differ from the value set in parameter **14-01 Switching Frequency** due to internal derating.

5.18.10 18-6* Diagnosis Readout 2

18-67 Alarm Word 4

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

View alarm word 4 as a hexadecimal value.

18-68 Warning Word 4

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

View warning word 4 as a hexadecimal value.

5.18.11 18-7* Rectifier Status

18-70 Mains Voltage

Default value:	0 V	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows the mains line-to-line voltage.

Index	Name
[0]	Average
[1]	Phase R to S
[2]	Phase S to T
[3]	Phase T to R

18-71 Mains Frequency

Default value:	0 Hz	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	True

Shows the mains frequency.

18-72 Mains Imbalance

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Shows the maximum imbalance for the 3 mains line-to-line measurements.

18-73 Worst Inrush

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter identifies which active inrush produces the data shown in parameter **18-70 Mains Voltage**, parameter **18-71 Mains Frequency**, parameter **18-72 Mains Imbalance**, and parameter **18-75 Rectifier DC Volt**. 1 = inrush 1, 2 = inrush 2, and so on.

18-74 Inrush Mode

Default value:	0	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows the reported mode of each inrush board. The values are:

- 0 = unknown
- 1 = inrush

- 2 = running

Index	Name
[0]	Inrush1
[1]	Inrush2
[2]	Inrush3
[3]	Inrush4

18-75 Rectifier DC Volt

Default value:	0 V	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the DC voltage measured on the rectifier module.

18-76 Mains Voltage 2

Default value:	0 V	Parameter type:	Readout, Array [16]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View the mains line-to-line measurements. The values are RMS.

Index	Name
[0]	Inrush1 average
[1]	Inrush2 average
[4]	Inrush1 L1
[5]	Inrush2 L1
[8]	Inrush1 L2
[9]	Inrush2 L2
[12?]	Inrush1 L3
[13?]	Inrush2 L3

18-77 Mains Frequency 2

Default value:	0 Hz	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

View the mains frequency measurement.

Index	Name
[0]	Inrush1
[1]	Inrush2

Index	Name
[2]	Inrush3
[3]	Inrush4

18-78 Mains Imbalance 2

Default value:	0%	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View the maximum measured imbalance for the 3 mains line-to-line measurements.

Index	Name
[0]	Inrush1
[1]	Inrush2
[2]	Inrush3
[3]	Inrush4

18-79 Rectifier DC Volt. 2

Default value:	0 V	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View the DC voltage measurement from the rectifier module.

Index	Name
[0]	Inrush1
[1]	Inrush2
[2]	Inrush3
[3]	Inrush4

5.19 Parameter Group 20-** FC Closed Loop

5.19.1 Introduction to FC Closed Loop Parameters

Closed-loop PID

This parameter group is used for configuring the closed-loop PID controller that controls the output frequency of the drive.

Closed-loop DRC

DRC (disturbance rejection control) improves adherence to the wanted process control setpoint (for example, wanted water pressure) by responding more rapidly to both incidental load disturbances and changes in the setpoint. DRC reacts rapidly to ensure that the system quickly returns to the required pressurization. This improved regulation ensures process consistency and reduces oscillations that may harm the mechanical infrastructure. DRC relies on a proprietary control algorithm that compensates for any behavior that deviates from the expected behavior based on the basic physical model generated by DRC Identify. Basically, DRC depends on the system characteristics measured by parameter **20-79 Autotuning** when it is set to *SPC*. The DRC is then engaged based on the measured system information retrieved during the auto-tuning process. DRC responsiveness is initially set to a value that depends on whether the

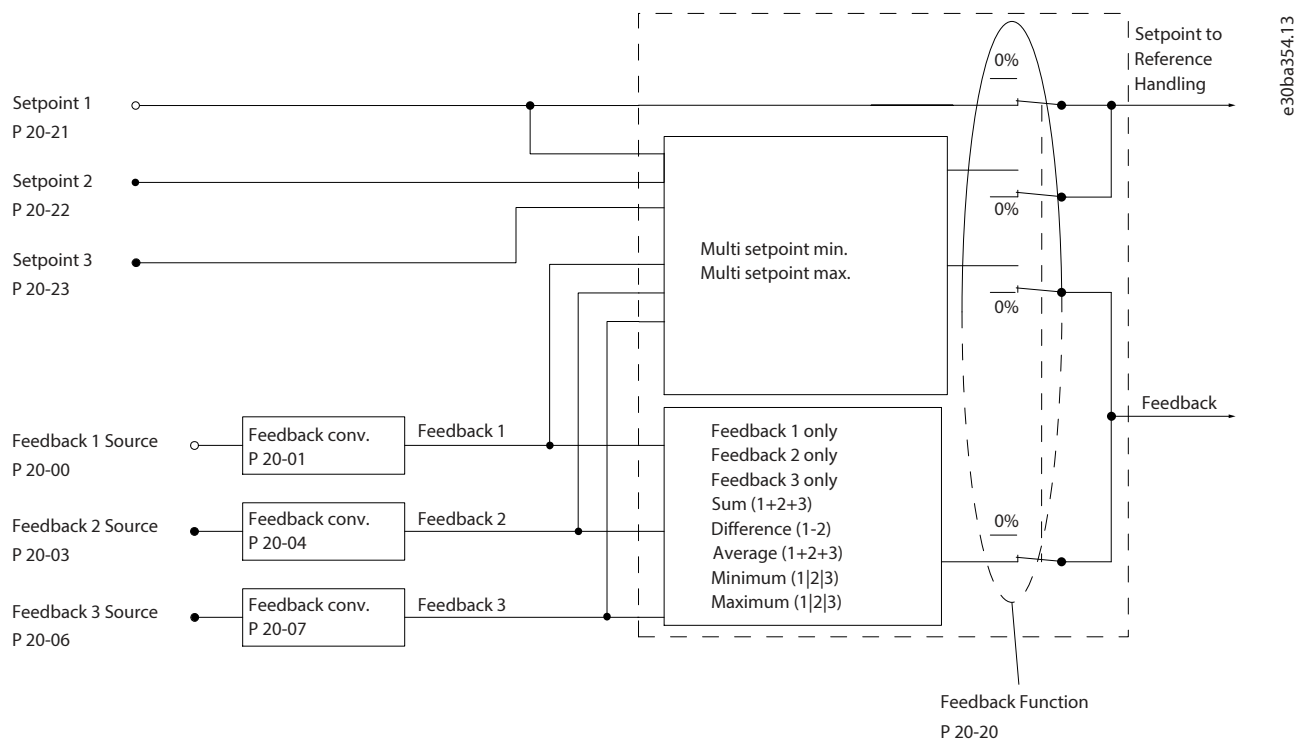
relevant system is defined as *Normal* (default) or *Fast*, which can be modified in parameter **20-71 Controller Performance**. An example of a fast system is an irrigation system with short ramp times which requires rapid responses when there are changes to the wanted water pressure or opened valves.



NOTE: DRC is not recommended for usage in systems that uses cascade controller functionality (for example, municipal water distribution systems).

5.19.2 20-0* Feedback

This parameter group is used to configure the feedback signal for the closed-loop PID controller. Whether the drive is in closed-loop mode or open-loop mode, the feedback signals can be shown on the LCP display. It can also be used to control an analog output of a drive, and it can be sent over various serial communication protocols.



20-00 Feedback 1 Source

Default value:	[2] Analog input 54	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: If feedback is not used, set its source to **[0] No function**. Parameter **20-20 Feedback Function** determines how the PID controller uses the 3 possible feedback.

Up to 3 different feedback signals can be used to provide the feedback signal for the PID controller of the drive. This parameter defines which input is used as the source of the 1st feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on VLT® General Purpose I/O MCB 101.

Option	Name	Description
[0]	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]*	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

20-01 Feedback 1 Conversion

Default value:	[0] Linear	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

This parameter allows a conversion function to be applied to feedback 1.

Option	Name	Description
[0]*	Linear	Linear has no effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback.

$$\text{flow} \propto \sqrt{\text{pressure}}$$

20-02 Feedback 1 Source Unit

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is only available when using pressure to temperature feedback conversion. If option *[0] Linear* is selected in parameter *20-01 Feedback 1 Conversion*, the setting of any option in parameter *20-02 Feedback 1 Source Unit* does not matter as the conversion is 1-to-1.

This parameter determines the unit that is used for this feedback source before applying the feedback conversion of parameter *20-01 Feedback 1 Conversion*. This unit is not used by the PID controller.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	

Option	Name	Description
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

20-03 Feedback 2 Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: If feedback is not used, set its source to **[0] No function**. Parameter **20-20 Feedback Function** determines how the PID controller uses the 3 possible feedback.

Up to 3 different feedback signals can be used to provide the feedback signal for the PID controller of the drive. This parameter defines which input is used as the source of the 2nd feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on VLT® General Purpose I/O MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

20-04 Feedback 2 Conversion

Default value:	[0] Linear	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

This parameter allows a conversion function to be applied to feedback 2.

Option	Name	Description
[0]*	Linear	Linear has no effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback.

$$\text{flow} \propto \sqrt{\text{pressure}}$$

20-05 Feedback 2 Source Unit

Default value:	[0]* None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is only available when using pressure to temperature feedback conversion. If option [0] *Linear* is selected in parameter **20-04 Feedback 2 Conversion**, the setting of any option in parameter **20-05 Feedback 2 Source Unit** does not matter as the conversion is 1-to-1.

This parameter determines the unit that is used for this feedback source before applying the feedback conversion of parameter **20-04 Feedback 2 Conversion**. This unit is not used by the PID controller.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	

Option	Name	Description
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

20-06 Feedback 3 Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: If feedback is not used, set its source to *[0] No function*. Parameter *20-20 Feedback Function* determines how the PID controller uses the 3 possible feedback.

Up to 3 different feedback signals can be used to provide the feedback signal for the PID controller of the drive. This parameter defines which input is used as the source of the 3rd feedback signal. Analog input X30/11 and analog input X30/12 refer to inputs on VLT® General Purpose I/O MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

20-07 Feedback 3 Conversion

Default value:	[0] Linear	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

This parameter allows a conversion function to be applied to feedback 3.

Option	Name	Description
[0]*	Linear	Linear has no effect on the feedback.
[1]	Square root	Commonly used when a pressure sensor is used to provide flow feedback.

$$\text{flow} \propto \sqrt{\text{pressure}}$$

20-08 Feedback 3 Source Unit

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is only available when using pressure to temperature feedback conversion. If option *[0] Linear* is selected in parameter *20-07 Feedback 3 Conversion*, the setting of any option in parameter *20-08 Feedback 3 Source Unit* does not matter as the conversion is 1-to-1.

This parameter determines the unit that is used for this feedback source before applying the feedback conversion of parameter *20-07 Feedback 3 Conversion*. This unit is not used by the PID controller.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	

Option	Name	Description
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

20-12 Reference/Feedback Unit

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter determines the unit that is used for references and feedback in closed-loop operation.

Option	Name	Description
[0]	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	

Option	Name	Description
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	

Option	Name	Description
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

5.19.3 20-2* Feedback/Setpoint

This parameter group is used to determine how the PID controller uses the 3 possible feedback signals to control the output frequency of the drive. This group is also used to store the 3 internal setpoint references.

Parameter 20-20 Feedback Function

Default value:	[4] Maximum	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter determines how the 3 possible forms of feedback are used to control the output frequency of the drive.

Option	Name	Description
[0]	Sum	Sets up the PID controller to use the sum of feedback 1, feedback 2, and feedback 3 as the feedback.
 NOTE: Set any unused feedback to [0] <i>No function</i> in: - Parameter 20-00 Feedback 1 Source - Parameter 20-02 Feedback 2 Source - Parameter 20-06 Feedback 3 Source The sum of setpoint 1 and any other references that are enabled (see parameter group 3-1*References) are used as the setpoint reference of the PID controller.		
[1]	Difference	Sets up the PID controller to use the difference between feedback 1 and feedback 2 as the feedback. Feedback 3 is not used with this selection. Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled are used as the setpoint reference of the PID controller.

Option	Name	Description
[2]	Average	Sets up the PID controller to use the average of feedback 1, feedback 2, and feedback 3 as the feedback.  NOTE: Set any unused feedback to [0] <i>No function</i> in: - Parameter 20-00 Feedback 1 Source - Parameter 20-02 Feedback 2 Source - Parameter 20-06 Feedback 3 Source The sum of setpoint 1 and any other references that are enabled are used as the setpoint reference of the PID controller.
[3]	Minimum	Sets up the PID controller to compare feedback 1, feedback 2, and feedback 3. The PID controller uses the lowest value as the feedback.  NOTE: Set any unused feedback to [0] <i>No function</i> in: - Parameter 20-00 Feedback 1 Source - Parameter 20-02 Feedback 2 Source - Parameter 20-06 Feedback 3 Source Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled are used as the PID controller's reference.
[4]*	Maximum	Sets up the PID controller to compare feedback 1, feedback 2, and feedback 3. The PID controller uses the highest value as the feedback.  NOTE: Set any unused feedback to [0] <i>No function</i> in: - Parameter 20-00 Feedback 1 Source - Parameter 20-02 Feedback 2 Source - Parameter 20-06 Feedback 3 Source Only setpoint 1 is used. The sum of setpoint 1 and any other references that are enabled are used as the setpoint reference of the PID controller.

Option	Name	Description
[5]	Multi setpoint min	Sets up the PID controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is the farthest below its corresponding setpoint reference. If all feedback signals are above their corresponding setpoints, the PID controller uses the feedback/setpoint pair with the least difference between the 2.  NOTE: Set any unused feedback to [0] <i>No function</i> in: • Parameter 20-00 Feedback 1 Source • Parameter 20-02 Feedback 2 Source • Parameter 20-06 Feedback 3 Source Each setpoint reference is the sum of its respective parameter value and any other references that are enabled.
[6]	Multi setpoint max	Sets up the PID controller to calculate the difference between feedback 1 and setpoint 1, feedback 2 and setpoint 2, and feedback 3 and setpoint 3. It uses the feedback/setpoint pair in which the feedback is farthest above its corresponding setpoint reference. If all feedback signals are below their corresponding setpoints, the PID controller uses the feedback/setpoint pair with the least difference between the 2.  NOTE: Set any unused feedback to [0] <i>No function</i> in: • Parameter 20-00 Feedback 1 Source • Parameter 20-02 Feedback 2 Source • Parameter 20-06 Feedback 3 Source Each setpoint reference is the sum of its respective parameter value and any other references that are enabled.

The PID controller uses the feedback resulting from the function selected in parameter **20-20 Feedback Function** to control the output frequency of the drive. This feedback can also be:

- Shown on the display of the drive.
- Used to control an analog output of a drive.
- Transmitted over various serial communication protocols.

The drive can be configured to handle multi-zone applications. 2 different multi-zone applications are supported:

- Multi-zone, single setpoint
- Multi-zone, multi-setpoint

Examples 1 and 2 show the difference between the 2 applications.

Example 1 - Multi-zone, single setpoint

In an office building, a VAV (variable air volume) VLT® HVAC Drive system must ensure a minimum pressure at selected VAV boxes. Due to the varying pressure losses in each duct, the pressure at each VAV box cannot be assumed to be the same. The minimum pressure required is the same for all VAV boxes. This control method can be set up by setting parameter **20-20 Feedback Function** to [3] **Minimum** and entering the desired pressure in parameter **20-21 Setpoint 1**. If any feedback is below the setpoint, the PID controller increases the fan speed. If all feedbacks are above the setpoint, the PID controller decreases the fan speed.

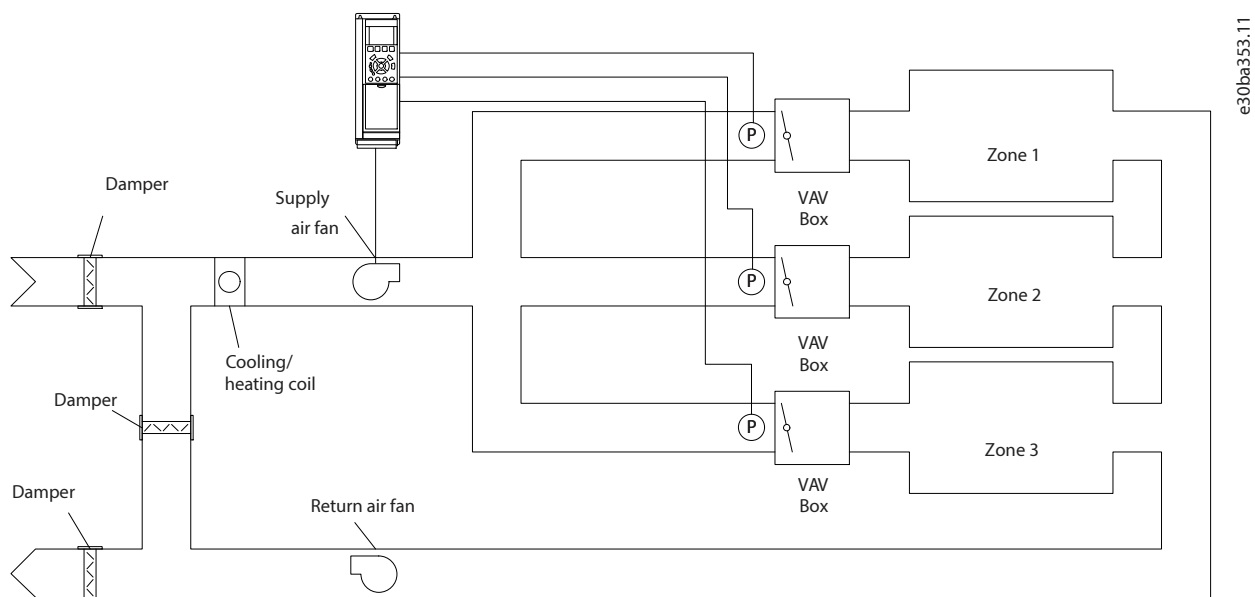


Figure 94: Example, Multi-zone, Single Setpoint

Example 2, multi-zone, multi-setpoint

The previous example illustrates the use of multi-zone, single-setpoint control. If the zones require different pressures for each VAV box, each setpoint may be specified in

- parameter **20-21 Setpoint 1**
- parameter **20-22 Setpoint 2**
- parameter **20-23 Setpoint 3**

By selecting **[5] Multi-setpoint minimum** in parameter **20-20 Feedback Function**, the PID controller increases the fan speed if any of the feedbacks are below their setpoints. If all feedbacks are above their individual setpoints, the PID controller decreases the fan speed.

20-21 Setpoint 1

Default value:	0 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True



NOTE: The setpoint entered in this parameter is added to any other references that are enabled.

Setpoint 1 is used in closed-loop mode to enter a setpoint reference that is used by the PID controller of the drive.

20-22 Setpoint 2

Default value:	0 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True



NOTE: The setpoint entered in this parameter is added to any other references that are enabled.

Setpoint 2 is used in closed-loop mode to enter a setpoint reference that is used by the PID controller of the drive.

20-23 Setpoint 3

Default value:	0 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True



NOTE: The setpoint entered in this parameter is added to any other references that are enabled.

Setpoint 3 is used in closed-loop mode to enter a setpoint reference that is used by the PID controller of the drive.

5.19.4 20-5* DRC

20-50 Controller Selection

Default value:	[0] PID	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the PCL control principle. For extended PCL, the control principle is always PID.

Option	Name	Description
[0]*	PID	
[1]	DRC	

20-52 Gain Estimate

Default value:	1.00	Parameter type:	Range, 0.00 - 100.00
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Use this parameter for estimating the system gain.

20-53 Time Constant Estimate

Default value:	1.000 s	Parameter type:	Range, 0.000 - 100.000 s
Setup:	All setups	Conversion index:	-3
Data type:	UInt32	Change during operation:	True

Use this parameter for estimating the system time constant.

20-54 Deadtime Estimate

Default value:	10.000 s	Parameter type:	Range, 0.000 - 100.000 s
Setup:	All setups	Conversion index:	-3
Data type:	UInt32	Change during operation:	True

Use this parameter for estimating the system deadtime.

20-55 Controller Gain

Default value:	Size related	Parameter type:	Range, 0.0 - 1.0
Setup:	All setups	Conversion index:	-1
Data type:	Uint8	Change during operation:	True

This parameter determines the dynamic response of the DRC controller. To achieve a fast response, increase the parameter value. To prioritize stability over fast responses, decrease the parameter value.

20-56 Tuned Cascade Capacity

Default value:	100%	Parameter type:	Range, 100 - 800%
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter shows the combined capacity of the motors that were part of the last successful tuning experiment.

5.19.5 20-6* Sensorless

Parameters for sensorless function. See also:

- Parameter **20-20 Feedback 1 Source**
- Parameter **18-50 Sensorless Readout [Unit]**
- Parameter **16-26 Power Filtered [kW]**
- Parameter **16-27 Power Filtered [hp]**



NOTE: Sensorless unit and sensorless information require setup by VLT® Motion Control Tool MCT 10 with sensorless-specific plug-in.

20-60 Sensorless Unit

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit to be used with parameter **18-50 Sensorless Readout [Unit]**.

Option	Name	Description
[20]	l/s	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[71]	bar	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[120]	GPM	

Option	Name	Description
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in Hg	

20-69 Sensorless Information

Default value:	0	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

View the information about the sensorless data.

5.19.6 20-7* Autotuning

PID autotuning

The closed-loop controller of the drive (parameter group **20-** FC Closed Loop**) can be autotuned, which simplifies and saves time during commissioning, while ensuring accurate control adjustment. To use autotuning, configure the drive for closed loop in parameter **1-00 Configuration Mode**.

Use a graphical local control panel (GLCP) to react to messages during the autotuning sequence.

Selecting either PID or SPC in parameter **20-79 PID Autotuning** puts the drive in autotuning mode. The LCP then shows on-screen instructions.

To start the fan/pump, press [Auto On] and apply a start signal. The default control settings ensure that the setpoint is eventually reached. For PID autotuning, it is possible to adjust the speed manually by pressing [▲] or [▼] to a level where the feedback is around the system setpoint.



NOTE: If the feedback goes outside the specified limits (2073 and 2074) defined during autotune setup, the autotuning is discarded. The limits also serve as application protection during autotuning execution.



NOTE: It is not possible to run the motor at maximum or minimum speed when manually adjusting the motor speed due to the need of increasing or decreasing the motor speed during autotuning.

Autotuning introduces step changes while operating at a steady state and then monitors the feedback. For PID control, the autotuning feedback response defines the required values for parameter **20-93 PID Proportional Gain**, and parameter **20-94 PID Integral Time** is calculated. Parameter **20-95 PID Differentiation Time** is set to value 0. Parameter **20-81 PID Normal/Inverse Control** is determined during the tuning process.

These calculated values are presented in the LCP and can be either accepted or rejected. Once accepted, the values are written to the relevant parameters and autotuning mode is disabled in parameter **20-79 PID Autotuning**. Depending on the system, the time required to carry out autotuning could be several minutes.

Before carrying out the autotuning, set the following parameters according to the load inertia:

- Parameter **3-41 Ramp 1 Ramp Up Time**
- Parameter **3-42 Ramp 1 Ramp Down Time**

or

- Parameter **3-51 Ramp 2 Ramp Up Time**
- Parameter **3-52 Ramp 2 Ramp Down Time**

If PID autotuning is carried out with slow ramp times, the autotuned parameters typically result in slow control. Before activating PID autotuning, remove excessive feedback sensor noise using the input filter (parameter groups **6-** Analog In/Out**, **5-** Pulse Input**, and **26-** Analog I/O Option MCB 109**, parameter **6-16 Terminal 53 Filter Time Constant**, parameter **6-26 Terminal 54 Filter Time Constant**, parameter **5-54 Pulse Filter Time Constant #29**, parameter **5-59 Pulse Filter Time Constant #33**). To obtain the most accurate controller parameters, carry out PID autotuning when the application runs in typical operation with a typical load.

SPC autotuning

SPC initiates a tuning of DRC. If feedback from the system determines the system to be 2nd order, autotuning proceeds automatically with tuning of PID parameters. If SPC discards the DRC, it is shown by the process bar going to step 4.

DCR assumes that the target applications of the drive can be generically modeled as 1st order plus dead-time systems. DRC autotuning is providing the feedback for calculation.

- τ = time constant of process system K_p (process system gain).
- θ = time delay between input and output. DRC can only be set up by using SPC.

20-70 Closed Loop Type

Default value:	[0] Auto	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the application response speed if it is known. The default setting is sufficient for most applications. A more precise value decreases the time needed for carrying out PID adaptation. The setting has no impact on values of parameters and only affects the auto-tuning speed.

Option	Name	Description
[0]*	Auto	Takes 30–120 s to complete.
[1]	Fast pressure	Takes 10–60 s to complete.
[2]	Slow pressure	Takes 30–120 s to complete
[3]	Fast temperature	Takes 10–20 minutes to complete.
[4]	Slow temperature	Takes 30–60 minutes to complete.

20-71 PID Performance

Default value:	[0] Normal	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the application response speed if it is known. The default setting is sufficient for most applications. A more precise value decreases the time needed for carrying out PID adaptation. The setting has no impact on values of parameters and only affects the auto-tuning speed.

Option	Name	Description
[0]*	Normal	Normal setting of this parameter is suitable for pressure control in fan systems.
[1]	Fast	Fast setting is used in pumping systems where a faster control response is wanted.

20-72 PID Output Change

Default value:	0.10	Parameter type:	Range, 0.01 - 0.5
Setup:	2 setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

This parameter sets the magnitude of step change during auto tuning. The value is a percentage of full speed. That is, if maximum output frequency in parameter **4-13 Motor Speed High Limit [RPM]**/parameter **4-14 Motor Speed High Limit [Hz]** is set to 40 Hz, 0.10 is 10% of 50 Hz, which is 5 Hz. Set this parameter to a value resulting in feedback changes of 10–20% for best tuning accuracy.

20-73 Minimum Feedback Level

Default value:	-999999 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	2 setups	Conversion index:	-2
Data type:	Int32	Change during operation:	True

Enter the minimum allowable feedback level in user units as defined in parameter **20-12 Reference/Feedback Unit**. If the level drops below parameter **20-73 Minimum Feedback Level**, auto tuning is aborted and an error message appears in the LCP.

20-74 Maximum Feedback Level

Default value:	999999 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	2 setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the maximum allowable feedback level in user units as defined in parameter **20-12 Reference/Feedback Unit**. If the level rises above parameter **20-74 Maximum Feedback Level**, auto tuning is aborted and an error message appears in the LCP.

20-79 Autotuning

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the controller which should be autotuned. Once the auto tuning has successfully completed and the settings have been accepted or rejected via [OK] or [Cancel] at the end of tuning, this parameter resets to [0] *Disabled*.

Option	Name	Description
[0]*	Disabled	Auto tuning is disabled.
[1]	PID	
[2]	Smart process	
[3]	DRC	

5.19.7 20-8* PID Basic Settings

This parameter group is used to configure the basic operation of the PID controller, including:

- Response to the feedback above or below the setpoint.
- The speed at which it first starts functioning.
- When it indicates that the system has reached the setpoint.

20-81 PID Normal/Inverse Control

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Normal	The output frequency of the drive decreases when the feedback is greater than the setpoint reference. This behavior is common for pressure-controlled supply fan and pump applications.
[1]	Inverse	The output frequency of the drive increases when the feedback is greater than the setpoint reference. This behavior is common for temperature-controlled cooling applications, such as cooling towers.

20-82 PID Start Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - Par. 4-13 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is only visible if parameter *0-02 Motor Speed Unit* is set to [0] *RPM*.

When the drive is first started, it initially ramps up to this output speed in open-loop mode, following the active ramp-up time. When the programmed output speed is reached, the drive automatically switches to closed-loop mode, and the PID controller begins to function. This is useful in applications that require quick acceleration to a minimum speed at start-up.

20-83 PID Start Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - Par. 4-14 [Hz]
Setup:	All setups	Conversion index:	-1

Data type: Uint16 **Change during operation:** True



NOTE: This parameter is only visible if parameter **0-02 Motor Speed Unit** is set to **[1] Hz**.

When the drive is first started, it initially ramps up to this output frequency in open-loop mode, following the active ramp-up time. When the output frequency programmed is reached, the drive automatically switches to closed-loop mode, and the PID controller begins to function. This is useful in applications that require quick acceleration to a minimum speed at start-up.

20-84 On Reference Bandwidth

Default value: 5% **Parameter type:** Range, 0 - 200%
Setup: All setups **Conversion index:** 0
Data type: Uint8 **Change during operation:** True

When the difference between the feedback and the setpoint reference is less than the value of this parameter, the display of the drive shows *Run on reference*. This status can be communicated externally by programming the function of a digital output for **[8] Run on reference/no warning**. Also, for serial communication, the On Reference status bit of the drive status word is high (value = 1). The *On reference bandwidth* is calculated as a percentage of the setpoint reference.

5.19.8 20-9* PID Controller

Use these parameters to adjust the PID controller manually. By adjusting the PID controller parameters, the control performance may be improved.

20-91 PID Anti Windup

Default value: [1] On **Parameter type:** Option
Setup: All setups **Conversion index:** –
Data type: Uint8 **Change during operation:** True



NOTE: Option **[1] On** is activated automatically if 1 of the following options is selected in parameters in parameter group **21-** Ext. Closed Loop: [0] Normal, [X] Enabled Ext CLX PID**.

Option	Name	Description
[0]	Off	The integrator continues to change value also after output has reached 1 of the extremes. This can afterwards cause a delay of change of the output of the controller.
[1]*	On	The integrator is locked if the output of the built-in PID controller has reached 1 of the extremes (minimum or maximum value) and therefore is not able to add further changes to the value of the process parameter controlled. This allows the controller to respond more quickly when it can control the system again.

20-93 PID Proportional Gain

Default value: 2 **Parameter type:** Range, 0=Off - 10
Setup: All setups **Conversion index:** -2
Data type: Uint16 **Change during operation:** True



NOTE: Always set the required value for parameter **20-14 Maximum Reference/Feedb.** before setting the values for the PID controller in parameter group **20-9* PID Controller**.

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

If (error x gain) jumps with a value equal to what is set in parameter **20-14 Maximum Reference/Feedb.**, the PID controller tries to change the output speed equal to what is set in parameter **4-13 Motor Speed High Limit [RPM]**/parameter **4-14 Motor Speed High Limit [Hz]**. However, the output speed is limited by this setting.

Calculate the proportional band (error causing output to change from 0–100%) with this formula:

$$\left(\frac{1}{\text{Proportional gain}} \right) \times (\text{Max reference})$$

20-94 PID Integral Time

Default value:	8 s	Parameter type:	Range, 0.01 - 10000 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

The integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches zero. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in parameter **20-93 PID Proportional Gain**. When no deviation is present, the output from the proportional controller is 0.

20-95 PID Differentiation Time

Default value:	0 s	Parameter type:	Range, 0=Off - 10 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The differentiator monitors the rate of change of the feedback. If the feedback is changing quickly, it adjusts the output of the PID controller to reduce the rate of change of the feedback. Quick PID controller response is obtained when this value is large. However, if too large a value is used, the output frequency of the drive may become unstable. Differentiation time is useful in situations where extremely fast drive response and precise speed control are required. It can be difficult to adjust this for proper system control. Differentiation time is not commonly used in HVAC applications. Therefore, it is best to leave this parameter at 0 or OFF.

20-96 PID Diff. Gain Limit

Default value:	5	Parameter type:	Range, 1 - 50
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

The differential function of a PID controller responds to the rate of change of the feedback. As a result, an abrupt change in the feedback can cause the differential function to make a large change in the PID controller output. This parameter limits the maximum effect that the PID controller differential function can produce. A smaller value reduces the maximum effect of the PID controller differential function. This parameter is only active when parameter **20-95 PID Differentiation Time** is not set to OFF (0 s).

5.20 Parameter Group 21-** Extended Closed Loop

5.20.1 Introduction to Extended Closed Loop

The FC 202 offers 3 extended closed-loop PID controllers in addition to the PID controller. These can be configured independently either to control external actuators (valves, dampers, and so on) or to be used with the internal PID controller to improve the dynamic responses to setpoint changes or load disturbances.

The extended closed-loop PID controllers may be interconnected or connected to the PID closed-loop controller to form a dual-loop configuration.

To control a modulating device, for example a valve motor, that device must be a positioning servo motor with built-in electronics accepting either a 0–10 V (signal from VLT® Analog I/O Option MCB 109) or a 0/4–20 mA (signal from control card and/or VLT® General Purpose I/O MCB 101) control signal. The output function can be programmed in the following parameters:

- Control card, terminal 42: Parameter **6-50 Terminal 42 Output** (settings [113]...[115] or [149]...[151], Ext. Closed Loop 1/2/3)
- VLT® General Purpose I/O MCB 101, terminal X30/8: Parameter **6-60 Terminal X30/8 Output** (settings [113]...[115] or [149]...[151], Ext. Closed Loop 1/2/3)
- VLT® Analog I/O Option MCB 109, terminal X42/7....11: Parameter **26-40 Terminal X42/7 Output**, parameter **26-50 Terminal X42/9 Output**, parameter **26-60 Terminal X42/11 Output** (settings [113]...[115], Ext. Closed Loop 1/2/3)

VLT® General Purpose I/O MCB 101 and VLT® Analog I/O Option MCB 109 are optional cards.

5.20.2 21-0* Extended CL Autotuning

The extended closed-loop PID controllers can each be autotuned, which simplifies and saves time during commissioning, while ensuring accurate PID control adjustment.

To use PID autotuning, configure the relevant extended PID controller for the application.

Use a graphical LCP to react to messages during the autotuning sequence.

When enabling autotuning, parameter **21-09 PID Autotuning** puts the relevant PID controller into PID autotuning mode. The LCP then provides on-screen instructions.

PID autotuning introduces step changes and then monitors the feedback. Based on the feedback response, the following required values are calculated:

- PID proportional gain
 - Parameter **21-21 Ext. 1 Proportional Gain** for EXT CL 1.
 - Parameter **21-41 Ext. 2 Proportional Gain** for EXT CL 2.
 - Parameter **21-61 Ext. 3 Proportional Gain** for EXT CL 3.
- Integral time
 - Parameter **21-22 Ext. 1 Integral Time** for EXT CL 1.
 - Parameter **21-42 Ext. 2 Integral Time** for EXT CL 2.
 - Parameter **21-62 Ext. 3 Integral Time** for EXT CL 3.

The PID differentiation time is set to 0 in the following parameters:

- Parameter **21-23 Ext. 1 Differentiation Time** for EXT CL 1.
- Parameter **21-43 Ext. 2 Differentiation Time** for EXT CL 2.
- Parameter **21-63 Ext. 3 Differentiation Time** for EXT CL 3.
- Parameter **21-20 Ext. 1 Normal/Inverse Control** for EXT CL 1.
- Parameter **21-40 Ext. 2 Normal/Inverse Control** for EXT CL 2.

- Parameter **21-60 Ext. 3 Normal/Inverse Control** for EXT CL 3.

These calculated values are presented on the LCP and can either be accepted or rejected. Once accepted, the values are written to the relevant parameters, and PID autotuning mode is disabled in parameter **21-09 PID Autotuning**.

Depending on the system being controlled, the time required to carry out PID autotuning could be several minutes.

Before activating the PID autotuning, remove excessive feedback sensor noise by using the input filter (parameter groups **5-5* Pulse Input**, **6-** Analog In/Out**, and **26-** Analog I/O Option MCB 109**, terminal 53/54 filter time constant, and pulse filter time constant #29/33).

21-00 Closed Loop Type

Default value:	[0] Auto	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter defines the application response. The default mode should be sufficient for most applications. If the relative application speed is known, it can be selected here. This decreases the time needed for carrying out PID autotuning.

Option	Name	Description
[0*]	Auto	
[1]	Fast pressure	
[2]	Slow pressure	
[3]	Fast temperature	
[4]	Slow temperature	

21-01 PID Performance

Default value:	[0] Normal	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0*]	Normal	Normal setting for this parameter is suitable for pressure control in fan systems.
[1]	Fast	Fast setting would generally be used in pumping systems where a faster control response is desirable.

21-02 PID Output Change

Default value:	0.10	Parameter type:	Range, 0.01 - 0.50
Setup:	2 setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter sets the magnitude of step change during auto tuning. The value is a percentage of full operating range. That is, if the maximum analog output voltage is set to 10 V, 0.10 is 10% of 10 V, which is 1 V. Set this parameter to a value resulting in feedback changes of 10–20% for best tuning accuracy.

21-03 Minimum Feedback Level

Default value:	-999999.999	Parameter type:	Range, -999999.999 - par. 21-04
Setup:	2 setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the minimum allowable feedback level in user units as defined:

- Parameter **21-10 Ext. 1 Ref./Feedback Unit** for EXT CL 1.
- Parameter **21-30 Ext. 2 Ref./Feedback Unit** for EXT CL 2.
- Parameter **21-50 Ext. Ref./Feedback Unit** EXT CL.

If the level drops below parameter **21-03 Minimum Feedback Level**, PID auto tuning is aborted, and an error message appears in the display.

21-04 Maximum Feedback Level

Default value:	999999.999	Parameter type:	Range, Par. 21-03 - 999999.999
Setup:	2 setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the maximum allowable feedback level in user units as defined:

- Parameter **21-10 Ext. 1 Ref./Feedback Unit** for EXT CL 1.
- Parameter **21-30 Ext. 2 Ref./Feedback Unit** for EXT CL 2.
- Parameter **21-50 Ext. Ref./Feedback Unit** EXT CL.

If the level rises above parameter **21-04 Maximum Feedback Level**, PID autotuning is aborted, and an error message appears in the display.

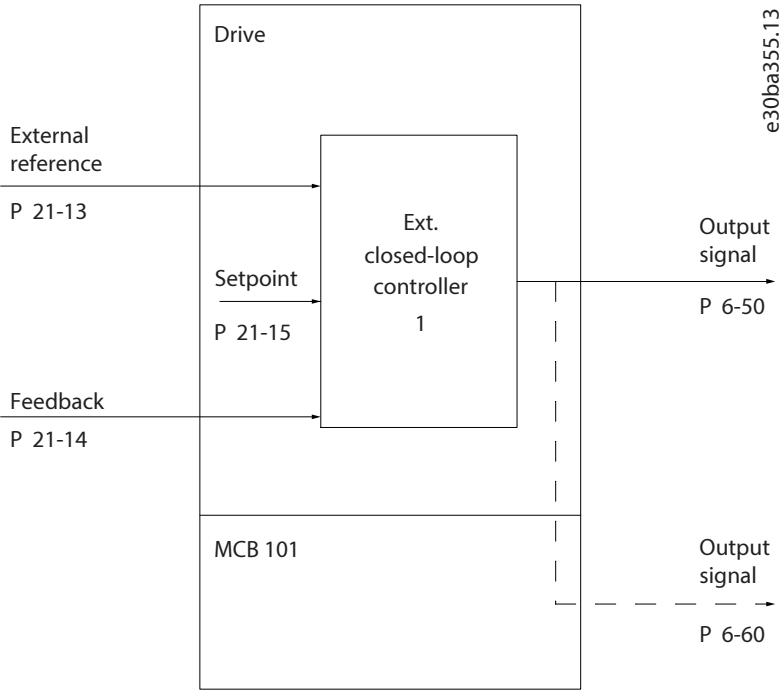
21-09 PID Autotuning

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter enables selection of the extended PID controller to be autotuned and starts the PID autotuning for that controller. Once the autotuning has successfully completed, and the settings have been accepted or rejected with **[OK]** or **[Cancel]** when autotuning has ended, this parameter resets to **[0] Disabled**.

Option	Name	Description
[0*]	Disabled	
[1]	Enabled EXT CL 1 PID	
[2]	Enabled EXT CL 2 PID	
[3]	Enabled EXT CL 3 PID	

5.20.3 21-1* Closed Loop Ref/Feedback



21-10 Ext. 1 Ref./Feedback Unit

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit for the reference and feedback.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	

Option	Name	Description
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

21-11 Ext. 1 Minimum Reference

Default value:	0 ExtPID1Unit	Parameter type:	Range, -999999.999 - par. 21-12 Ext.PID1Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Select the minimum reference for the closed-loop 1 controller.

21-12 Ext. Maximum Reference

Default value:	100 ExtPID1Unit	Parameter type:	Range, par. 21-11 - 999999.999 Ext.PID1Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True



NOTE: Set the value for parameter **21-12 Ext. 1 Maximum Reference** before setting the values for the PID controller in parameter group **20-9* PID Controller**.

Select the maximum reference for the closed-loop 1 controller. The dynamics of the PID controller depend on the value set in this parameter. See also parameter **21-21 Ext. 1 Proportional Gain**.

21-13 Ext. 1 Reference Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: If feedback is not used, set its source to **[0] No function**. Parameter **20-20 Feedback Function** determines how the PID controller uses the 3 possible feedbacks.

This parameter defines which input on the drive should be treated as the source of the reference signal for the closed-loop 1 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[11]	Local bus reference	
[20]	Digital pot. meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	

Option	Name	Description
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[33]	PCD bus reference	
[35]	Digital input select	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	

21-14 Ext. 1 Feedback Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter defines which input on the drive should be treated as the source of the feedback signal for the closed-loop 1 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	

Option	Name	Description
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

21-15 Ext. 1 Setpoint

Default value:	0 ExtPID1Unit	Parameter type:	Range, -999999.999 - 999999.999 Ext.PID1Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

The setpoint reference is used in extended 1 closed loop. Ext. 1 setpoint is added to the value from the Ext. 1 reference source selected in parameter **21-13 Ext. 1 Reference Source**.

21-17 Ext. Reference [Unit]

Default value:	0 ExtPID1Unit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Readout of the reference value for the closed-loop 1 controller.

21-18 Ext. 1 Feedback [Unit]

Default value:	0 ExtPID1Unit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Readout of the feedback value for the closed-loop 1 controller.

21-19 Ext. 1 Output [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Readout of the output value for the closed-loop 1 controller.

5.20.4 21-2* Closed Loop 1 PID

21-20 Ext. 1 Normal/Inverse Control

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–

Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0*]	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increases the output when feedback is higher than the reference.

21-21 Ext. 1 Proportional Gain

Default value:	0.50	Parameter type:	Range, 0=Off - 10
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

If (error x gain) jumps with a value equal to what is set in parameter **20-14 Maximum Reference/Feedb.**, the PID controller tries to change the output speed equal to what is set in parameter **4-13 Motor Speed High Limit [RPM]**/parameter **4-14 Motor Speed High Limit [Hz]**.

However, the output speed is limited by this setting. The proportional band (error causing output to change from 0–100%) can be calculated with this formula:

$$\left(\frac{1}{\text{Proportional gain}} \right) \times (\text{Maximum reference})$$

21-22 Ext. 1 Integral Time

Default value:	20 s	Parameter type:	0.01 - 10000=Off s
Setup:	All setups	Conversion index:	-2
Data type:	UInt32	Change during operation:	True

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in parameter **20-93 PID Proportional Gain**. When no deviation is present, the output from the proportional controller is 0.

21-23 Ext. 1 Differentiation Time

Default value:	0 s	Parameter type:	Range, 0=Off - 10 s
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator is.

21-24 Ext. 1 Dif. Gain Limit

Default value:	5	Parameter type:	Range, 1 - 50
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	True

Set a limit for the differentiator gain (DG). The DG increases if there are fast changes. Limit the DG to obtain a pure differentiator gain when changes are slow and a constant differentiator gain when quick changes occur.

21-26 Ext. 1 On Reference Bandwidth

Default value:	5%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the on-reference bandwidth. When the PID control error (the difference between the reference and the feedback) is less than the value of this parameter, the on-reference status bit is high.

5.20.5 21-3* Closed Loop 2 Ref/Fb

21-30 Ext. 2 Ref./Feedback Unit

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit for the reference and feedback.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	

Option	Name	Description
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

21-31 Ext. 2 Minimum Reference

Default value:	0 ExtPID2Unit	Parameter type:	Range, -999999.999 - par. 21-32 Ext.PID2Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Select the minimum reference for the closed-loop 2 controller.

21-32 Ext. 2 Maximum Reference

Default value:	100 ExtPID2Unit	Parameter type:	Range, par. 21-31 - 999999.999 Ext.PID1Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True



NOTE: Set the value for parameter **21-32 Ext. 2 Maximum Reference** before setting the values for the PID controller in parameter group **20-9* PID Controller**.

Select the maximum reference for the closed-loop 1 controller. The dynamics of the PID controller depend on the value set in this parameter. See also parameter **21-41 Ext. 2 Proportional Gain**.

21-33 Ext. 2 Reference Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: If feedback is not used, set its source to **[0] No function**. Parameter **20-20 Feedback Function** determines how the PID controller uses the 3 possible feedbacks.

This parameter defines which input on the drive should be treated as the source of the reference signal for the closed-loop 2 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[11]	Local bus reference	
[20]	Digital pot. meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[33]	PCD bus reference	

Option	Name	Description
[35]	Digital input select	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	

21-34 Ext. 2 Feedback Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter defines which input on the drive should be treated as the source of the feedback signal for the closed-loop 3 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	

Option	Name	Description
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

21-35 Ext. 2 Setpoint

Default value:	0 ExtPID2Unit	Parameter type:	Range, -999999.999 - 999999.999 Ext.PID1Unit
Setpoint:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

The setpoint reference is used in extended 2 closed loop. Ext. 1 setpoint is added to the value from the Ext. 1 reference source selected in parameter **21-33 Ext. 2 Reference Source**.

21-37 Ext. 2 Reference [Unit]

Default value:	0 ExtPID2Unit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Readout of the reference value for the closed-loop 2 controller.

21-38 Ext. 2 Feedback [Unit]

Default value:	0 ExtPID2Unit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Readout of the feedback value for the closed-loop 2 controller.

21-39 Ext. 2 Output [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Readout of the output value for the closed-loop 2 controller.

5.20.6 21-4* Closed Loop 2 PID

21-40 Ext. 2 Normal/Inverse Control

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0*]	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increases the output when feedback is higher than the reference.

21-41 Ext. 2 Proportional Gain

Default value:	0.50	Parameter type:	Range, 0=Off - 10
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

21-42 Ext. 2 Integral Time

Default value:	20 s	Parameter type:	0.01 - 10000=Off s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in parameter **20-93 PID Proportional Gain**. When no deviation is present, the output from the proportional controller is 0.

21-43 Ext. 2 Differentiation Time

Default value:	0 s	Parameter type:	Range, 0=Off - 10 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator.

21-44 Ext. 2 Dif. Gain Limit

Default value:	5	Parameter type:	Range, 1 - 50
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set a limit for the differentiator gain (DG). The DG increases if there are fast changes. Limit the DG to obtain a pure differentiator gain when changes are slow, and a constant differentiator gain when changes are quick.

21-46 Ext. 2 On Reference Bandwidth

Default value:	5%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the on-reference bandwidth. When the PID control error (the difference between the reference and the feedback) is less than the value of this parameter, the on-reference status bit is high.

5.20.7 21-5* Closed Loop 3 Ref/Fb

21-50 Ext. 3 Ref./Feedback Unit

Default value:	[0] None	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit for the reference and feedback.

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	

Option	Name	Description
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	hp	

21-51 Ext. 3 Minimum Reference

Default value:	0 ExtPID3Unit	Parameter type:	Range, -999999.999 - par. 21-52 Ext.PID3Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Select the minimum reference for the closed-loop 3 controller.

21-52 Ext. 3 Maximum Reference

Default value:	100 ExtPID3Unit	Parameter type:	Range, par. 21-51 - 999999.999 Ext.PID3Unit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True



NOTE: Set the value for parameter *21-52 Ext. 3 Maximum Reference* before setting the values for the PID controller in parameter group *20-9* PID Controller*.

Select the maximum reference for the closed-loop 3 controller. The dynamics of the PID controller depend on the value set in this parameter. See also parameter **21-61 Ext. 3 Proportional Gain**.

21-53 Ext. 3 Reference Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: If feedback is not used, set its source to **[0] No function**. Parameter **20-20 Feedback Function** determines how the PID controller uses the 3 possible feedback.

This parameter defines which input on the drive should be treated as the source of the reference signal for the closed-loop 3 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	Use this selection if feedback is not used.
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[11]	Local bus reference	
[20]	Digital pot. meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[30]	Ext. closed loop 1	
[31]	Ext. closed loop 2	
[32]	Ext. closed loop 3	
[33]	PCD bus reference	
[35]	Digital input select	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	

21-54 Ext. 3 Feedback Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–

Data type: Uint8 **Change during operation:** True

This parameter defines which input on the drive should be treated as the source of the feedback signal for the closed-loop 3 controller. Analog input X30/11 and analog input X30/12 refer to inputs on the VLT® General Purpose I/O Card MCB 101.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[15]	Analog input X48/2	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	
[101]	Bus feedback 2	
[102]	Bus feedback 3	
[104]	Sensorless flow	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[105]	Sensorless pressure	Requires setup by VLT® Motion Control Tool MCT 10 with sensorless plug-in.
[200]	Ext. closed loop 1	
[201]	Ext. closed loop 2	
[202]	Ext. closed loop 3	

21-55 Ext. 3 Setpoint

Default value: 0 ExtPID3Unit **Parameter type:** Range, -999999.999 - 999999.999 Ext.PID3Unit

Setup: All setups **Conversion index:** -3

Data type: Int32 **Change during operation:** True

The setpoint reference is used in extended 1 closed loop. Ext. 1 setpoint is added to the value from the Ext. 3 reference source selected in parameter **21-53 Ext. 3 Reference Source**.

21-57 Ext. 3 Reference [Unit]

Default value:	0 ExtPID3Unit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Readout of the reference value for the closed-loop 3 controller.

21-58 Ext. 3 Feedback [Unit]

Default value:	0 ExtPID3Unit	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Readout of the feedback value for the closed-loop 3 controller.

21-59 Ext. 3 Output [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Readout of the output value for the closed-loop 3 controller.

5.20.8 21-6* Closed Loop 3 PID

21-60 Ext. 3 Normal/Inverse Control

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0*]	Normal	Reduces the output when feedback is higher than the reference.
[1]	Inverse	Increases the output when feedback is higher than the reference.

21-61 Ext. 3 Proportional Gain

Default value:	0.50	Parameter type:	Range, 0=Off - 10
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

The proportional gain indicates the number of times the error between the setpoint and the feedback signal is to be applied.

21-62 Ext. 3 Integral Time

Default value:	20 s	Parameter type:	0.01 - 10000=Off s
Setup:	All setups	Conversion index:	-2
Data type:	UInt32	Change during operation:	True

Over time, the integrator accumulates a contribution to the output from the PID controller as long as there is a deviation between the reference/setpoint and feedback signals. The contribution is proportional to the size of the deviation. This ensures that the deviation (error) approaches 0. Quick response on any deviation is obtained when the integral time is set to a low value. Setting it too low, however, may cause the control to become unstable. The value set is the time needed for the integrator to add the same contribution as the proportional for a certain deviation. If the value is set to 10000, the controller acts as a pure proportional controller with a P-band based on the value set in parameter **20-93 PID Proportional Gain**. When no deviation is present, the output from the proportional controller is 0.

21-63 Ext. 3 Differentiation Time

Default value:	0 s	Parameter type:	Range, 0=Off - 10 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The differentiator does not react to a constant error. It only provides a gain when the feedback changes. The quicker the feedback changes, the stronger the gain from the differentiator.

21-64 Ext. 3 Dif. Gain Limit

Default value:	5	Parameter type:	Range, 1 - 50
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

21-66 Ext. 3 On Reference Bandwidth

Default value:	5%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the on-reference bandwidth. When the PID control error (the difference between the reference and the feedback) is less than the value of this parameter, the on-reference status bit is high.

5.21 Parameter Group 22-** Application Functions

5.21.1 22-0* Miscellaneous

This parameter group contains parameters used for monitoring water/wastewater applications.

22-00 External Interlock Delay

Default value:	0 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the delay time for the external interlock command.

22-01 Power Filter Time

Default value:	0.50 s	Parameter type:	Range, 0.02 - 10 s
Setup:	2 setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the time constant for the filtered power readout. A higher value will give a more steady readout but a slower system response to changes.

5.21.2 22-2* No-flow Detection

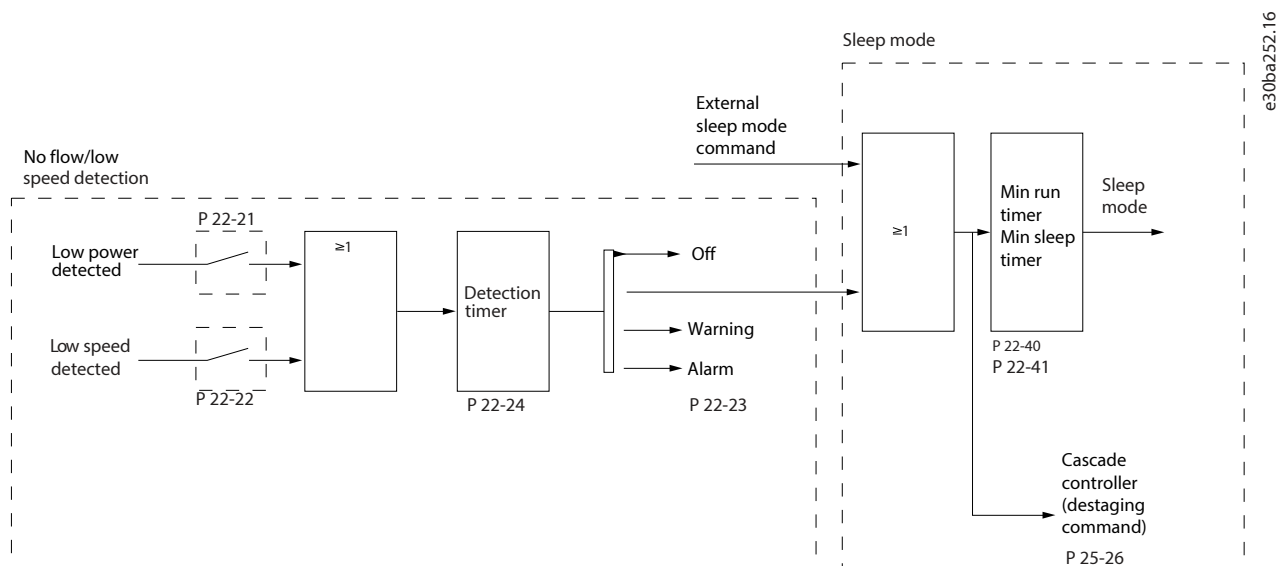


Figure 95: Signal Flow Chart

The VLT® AQUA Drive FC 202 includes functions that detect if the load conditions in the system allow the motor to be stopped:

- Low-power detection
- Low-speed detection

One of these 2 signals must be active for a set time (parameter **22-24 No-Flow Delay**) before the selected action takes place. Possible actions to select (in parameter **22-23 No-Flow Function**) are:

- No action
- Warning
- Alarm
- Sleep mode

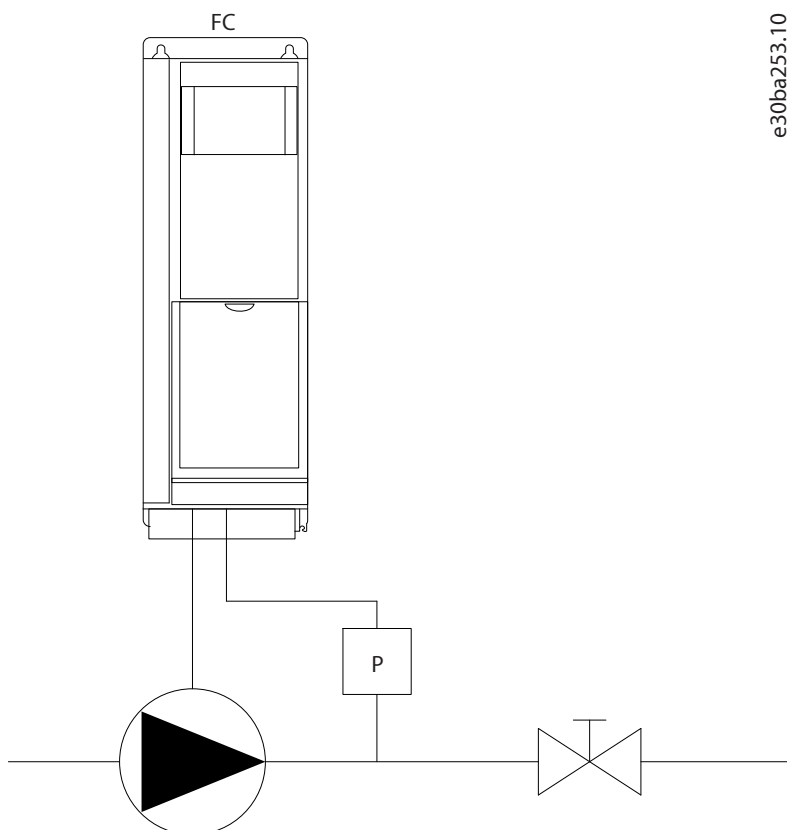
No-flow detection

This function is used to detect a no-flow situation in pump systems where all valves can be closed. It can be used both when controlled by the integrated PI controller in the drive or by an external PI controller. Program the actual configuration in parameter **1-00 Configuration Mode**. The configuration modes for the PI controllers are as follows:

- Integrated PI controller: Closed loop
- External PI controller: Open loop

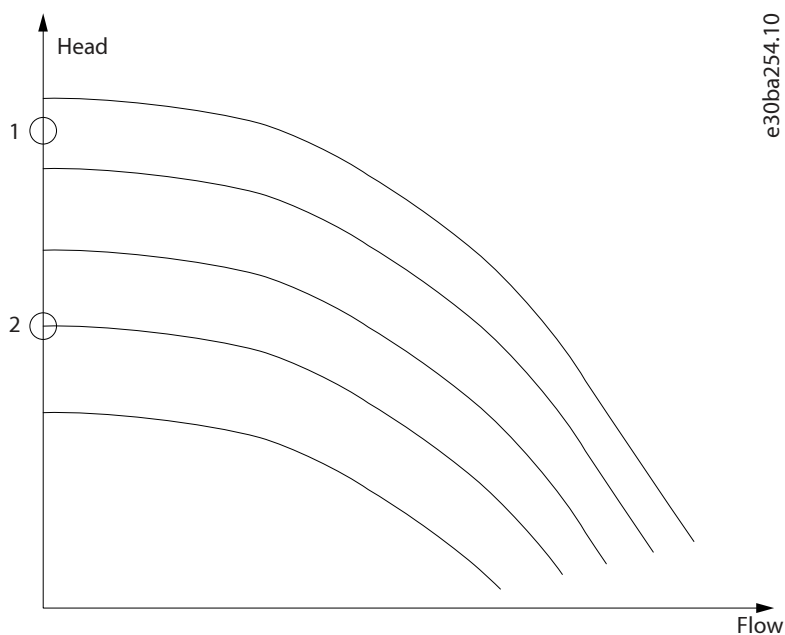


NOTE: Carry out no-flow tuning before setting the PI controller parameters.



e30ba253.10

Figure 96: No-flow Detection Scheme



e30ba254.10

Figure 97: No-flow Detection Graph

No-flow detection is based on the measurement of speed and power. For a certain speed, the drive calculates the power at no flow. The coherence is based on the adjustment of 2 sets of speed and associated power at no flow. By monitoring the power, it is possible to detect no-flow conditions in systems with fluctuating suction pressure, or if the pump has a flat characteristic towards low speed. Base the 2 sets of data on measurement of power at approximately 50% and 85% of maximum speed with the valve closed. The data

is programmed in parameter group **22-3* No-flow Power Tuning**. It is also possible to run a parameter **22-20 Low Power Auto Set-up**, automatically stepping through the commissioning process, and also automatically storing the data measured. Set the drive for open loop in parameter **1-00 Configuration Mode** when carrying out the auto setup (see parameter group **22-3* No-flow Power Tuning**).



NOTE: When using the integrated PI controller, carry out no-flow tuning before setting the PI controller parameters.

Low-speed detection

Low-speed detection gives a signal if the motor operates with minimum speed as set in parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]**. Actions are common with no-flow detection (individual selection not possible). The use of low-speed detection is not limited to systems with a no-flow situation. It can be used in any system where operation at minimum speed allows for a stop of the motor until the load calls for a speed higher than minimum speed. An example is systems with fans and compressors.



NOTE: In pump systems, ensure that the minimum speed in parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]** has been set high enough for detection as the pump can run with a rather high speed, even with valves closed.

Dry-pump detection

No-flow detection can also be used to detect if the pump has run dry (low power consumption and high speed). It can be used with both the integrated PI controller and an external PI controller. The conditions for dry-pump signal are:

- Power consumption below no-flow level.
- Pump running at maximum speed or maximum reference open loop, whichever is lowest.

The signal must be active for a set time (parameter **22-27 Dry Pump Delay**) before the selected action takes place. Possible actions to select (in parameter **22-26 Dry Pump Function**) are:

- Warning
- Alarm

Enable the low-power detection in parameter **22-21 Low Power Detection**. Perform the tuning using parameter group **22-3* No-Flow Power Tuning**.

In a dry-pump detection setup, select **[0] Off** in parameter **22-23 No-Flow Function**. Otherwise, make sure that the options in that parameter do not prevent the dry-pump detection.

22-20 Low Power Auto Set-up

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

Start of auto setup of power data for no-flow power tuning.

Option	Name	Description
[0*]	Off	
[1]	Enabled	 NOTE: Do the auto setup when the system has reached normal operating temperature.  NOTE: It is important that parameter <i>4-13 Motor Speed High Limit [RPM]</i> or parameter <i>4-14 Motor Speed High Limit [Hz]</i> is set to the maximum operational speed of the motor.  NOTE: Do the auto setup before configuring the integrated PI controller as the settings are reset when changing from closed loop to open loop in parameter <i>1-00 Configuration Mode</i>.  NOTE: Carry out the tuning with the same settings in parameter <i>1-03 Torque Characteristics</i> as for operation after the tuning. An auto setup sequence is activated, automatically setting the speed to approximately 50% and 85% of nominal motor speed (parameter <i>4-13 Motor Speed High Limit [RPM]</i> and parameter <i>4-14 Motor Speed High Limit [Hz]</i>). At those 2 speeds, the power consumption is automatically measured and stored. Before enabling auto setup: • Close valves to create a no-flow condition. • Set the drive to open loop (parameter <i>1-00 Configuration Mode</i>). It is important also to set parameter <i>1-03 Torque Characteristics</i>.

22-21 Low Power Detection

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter for enabling/disabling no-flow detection based on measured motor power.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	To set the parameters in parameter group <i>22-3* No-flow Power Tuning</i> for proper operation, carry out the low-power detection commissioning.

22-22 Low Speed Detection

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter for enabling/disabling no-flow detection based on operation at motor speed low limit.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	Detects when the motor operates at a speed as set in parameter 4-11 Motor Speed Low Limit [RPM] or parameter 4-12 Motor Speed Low Limit [Hz] .
[2]	Enabled with boost	This option is available when [3] Closed loop is selected in parameter 1-00 Configuration Mode. Enable this option to improve the low-speed detection for applications with at least 1 of the following characteristics: • Varying inlet pressure. • A pressure drop at the outlet caused by closing a non-return valve. In such applications, the drive potentially does not reduce the speed to the minimum as required for the normal low-speed detection. When this option is selected, the drive creates a pressure pulse (boost of the pressure) when the feedback is within the range defined in parameter 7-39 On Reference Bandwidth for a period defined in parameter 22-40 Minimum Run Time or longer. Parameter 22-45 Setpoint Boost adjusts the height of the pulses. Parameter 22-46 Maximum Boost Time defines the maximum length of the pulse.  NOTE: If selecting this option, ensure that the system can withstand the boost pressure.

Option	Name	Description
[3]	Enabled for multiple drives	For applications with multiple drives. Enable low-speed detection with the following features: • Minimum run time • Minimum sleet time • Boost
[4]	Enabled multidrive boost	For applications with multiple drives. This option is available when [3] Closed loop is selected in parameter 1-00 Configuration Mode. Enable this option to improve low-speed detection for applications with at least 1 of the following characteristics: • Varying inlet pressure. • A pressure drop at the outlet caused by closing a non-return valve. In such applications, the drive potentially does not reduce the speed to the minimum as required for the normal low-speed detection. When this option is selected, the drive created a pressure pulse (boost of the pressure) when the feedback is within the range defined in parameter 7-39 On Reference Bandwidth for a period defined in parameter 22-40 Minimum Run Time or longer. Parameter 22-45 Setpoint Boost adjusts the height of the pulses. Parameter 22-46 Maximum Boost Time defines the maximum length of the pulse.  NOTE: If selecting this option, ensure that the system can withstand the boost pressure. Refer to the Cascade Controller Options MCO 101/102 Operating Instructions for more information about the cascade controller.

22-23 No-flow Detection

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Common actions for low-power detection and low-speed detection (individual selections not possible).

Option	Name	Description
[0*]	Off	NOTE: Do not set parameter 14-20 Reset Mode to [13] Infinite auto reset when parameter 22-23 No-flow Function is set to [3] Alarm. Doing so causes the drive to continuously cycle between running and stopping when a no-flow condition is detected. NOTE: Disable the automatic bypass function of the bypass if - the drive has a constant-speed bypass with an automatic bypass function starting the bypass if a persistent alarm condition occurs, AND [3] Alarm is selected as the no-flow function.
[1]	Sleep mode	The drive enters sleep mode and stops when a no-flow condition is detected. See parameter group 22-4* Sleep Mode for programming options for sleep mode.
[2]	Warning	The drive continues to run but activates a no-flow warning (<i>warning 92, NoFlow</i>). A digital output or a serial communication bus can communicate a warning to other equipment.
[3]	Alarm	The drive stops running and activates a no-flow alarm (<i>alarm 92, NoFlow</i>). A drive digital output or a serial communication bus can communicate an alarm to other equipment.

22-24 No-flow Delay

Default value:	10 s	Parameter type:	Range, 1 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the time that low power/low speed must stay detected to activate a signal for actions. If detection disappears before the time runs out, the timer is reset.

22-26 Dry Pump Function

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the action for dry-pump operation. To use the dry-pump detection:

- Enable low-power detection in parameter **22-21 Low Power Detection**.
- Commission low-power detection using either parameter group **22-3* No-flow Power Tuning** or parameter **22-20 Low Power Auto Set-up**.



NOTE: Do not set parameter **14-20 Reset Mode** to **[13] Infinite auto reset** when parameter **22-26 Dry Pump Function** is set to **[2] Trip**. Doing so causes the drive to continuously cycle between running and stopping when a dry-pump condition is detected.



NOTE: For drives with constant-speed bypass: If an automatic bypass function starts the bypass at persistent alarm conditions, disable the automatic bypass function, if [2] *Trip* or [3] *Manual reset trip* is selected as the dry-pump function.

Option	Name	Description
[0]*	Off	
[1]	Warning	The drive continues to run but activates a dry-pump warning (<i>warning 93, Dry pump</i>). A drive digital output or a serial communication bus can communicate a warning to other equipment.
[2]	Trip	The drive trips and activates a dry-pump alarm
[3]	Manual reset trip	The drive trips and activates a no-flow alarm (<i>alarm 92, NoFlow</i>). A drive digital output or a serial communication bus can communicate an alarm to other equipment.
[4]	Stop and trip	

22-27 Dry Pump Delay

Default value:	10 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter defines for how long the dry-pump condition must be active before activating a warning or an alarm. The drive waits for the no-flow delay time (parameter **22-24 No-flow Delay**) to expire before the timer for the dry-pump delay starts.

22-28 No-flow Low Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 [RPM]
Setup:	All setup	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Set the no-flow speed reference in RPM.

22-29 No-flow Low Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-14 [Hz]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the no-flow speed reference in Hz.

5.21.3 22-3* No-flow Power Tuning



NOTE: Set parameter **1-03 Torque Characteristics** before tuning takes place.

If auto setup is disabled in parameter **22-20 Low Power Auto Set-up**, the tuning sequence is as follows:

1. Close the main valve to stop flow.
2. Run the motor until the system has reached normal operating temperature.

3. Press *[Hand On]* and adjust speed for approximately 85% of rated speed. Note the exact speed.
4. Read power consumption either by looking for actual power in the data line in the LCP or by viewing 1 of the following parameters in the Main Menu:
 - a. Parameter **16-10 Power [kW]** or
 - b. Parameter **16-11 Power [hp]**
5. Note the power readout.
6. Change speed to approximately 50% of the rated speed. Note the exact speed.
7. Read power consumption either by looking for actual power in the data line in the LCP or by viewing 1 of the following parameters in the Main Menu:
 - a. Parameter **16-10 Power [kW]** or
 - b. Parameter **16-11 Power [hp]**
8. Note the power readout.
9. Program the speeds used in:
 - a. parameter **22-32 Low Speed [RPM]**
 - b. parameter **22-33 Low Speed [Hz]**
 - c. parameter **22-36 High Speed [RPM]**
 - d. parameter **22-37 High Speed [Hz]**
10. Program the associated power values in:
 - a. parameter **22-34 Low Speed Power [kW]**
 - b. parameter **22-35 Low Speed Power [hp]**
 - c. parameter **22-38 High Speed Power [kW]**
 - d. parameter **22-39 High Speed Power [hp]**
11. Press *[Auto On]* or *[Off]* to complete the tuning sequence.

22-30 No-flow Power

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	True

Readout of calculated no-flow power at actual speed. If power drops to the display value, the drive considers the condition as a no-flow situation.

22-31 Power Correction Factor

Default value:	100%	Parameter type:	Range, 1 - 400%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Make corrections to the calculated power in parameter **22-30 No-flow Power**. If no-flow is detected when it should not be, decrease the setting. However, if no-flow is not detected when it should be, increase the setting to above 100%.

22-32 Low Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 22-36 [RPM]
Setup:	All setups	Conversion index:	67

Data type:	Uint16	Change during option:	True

Use this parameter if parameter **0-02 Motor Speed Unit** is set to **[0] RPM** (parameter is not visible if **[1] Hz** is selected). Set used speed at the 50% level. This function is used for storing values necessary for tuning no-flow detection.

22-33 Low Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 22-37 [Hz]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Use this parameter if parameter **0-02 Motor Speed Unit** is set to **[1] Hz** (parameter is not visible if **[0] RPM** is selected). Set used speed at the 50% level. This function is used for storing values necessary for tuning no-flow detection.

22-34 Low Speed Power [kW]

Default value:	Size related	Parameter type:	Range, 0 - 5.50 kW
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	True

Use this parameter if parameter **0-03 Regional Settings** is set for **[0] International** (parameter not visible if **[1] North America** is selected). Set power consumption at the 50% speed level. This function is used for storing values necessary for tuning no-flow detection.

22-35 Low Speed Power [hp]

Default value:	Size related	Parameter type:	Range, 0 - 7.50 hp
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Use this parameter if parameter **0-03 Regional Settings** is set for **[1] North America** (parameter not visible if **[0] International** is selected). Set power consumption at the 50% speed level. This function is used for storing values necessary for tuning no-flow detection.

22-36 High Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Use this parameter if parameter **0-02 Motor Speed Unit** is set to **[0] RPM** (parameter is not visible if **[1] Hz** is selected). Set used speed at the 85% level. This function is used for storing values necessary for tuning no-flow detection.

22-37 High Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-14 [Hz]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Use this parameter if parameter **0-02 Motor Speed Unit** is set to **[1] Hz** (parameter is not visible if **[0] RPM** is selected). Set used speed at the 85% level. This function is used for storing values necessary for tuning no-flow detection.

22-38 High Speed Power [kW]

Default value:	Size related	Parameter type:	Range, 0 - 5.50 kW
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	True

Use this parameter if parameter **0-03 Regional Settings** is set for **[0] International** (parameter not visible if **[1] North America** is selected). Set power consumption at the 85% speed level. This function is used for storing values necessary for tuning no-flow detection.

22-39 High Speed Power [hp]

Default value:	Size related	Parameter type:	Range, 0 - 7.50 hp
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Use this parameter if parameter **0-03 Regional Settings** is set for **[1] North America** (parameter not visible if **[0] International** is selected). Set power consumption at the 85% speed level. This function is used for storing values necessary for tuning no-flow detection.

5.21.4 22-4* Sleep Mode

If the load on the system allows the motor to stop, and the load is monitored, the motor can be stopped by activating the sleep-mode function. This is not a normal stop command, but ramps the motor down to 0 RPM and stops energizing the motor. When in sleep mode, certain conditions are monitored to find out when load has been applied to the system again.

Sleep mode can be activated either from the no-flow detection/minimum speed detection (must be programmed via parameters for no-flow detection, see the signal flow-diagram in parameter group **22-2* No-flow Detection**) or via an external signal applied to 1 of the digital inputs (must be programmed via the parameters for configuration of the digital inputs, parameter group **5-1* Digital Inputs** selecting **[66] Sleep Mode**). Sleep mode is activated only when no wake-up conditions are present. To enable use of, for example, an electro-mechanical flow switch to detect a no-flow condition and activate sleep mode, the action takes place at the rising edge of the external signal applied (otherwise the drive would stay in sleep mode as the signal would be steadily connected).



NOTE: If sleep mode is to be based on no-flow detection/minimum speed, select **[1] Sleep Mode** in parameter **22-23 No-flow Function**

If parameter **25-26 Destage at No-flow** is set to **[1] Enabled**, activating sleep mode sends a command to the cascade controller (if enabled) to start de-staging of lag pumps (fixed speed) before stopping the lead pump (variable speed).

When entering sleep mode, the lower status line in the LCP shows *Sleep Mode*.

See also signal flow chart in parameter group **22-2* No-flow Detection**. There are the following ways of using the sleep mode function.

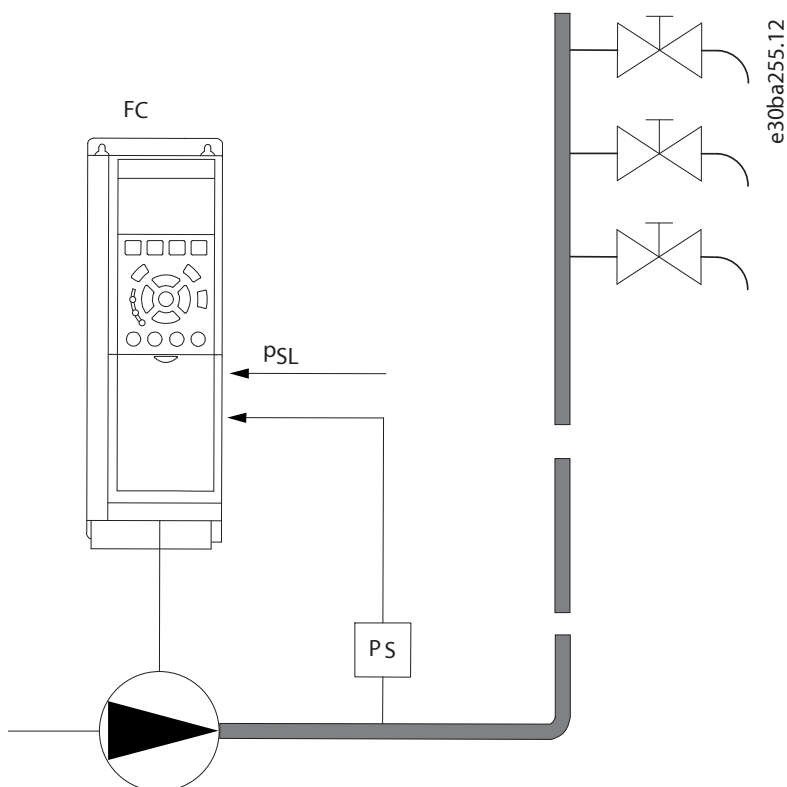


Figure 98: Sleep-mode Function

1. Systems where the integrated PI controller is used for controlling pressure or temperature, for example, boost systems with a pressure feedback signal applied to the drive from a pressure transducer. Set parameter **1-00 Configuration Mode** to [3] Closed Loop and configure the PI controller configured for desired reference and feedback signals.

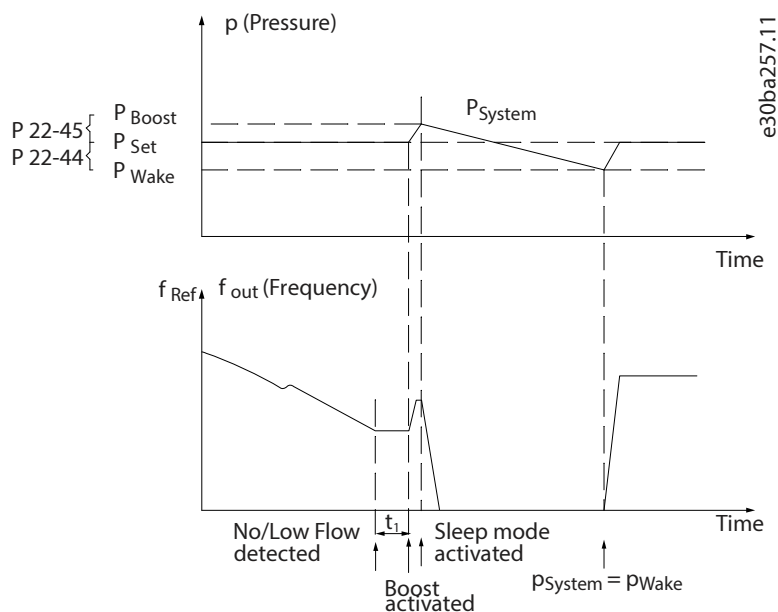


Figure 99: Example with Boost System

If no-flow is detected, the drive increases the setpoint for pressure to ensure a slight overpressure in the system (boost set in parameter **22-45 Setpoint Boost**). The feedback from the pressure transducer is monitored, and then this pressure has dropped with

a set percentage below the normal setpoint for pressure (P_{set}). The motor ramps up again and the pressure reached the set value (P_{set}).

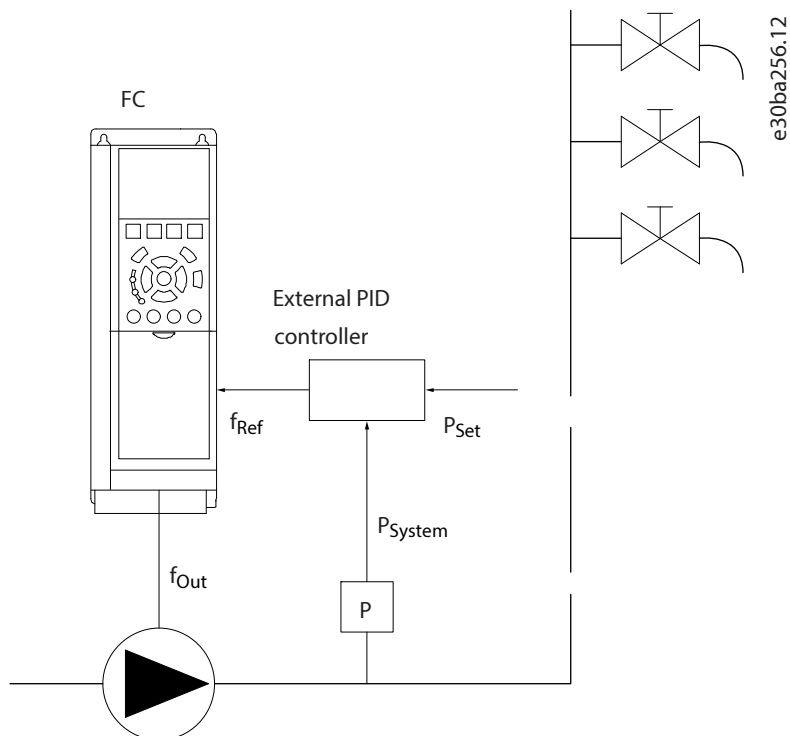


Figure 100: Boost System

2. In systems where the pressure or temperature is controlled by an external PI controller, the wake-up conditions cannot be based on feedback from the pressure/temperature transducer as the setpoint is not known. In the example with a boost system, the desired pressure, P_{setr} , is not known. Set parameter **1-00 Configuration Mode** to [0] Open Loop.

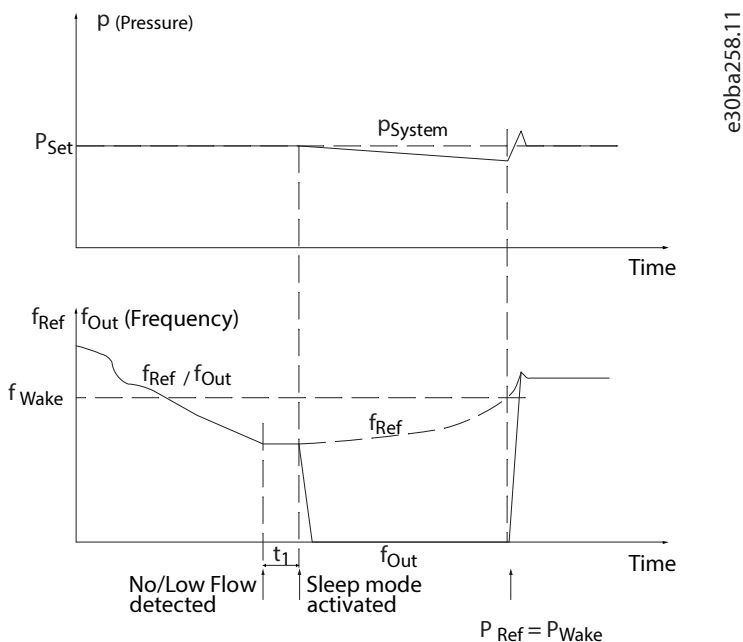


Figure 101: Example with Boost System

When low power or low speed is detected, the motor is stopped, but the reference signal (f_{ref}) from the external controller is still monitored. Because of the the low pressure created, the controller increases the reference signal to gain pressure. When the

reference signal has reached a set value, f_{waker} the motor restarts. The speed is set manually by an external reference signal (remote reference). Use default settings (parameter group 22-3* **No-flow Power Tuning**) for tuning of the no-flow function.

Table 47: Configuration overview

Function	Internal PI controller (parameter 1-00 Configuration Mode: closed loop)		External PI controller or manual control (parameter 1-00 Configuration Mode: open loop)	
	Sleep mode	Wake up	Sleep mode	Wake up
No-flow detection (pumps only)	Yes	–	Yes (except manual setting of speed)	–
Low-speed detection	Yes	–	Yes	–
External signal	Yes	–	Yes	–
Pressure/temperature (transmitted)	–	Yes	–	No
Output frequency	–	No	–	Yes



NOTE: Sleep mode is not active when local reference is active (press the navigation keys to set speed manually). See parameter 3-13 **Reference Site**. Sleep mode does not work in hand-on mode. Carry out auto setup in open loop before setting input/output in closed loop.

22-40 Minimum Run Time

Default value:	60 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the minimum running time for the motor after a start command (digital input or fieldbus) before entering sleep mode.

22-41 Minimum Sleep Time

Default value:	30 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the minimum time for staying in sleep mode. This setting overrides any wake-up conditions.

22-42 Wake-up Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4.13 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

To be used if parameter 0-02 **Motor Speed Unit** has been set to [0] **RPM** (parameter not visible if [1] **Hz** is selected). Only to be used if parameter 1-00 **Configuration Mode** is set to [0] **Open loop** and an external controller applies speed reference. Set the reference speed at which the sleep mode should be canceled.

22-43 Wake-up Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-14 [Hz]
Setup:	All setups	Conversion index:	-1

Data type:	Uint16	Change during operation:	True

To be used if parameter **0-02 Motor Speed Unit** has been set to **[1] Hz** (parameter not visible if **[0] RPM** is selected). Only to be used if parameter **1-00 Configuration Mode** is set to **[0] Open loop** and speed reference is applied by an external controller controlling the pressure. Set the reference at which speed the sleep mode should be canceled.

22-44 Wake-up Ref./FB Difference

Default value:	10%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Int8	Change during operation:	True

To be used if parameter **1-00 Configuration Mode** is set to **[3] Process Closed Loop** and the integrated PI controller is used for controlling the pressure. Set the pressure drop allowed in percentage of setpoint for the pressure (P_{set}) before canceling the sleep mode.

22-45 Setpoint Boost

Default value:	0%	Parameter type:	Range, -100 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Int8	Change during operation:	True

To be used if parameter **1-00 Configuration Mode** is set to **[3] Process Closed Loop** and the integrated PI controller is used. In a system with, for example, constant pressure control, it is advantageous to increase system pressure before the motor is stopped. This extends the time in which the motor is stopped and helps to avoid frequent start/stop. Set the overpressure/overtemperature in percentage of the setpoint for the pressure (P_{set})/temperature before entering sleep mode. If set to 5%, the boost pressure is $P_{set} \times 1.05$. The negative values can be used, for example, in cooling tower control where a negative change is needed.

22-46 Maximum Boost Time

Default value:	60 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

To be used if parameter **1-00 Configuration Mode** is set for **[3] Process Closed Loop** and the integrated PI controller is used for controlling the pressure. Set the maximum time for which boost mode is allowed. If the set time is exceeded, sleep mode is entered, not waiting for the set boost pressure to be reached.

5.21.5 22-5* End of Curve

The end-of-curve conditions occur when a pump is yielding too large a volume to ensure the set pressure. This situation can occur if a leakage occurs in the distribution pipe system after the pump. Such a leakage causes the pump to operate at the end of the pump characteristic valid for the maximum speed set in parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**. If the feedback is 2.5% of the programmed value in parameter **20-14 Maximum Reference/Feedb.** (or numerical value of parameter **20-13 Minimum Reference/Feedb.**, whichever is higher) below the setpoint for the required pressure for a set time (parameter **22-51 End of Curve Delay**), and the pump runs with maximum speed set in parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**, the function selected in parameter **22-50 End of Curve Function** takes place. It is possible to get a signal on 1 of the digital outputs by selecting **[192] End of Curve** in parameter group **5-3* Digital Outputs** and/or parameter group **5-4* Relays**. The signal is present when an end-of-curve condition occurs and the selection in parameter **22-50 End of Curve Function** is different from **[0] Off**. The end-of-curve condition can only be used when operating with the built-in PID controller (**[3] Closed loop** in parameter **1-00 Configuration Mode**).

22-50 End of Curve Function

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Automatic restart resets the alarm and restarts the system.



NOTE: Do not set parameter *14-20 Reset Mode* to *[13] Infinite auto reset* when parameter *22-50 End of Curve Function* is set to *[2] Trip*. Doing so would cause the drive to cycle continuously between running and stopping when an end-of-curve condition is detected.



NOTE: If the drive is equipped with a constant speed bypass with an automatic bypass function activating the bypass when persistent alarm conditions occur, disable the automatic bypass function if *[2] Trip* or *[3] Man. reset trip* is selected as the end-of-curve function.

Option	Name	Description
[0]*	Off	End-of-curve monitoring is not active.
[1]	Warning	The drive continues to run, but activates an end-of-curve warning (<i>warning 94, End of Curve</i>). A drive digital output or a fieldbus can communicate a warning to other equipment.
[2]	Trip	The drive stops running and activates an end-of-curve alarm (<i>alarm 94, End of Curve</i>). A drive digital output or a fieldbus can communicate an alarm to other equipment.
[3]	Man. reset trip	The drive stops running and activates an end-of-curve alarm (<i>alarm 94, End of Curve</i>). A drive digital output or a fieldbus can communicate an alarm to other equipment.
[4]	Stop and Trip	

22-51 End of Curve Delay

Default value:	10 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

When an end-of-curve condition is detected, a timer is activated. When the time set in this parameter expires, and the end-of-curve condition is steady during the entire period, the function set in parameter *22-50 End of Curve Function* is activated. If the condition disappears before the timer expires, the timer is reset.

Parameter 22-52 End of Curve Tolerance

Default value:	2.5%	Parameter type:	Range, 0.5 - 20.0%
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	True

Set the required tolerance of the end-of-curve function.

5.21.6 22-6* Broken Belt Detection

The broken-belt detection can be used in both closed-loop systems and open-loop systems for pumps and fans. If the estimated motor torque is below the broken belt torque value (parameter **22-61 Broken Belt Torque**) and the drive output frequency is above or equal to 15 Hz, the broken-belt function (parameter **22-60 Broken Belt Function**) is performed.

22-60 Broken Belt Function

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Do not set parameter **14-20 Reset Mode** to **[13] Infinite auto reset** when parameter **22-60 Broken Belt Function** is set to **[2] Trip**. Doing so would cause the drive to cycle continuously between running and stopping when a broken-belt condition is detected.



NOTE: If the drive is equipped with a constant speed bypass with an automatic bypass function activating the bypass when persistent alarm conditions occur, disable the automatic bypass function if **[2] Trip** or **[3] Stop and trip** is selected as the broken-belt function.

Option	Name	Description
[0]*	Off	End-of-curve monitoring is not active.
[1]	Warning	The drive continues to run, but activates a broken-belt warning (<i>warning 95, Broken Belt</i>). A drive digital output or a fieldbus can communicate a warning to other equipment.
[2]	Trip	The drive stops running and activates a broken-belt alarm (<i>alarm 95, Broken Belt</i>). A drive digital output or a fieldbus can communicate an alarm to other equipment.
[3]	Stop and Trip	

22-61 Broken Belt Torque

Default value:	10%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Set the broken-belt torque as a percentage of the rated motor torque.

22-62 Broken Belt Delay

Default value:	10 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Sets the time for which the broken-belt conditions must be active before carrying out the action selected in parameter **22-60 Broken Belt Function**.

5.21.7 22-7* Short Cycle Protection

In some applications, a need for limiting the number of starts often exists. One way to do this is to ensure a minimum run time (between a start and a stop) and a minimum interval between starts. This means that any normal stop command can be overridden by parameter **22-77 Minimum Run Time** and any normal start command (start/jog/freeze) can be overridden by parameter **22-76 Interval Between Starts**.

None of the 2 functions are active if hand-on mode or off mode has been activated via the LCP. If [Hand On] or [Off] is pressed, the 2 timers are reset to 0. The timers do not start counting until [Auto On] is pressed, and an active start command is applied.

22-75 Short Cycle Protection

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0*]	Disabled	The timer set in parameter 22-76 Interval between Starts is disabled.
[1]	Enabled	The timer set in parameter 22-76 Interval between Starts is enabled.

22-76 Interval between Starts

Default value:	Setting in par. 22-77	Parameter type:	Range, par. 22-77 - 3600 s
Setup:	All setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Sets the minimum time between 2 starts. Any normal start command (start/jog/freeze) is disregarded until the timer has expired.

22-77 Minimum Run Time

Default value:	0 s	Parameter type:	Range, 0 - par. 22-76 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True



NOTE: This parameter does not work in cascade mode.

Sets the minimum run time after a normal start command (start/jog/freeze). Any normal stop command is disregarded until the set time has expired. The timer starts counting following a normal start command (start/jog/freeze). A coast (inverse) or an external interlock command overrides the timer.

22-78 Minimum Run Time Override

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter only works in systems with inverse PID control.

Option	Name	Description
[0]*	Disabled	Feedback does not override the minimum run time.
[1]	Enabled	Feedback overrides the minimum run time.

22-79 Minimum Run Time Override Value

Default value:	0 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Set the feedback value at which the minimum-run-time timer must be overridden. When the feedback drops below this value, the motor is destaged even if the minimum-run-time timer has not expired.

5.21.8 22-8* Flow Compensation

Sometimes it is not possible for a pressure transducer to be placed at a remote point in the system, and it can only be placed close to the fan/pump outlet. Flow compensation operates by adjusting the setpoint according to the output frequency, which is almost proportional to flow, thus compensating for higher losses at higher flow rates.

H_{DESIGN} (required pressure) is the setpoint for closed-loop (PI) operation of the drive and is set for closed-loop operation without flow compensation.

It is recommended to use slip compensation and RPM unit.

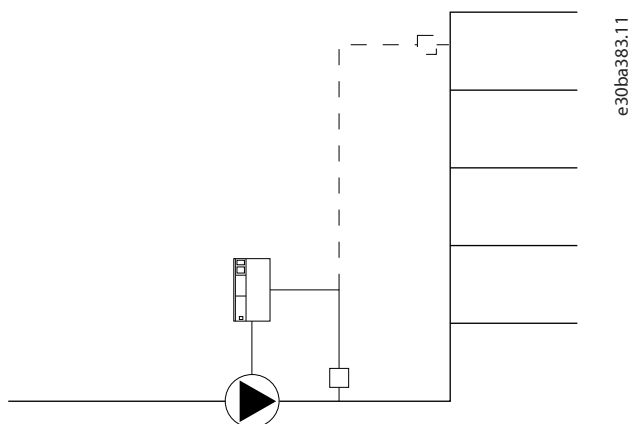


Figure 102: Flow Compensation



NOTE: When flow compensation is used with the cascade controller (parameter group **25-** Cascade Controller**), the actual setpoint does not depend on speed (flow), but on the number of pumps cut in.

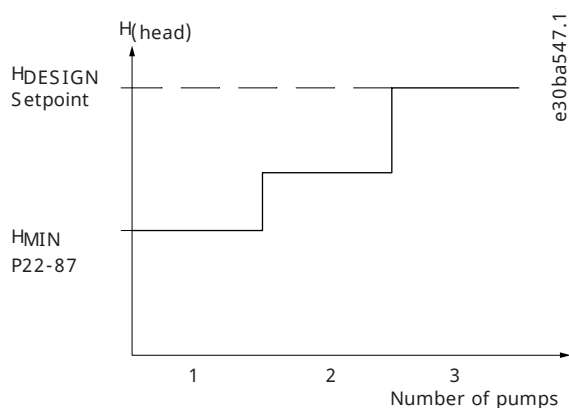


Figure 103: Flow Compensation with Cascade Controller

There are 2 methods which can be employed, depending on whether or not the speed at system design working point is known.

Table 48: Setpoint Defined by Number of Pumps

Parameter used	Speed at design point KNOWN	Speed at design point UNKNOWN	Cascade controller
Parameter 22-80 Flow Compensation	+	+	+
Parameter 22-81 Square-linear Curve Approximation	+	+	-
Parameter 22-82 Work Point Calculation	+	+	-
Parameter 22-83 Speed at No Flow [RPM]/parameter 22-84 Speed at No Flow [Hz]	+	+	-
Parameter 22-85 Speed at Design Point [RPM]/Parameter 22-86 Speed at Design Point [Hz]	+	-	-
Parameter 22-87 Pressure at No-Flow Speed	+	+	+
Parameter 22-88 Pressure at Rated Speed	-	+	-
Parameter 22-89 Flow at Design Point	-	+	-
Parameter 22-90 Flow at Rated Speed	-	+	-

22-80 Flow Compensation

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	-
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0*]	Disabled	Setpoint compensation is not active.
[1]	Enabled	Setpoint compensation is active and allows flow-compensated setpoint operation.

22-81 Square-Linear Curve Approximation

Default value:	100%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True



NOTE: This parameter is invisible in cascade mode.

Example 1: Adjustment of this parameter allows the shape of the control curve to be adjusted.

- 0% = Linear
- 100% = Ideal shape (theoretical)

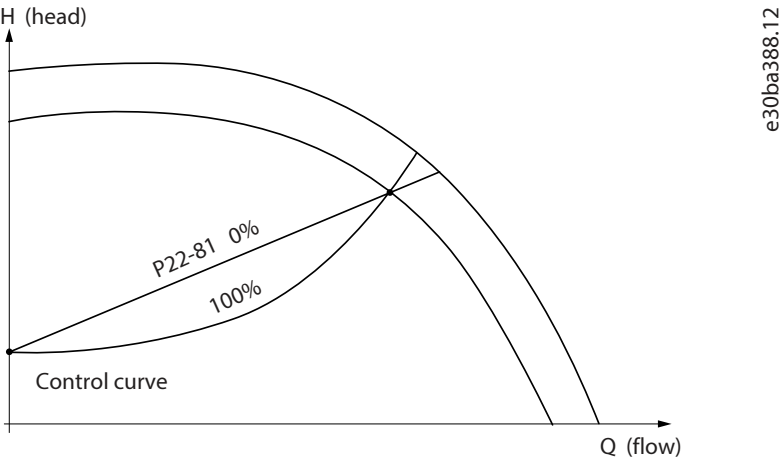


Figure 104: Square-Linear Curve Approximation

22-82 Work Point Calculation

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

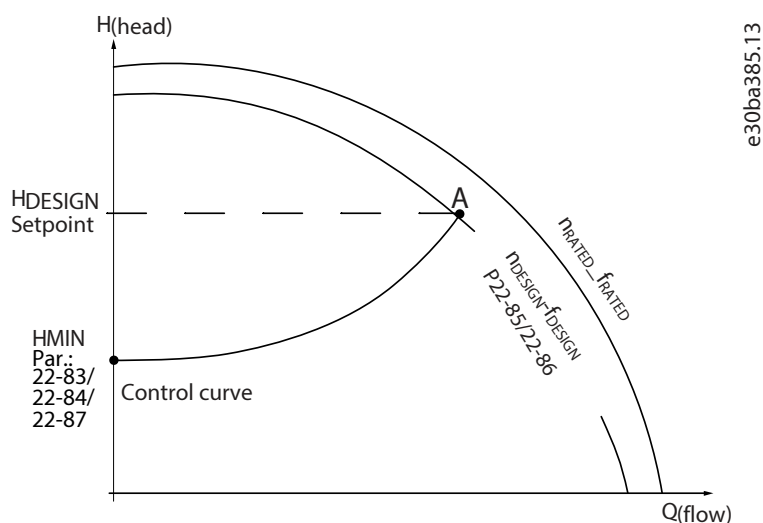


Figure 105: Example 1: Speed at Known System Design Working Point

From the datasheet showing characteristics for the specific equipment at different speeds, reading across from the H_{DESIGN} point and the Q_{DESIGN} point allows finding point A, which is the system design working point. The pump characteristics at this point should be identified and the associated speed programmed. Closing the valves and adjusting the speed until H_{MIN} has been achieved allows the speed at the no-flow point to be identified. Adjustment of parameter **22-81 Square-linear Curve Approximation** then allows the shape of the control curve to be adjusted infinitely.

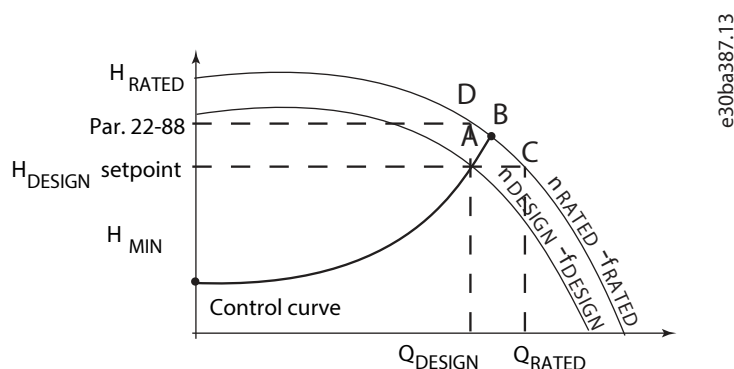


Figure 106: Example 2: Speed at Unknown System Design Working Point

Speed at system design working point is not known: Where the speed at system design working point is unknown, another reference point on the control curve has to be determined based on the datasheet. Looking at the curve for the rated speed and plotting the design pressure (H_{DESIGN} , Point C), the flow at that pressure, Q_{RATED} , can be determined. Similarly, by plotting the design flow (Q_{DESIGN} , Point D), the pressure H_{DESIGN} at that flow can be determined. Knowing these 2 points on the pump curve, along with H_{MIN} as described, allows the drive to calculate the reference point B and thus to plot the control curve, which also includes the system design working point A.

Option	Name	Description
[0]*	Disabled	Work point calculation is not active. To be used if speed at design point is known.
[1]	Enabled	Work point calculation is active. Enabling this parameter allows the calculation of the unknown system design working point at 50/60 Hz speed, from the input data set in: - Parameter 22-83 Speed at No-Flow [RPM] - Parameter 22-84 Speed at No-Flow [Hz] - Parameter 22-87 Pressure at No-Flow Speed - Parameter 22-88 Pressure at Rated Speed - Parameter 22-89 Flow at Design Point - Parameter 22-90 Flow at Rated Speed

22-83 Speed at No-Flow [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 22-85 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Changes during operation:	True

Resolution 1 RPM. Enter the motor speed in RPM at which flow is 0, and minimum pressure, H_{MIN} , is achieved. Alternatively, enter the speed in Hz in parameter **22-84 Speed at No-Flow [Hz]**. If parameter **0-02 Motor Speed Unit** is set to RPM, parameter **22-85 Speed at Design Point [RPM]** should also be used. Closing the valves and reducing the speed until minimum pressure, H_{MIN} , is achieved determines this value.

22-84 Speed at No-Flow [Hz]

Default value:	Size related	Parameter type:	Range, 0 - par. 22-86 [Hz]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Resolution 0.033 Hz. Enter the motor speed in Hz at which flow is 0 and minimum pressure, H_{MIN} , is achieved. Alternatively, enter the speed in RPM in parameter **22-83 Speed at No-Flow [RPM]**. If parameter **0-02 Motor Speed Unit** is set to Hz, parameter **22-86 Speed at Design Point [Hz]** should also be used. Closing the valves and reducing the speed until minimum pressure, H_{MIN} , is achieved determines this value.

22-85 Speed at Design Point [RPM]

Default value:	Size related	Parameter type:	Range, 0 - 60000 RPM
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Resolution 1 RPM. Only visible when parameter **22-82 Work Point Calculation** is set to **[0] Disabled**. Enter the motor speed in RPM at which the system design working point is achieved. Alternatively, enter the speed in Hz in parameter **22-86 Speed at Design Point [Hz]**. If parameter **0-02 Motor Speed Unit** is set to RPM, parameter **22-83 Speed at No-Flow [RPM]** should also be used.

22-86 Speed at Design Point [Hz]

Default value:	Size related	Parameter type:	Range, 0.0 - par. 4-19 [Hz]
Setup:	All setups	Conversion index:	-1

Data type:	Uint16	Change during operation:	True

Resolution 0.033 Hz. Only visible when parameter **22-82 Work Point Calculation** is set to **[0] Disabled**. Enter the motor speed in Hz at which the system design working point is achieved. Alternatively, enter the speed in RPM in parameter **22-85 Speed at Design Point [RPM]**. If parameter **0-02 Motor Speed Unit** is set to Hz, parameter **22-83 Speed at No-Flow [RPM]** should also be used.

22-87 Pressure at No-Flow Speed

Default value	0	Parameter type:	Range, 0 - par. 22-88
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the pressure H_{MIN} corresponding to speed at no-flow in reference/feedback units.

22-88 Pressure at Rated Speed

Default value:	999999.999	Parameter type:	Range, par. 22-87 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the value corresponding to the pressure at rated speed in reference/feedback units. This value can be defined using the pump datasheet.

22-89 Flow at Design Point

Default value:	0	Parameter type:	Range, 0 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the value corresponding to the flow at design point. No units are required.

22-90 Flow at Rated Speed

Default value:	Size related	Parameter type:	Range, 0 - 999999999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the value corresponding to the flow at rated speed. This value can be defined using the pump datasheet.

5.22 Parameter Group 23-** Time-based Functions

5.22.1 23-0* Timed Actions

Use timed actions for actions performed on a daily or weekly basis, for example different references for working hours/non-working hours. Up to 10 timed actions can be programmed in the drive. Select the timed action number from the list when entering parameter group **23-** Time-based Functions** on the LCP. Parameter **23-00 ON Time** and parameter **23-04 Occurrence** then refer to the selected timed action number. Each timed action is divided into an ON time and an OFF time, in which 2 different actions may be performed.

Display lines 2 and 3 in the LCP show the status for timed actions mode (parameter **0-23 Display Line 2 Large** and parameter **0-24 Display Line 3 Large**, setting **[1643] Timed Actions Status**).



NOTE: A change in mode via the digital inputs can only take place if parameter **23-08 Timed Actions Mode** is set to **[0] Times Actions Auto**. If commands are applied simultaneously to the digital inputs for constant OFF and constant ON, the timed actions mode changes to timed actions auto and the 2 commands are disregarded. If parameter **0-70 Date and Time** is not set or the drive is set to hand-on mode or OFF mode (for example via the LCP), the timed actions mode is changed to **[0] Disabled**. The timed actions have a higher priority than the same actions/commands activated by the digital inputs or the smart logic controller.

The actions programmed in timed actions are merged with corresponding actions from digital inputs, control word via bus, and smart logic controller, according to merge rules set up in parameter group **8-5* Digital/Bus**.



NOTE: Program the clock (parameter group **0-7* Clock Settings**) correctly for timed actions to function.



NOTE: When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.



NOTE: The PC-based configuration tool VLT® Motion Control Tool MCT 10 comprises a special guide for easy programming of timed actions.

23-00 ON Time

Default value:	Size related	Parameter type:	Array [10]
Setup:	2 setups	Conversion index:	0
Data type:	TimeOfDayWoDate	Change during operation:	True

Sets the ON time for the desired action.



NOTE: The drive has no back-up of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with back-up is installed. In parameter **0-79 Clock Fault**, it is possible to program a warning if the clock has not been set properly, for example after a power-down.

23-01 ON Action

Default value:	[0] Disabled	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: For options **[32] Set digital out A low** – **[43] Set digital out F high**, see also parameter group **5-3* Digital Outputs** and parameter group **5-4* Relays**.

Select the action during ON time. See parameter **13-52 SL Controller Action** for descriptions of the options.

Option	Name	Description
[0]*	Disabled	
[1]	No action	

Option	Name	Description
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	Dc brake	
[27]	Coast	
[28]	Freeze output	
[29]	Start timer 0	
[30]	Start timer 1	
[31]	Start timer 2	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset counter A	
[61]	Reset counter B	

Option	Name	Description
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	
[71]	Start timer 4	
[72]	Start timer 5	
[73]	Start timer 6	
[74]	Start timer 7	
[75]	Start timer 8	
[76]	Start timer 9	
[80]	Sleep mode	
[81]	Derag	
[82]	Reset derag counter	
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

23-02 OFF Time

Default value:	Size related	Parameter type:	Array [10]
Setup:	2 setups	Conversion index:	0
Data type:	TimeOfDayWoDate	Change during operation:	True

Sets the OFF time for the desired action.



NOTE: The drive has no back-up of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with back-up is installed. In parameter **0-79 Clock Fault**, it is possible to program a warning if the clock has not been set properly, for example after a power-down.

23-03 OFF Action

Default value:	[1] No action	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the action during OFF time. See parameter **13-52 SL Controller Action** for descriptions of the options.

Option	Name	Description
[1]*	No action	
[2]	Select set-up 1	
[3]	Select set-up 2	
[4]	Select set-up 3	
[5]	Select set-up 4	
[10]	Select preset ref 0	
[11]	Select preset ref 1	
[12]	Select preset ref 2	
[13]	Select preset ref 3	
[14]	Select preset ref 4	
[15]	Select preset ref 5	
[16]	Select preset ref 6	
[17]	Select preset ref 7	
[18]	Select ramp 1	
[19]	Select ramp 2	
[22]	Run	
[23]	Run reverse	
[24]	Stop	
[26]	DC brake	
[27]	Coast	
[28]	Freeze output	
[29]	Start timer 0	
[30]	Start timer 1	
[31]	Start timer 2	
[32]	Set digital out A low	
[33]	Set digital out B low	
[34]	Set digital out C low	
[35]	Set digital out D low	
[36]	Set digital out E low	
[37]	Set digital out F low	
[38]	Set digital out A high	
[39]	Set digital out B high	
[40]	Set digital out C high	
[41]	Set digital out D high	
[42]	Set digital out E high	
[43]	Set digital out F high	
[60]	Reset counter A	

Option	Name	Description
[61]	Reset counter B	
[62]	Counter A (up)	
[63]	Counter A (down)	
[64]	Counter B (up)	
[65]	Counter B (down)	
[70]	Start timer 3	
[71]	Start timer 4	
[72]	Start timer 5	
[73]	Start timer 6	
[74]	Start timer 7	
[75]	Start timer 8	
[76]	Start timer 9	
[80]	Sleep mode	
[81]	Derag	
[82]	Reset derag counter	
[90]	Set ECB bypass mode	
[91]	Set ECB drive mode	
[100]	Reset alarms	
[101]	Reset flow totalized volume counter	
[102]	Reset flow actual volume counter	

23-04 Occurrence

Default value:	[0] All days	Parameter type:	Option, Array [10]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select which days the timed action applies to. Specify working/non-working days in:

- Parameter **0-81 Working Days**.
- Parameter **0-82 Additional Working Days**.
- Parameter **0-83 Additional Non-Working Days**.

Option	Name	Description
[0]*	All days	
[1]	Working days	
[2]	Non-working days	
[3]	Monday	
[4]	Tuesday	
[5]	Wednesday	
[6]	Thursday	

Option	Name	Description
[7]	Friday	
[8]	Saturday	
[9]	Sunday	
[10]	Day 1 of month	
[11]	Day 2 of month	
[12]	Day 3 of month	
[13]	Day 4 of month	
[14]	Day 5 of month	
[15]	Day 6 of month	
[16]	Day 7 of month	
[17]	Day 8 of month	
[18]	Day 9 of month	
[19]	Day 10 of month	
[20]	Day 11 of month	
[21]	Day 12 of month	
[22]	Day 13 of month	
[23]	Day 14 of month	
[24]	Day 15 of month	
[25]	Day 16 of month	
[26]	Day 17 of month	
[27]	Day 18 of month	
[28]	Day 19 of month	
[29]	Day 20 of month	
[30]	Day 21 of month	
[31]	Day 22 of month	
[32]	Day 23 of month	
[33]	Day 24 of month	
[34]	Day 25 of month	
[35]	Day 26 of month	
[36]	Day 27 of month	
[37]	Day 28 of month	
[38]	Day 29 of month	
[39]	Day 30 of month	
[40]	Day 31 of month	

5.22.2 23-0* Timed Actions Settings

23-08 Timed Actions Mode

Default value:	[0] Timed actions auto	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Enable and disable automatic timed actions.

Option	Name	Description
[0]*	Timed actions auto	Enable timed actions.
[1]	Timed actions disabled	Disable timed actions, normal operation according to control commands.
[2]	Constant on actions	Disable timed actions. Constant on actions are activated.
[3]	Constant off actions	Disable timed actions. Constant off actions are activated.

23-09 Timed Actions Reactivation

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Option	Name	Description
[0]	Disabled	After an update of: • power cycling • setting date • time • change of summertime • change of Hand Auto mode • change of Constant On and Off • setup change where all activated ON actions are overridden to OFF actions until passing the next time for an ON action. Any OFF actions remain unchanged.
[1]*	Enabled	After an update of time/condition On and OFF actions are immediately set to the actual time programming of ON and OFF actions.

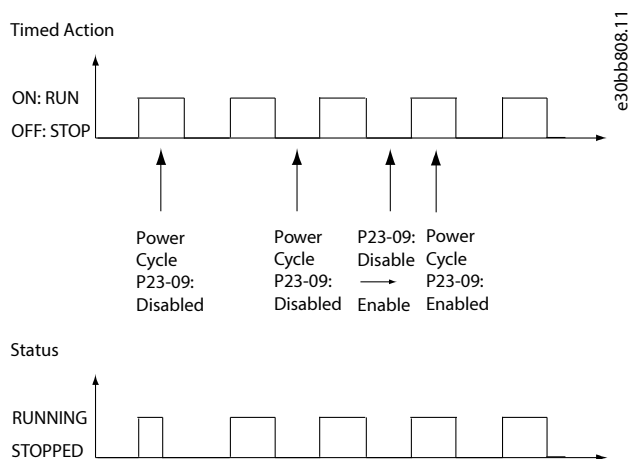


Figure 107: Example of Reactivation Test

5.22.3 23-1* Maintenance

Wear and tear calls for periodic inspection and service of elements in the application, for example motor bearings, feedback sensors, seals, and filters. With preventive maintenance, the service intervals can be programmed into the drive. The drive gives a message when maintenance is required. 20 preventive maintenance events can be programmed into the drive.

Specify the following for each event:

- Maintenance item (for example, motor bearings).
- Maintenance action (for example, replacement).
- Maintenance time base (for example, running hours, or a specific date and time).
- Maintenance time interval or the date and time of next maintenance.



NOTE: To disable a preventive maintenance event, set the associated parameter **23-12 Maintenance Base** to **[0] Disabled**.

Preventive maintenance can be programmed from the LCP, but use of the PC-based VLT® Motion Control Tool MCT 10 is recommended.

Untitled - MCT 10 SET - up Software						
File Edit View Insert Communication Tools OptionsHelp						
Network Project VLT AQUA DRIVE All Parameters Operation/Display Load/Motor Brakes Reference / Ramps Limits / Warnings Digital In/Out Analog In/Out Comm. andOptions Smart logic Special Functions Drive Information Data Readouts Info & Readouts Drive Closed Loop Ext. Closed Loop Application Functions Time-based Functions Timed Actions Maintenance Maintenance Reset Energy Log Trending Payback Counter Cascade Controller Water Application Functions Cascade Controller						
ID	Name	Setup 1	Setup 2	Setup 3	Setup 4	
2310.0	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.1	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.2	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.3	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.4	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.5	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.6	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.7	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.8	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.9	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.10	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.11	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.12	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.13	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.14	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.15	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.16	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.17	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.18	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2310.19	Maintenance Item	Motor bearings	Motor bearings	Motor bearings	Motor bearings	
2311.0	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate	
2311.2	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate	
2311.3	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate	
2311.4	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate	
2311.5	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate	
2311.6	Maintenance Action	Lubricate	Lubricate	Lubricates	Lubricate	

Figure 108: Maintenance Menu, MCT 10

The LCP indicates (with a wrench icon and letter M) when it is time for a preventive maintenance action and can be programmed to be indicated on a digital output in parameter group **5-3* Digital Outputs**. The preventive maintenance status is shown in parameter **16-96 Maintenance Word**. A preventive maintenance indication can be reset from a digital input, the FC bus, or manually from the LCP through parameter **23-15 Reset Maintenance Word**.



NOTE: The preventive maintenance events are defined in a 20-element array. Hence, each preventive maintenance event must use the same array element index in parameter **23-10 Maintenance Item** to parameter **23-14 Maintenance Date and Time**.

23-10 Maintenance Item

Default value:	[1] Motor Bearings	Parameter type:	Option, Array [20]
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Array with 20 elements shown below the parameter number in the display. Press [OK] and step between elements with [◀], [▶], [▲], and [▼]. Select the item to be associated with the preventive maintenance event.

Option	Name	Description
[1]*	Motor bearings	
[2]	Fan bearings	
[3]	Pump bearings	
[4]	Valve	
[5]	Pressure transmitter	
[6]	Flow transmitter	

Option	Name	Description
[7]	Temperature transm.	
[8]	Pump seals	
[9]	Fan belt	
[10]	Filter	
[11]	Drive cooling fan	
[12]	System health check	
[13]	Warranty	
[20]	Maintenance text 0	
[21]	Maintenance text 1	
[22]	Maintenance text 2	
[23]	Maintenance text 3	
[24]	Maintenance text 4	
[25]	Maintenance text 5	
[26]	Service log full	

23-11 Maintenance Action

Default value:	[1] Lubricate	Parameter type:	Option, Array [20]
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the action to be associated with the preventive maintenance event.

Option	Name	Description
[1]*	Lubricate	
[2]	Clean	
[3]	Replace	
[4]	Inspect/check	
[5]	Overhaul	
[6]	Renew	
[7]	Check	
[20]	Maintenance text 0	
[21]	Maintenance text 1	
[22]	Maintenance text 2	
[23]	Maintenance text 3	
[24]	Maintenance text 4	
[25]	Maintenance text 5	
[28]	Clear logs	

23-12 Maintenance Base

Default value:	[0] Disabled	Parameter type:	Option, Array [20]
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the time base to be associated with the preventive maintenance event.

Option	Name	Description
[0]*	Disabled	Disables the preventive maintenance event.
[1]	Running hours	The number of hours the motor has run. Running hours are not reset at power-on. Specify the maintenance time interval in parameter 23-13 Maintenance Interval .
[2]	Operating hours	The number of hours the drive has run. Operating hours are not reset at power-on. Specify the maintenance time interval in parameter 23-13 Maintenance Interval .
[3]	Date & time	Uses the internal clock. Specify the date and time of the next maintenance occurrence in parameter 23-14 Maintenance Date and Time .

23-13 Maintenance Interval

Default value:	1	Parameter type:	Array [20]
Setup:	1 setup	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Set the interval associated with the current preventive maintenance event. This parameter is only used if **[1] Running Hours** or **[2] Operating Hours** is selected in parameter **23-12 Maintenance Base**. The timer is reset in parameter **23-15 Reset Maintenance Word**.

23-14 Maintenance Date and Time

Default value:	Size related	Parameter type:	Array [20]
Setup:	1 setup	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

Set the date and time for the next maintenance occurrence if the preventive maintenance event is based on date/time. Date format depends on the setting in parameter **0-71 Date Format** while the time format depends on the setting in parameter **0-72 Time Format**.



NOTE: The drive has no backup of the clock function. The set date/time is reset to default (2000-01-01 00:00) after a power-down. In parameter **0-79 Clock Fault**, it is possible to program a warning if the clock has not been set properly, for example after a power-down. Set the time at least 1 hour later than actual time.



NOTE: When mounting a VLT® Analog I/O option MCB 109 option card, a battery back-up of the date and time is included.

23-15 Reset Maintenance Word

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–

Data type: Uint8 Change during operation: True



NOTE: When messages are reset, maintenance item, action, and maintenance date/time are not canceled. Parameter **23-12 Maintenance Time Base** is set to **[0] Disabled**.

Set this parameter to **[1] Do reset** to reset the maintenance word in parameter **16-96 Maintenance Word** and reset the message shown in the LCP. This parameter changes back to **[0] Do not reset** when pressing **[OK]**.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

23-16 Maintenance Text

Default value:	0	Parameter type:	Array [6]
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[20]	Change during operation:	True

6 individual texts (Maintenance Text 0...Maintenance Text 5) can be written for use in either parameter **23-10 Maintenance Item** or parameter **23-11 Maintenance Action**. The text is written according to the guidelines in parameter **0-37 Display Text 1**.

5.22.4 23-5* Energy Log

The drive is continuously accumulating the consumption of the controlled motor, based on the actual power yielded by the drive.

This data can be used for an energy log function allowing to compare and structure the information about the energy consumption related to time.

There are 2 functions:

- Data related to a preprogrammed period defined by a set date and time for start.
- Data related to a predefined period back in time, for example, last 7 days within the preprogrammed period.

For each of the above 2 functions, the data is stored in several counters allowing for selection time frame and a split on hours, days, or weeks.

The period/split (resolution) can be set in parameter **23-50 Energy Log Resolution**.

The data is based on the value registered by the kWh counter in the drive. This counter value can be read in parameter **15-02 kWh Counter** containing the accumulated value since the 1st power-up or latest reset of the counter (parameter **15-06 Reset kWh Counter**).

All data for the energy log is stored in counters, which can be read from parameter **23-53 Energy Log**.

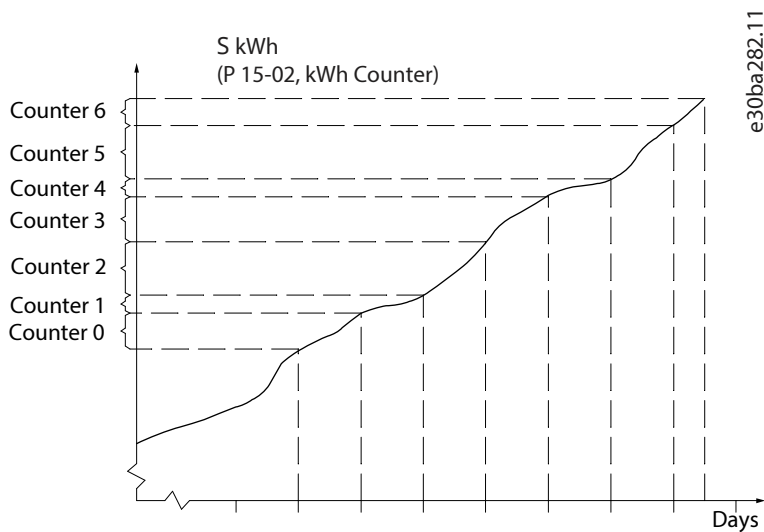


Figure 109: Energy Log Graph

Counter 00 always contains the oldest data. A counter covers a period from XX:00 to XX:59 if hours, or 00:00 to 23:59 if days. If logging either the last hours or last days, the counters shift contents at XX:00 every hour, or at 00:00 every day. The counter with the highest index is always subject to update (containing data for the actual hour since XX:00 or the actual day since 00:00).

The contents of counters can be shown as bars on the LCP. Select *Quick Menu, Loggings, Energy Log: Trending Continued Bin/Trending Timed Bin/Trending Comparison*.

23-50 Energy Log Resolution

Default value:	[5] Last 24 hours	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True



NOTE: The drive has no backup of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with backup is installed. Therefore, the logging is stopped until date/time is readjusted in parameter **0-70 Date and Time**. In parameter **0-79 Clock Fault**, it is possible to program a warning if the clock has not been set properly, for example, after a power-down.

Select the type of period for logging consumption: **[0] Hour of day**, **[1] Day of week**, or **[2] Day of month**. The counters contain the logging data from the preprogrammed date/time for start (parameter **23-51 Period Start**) and the numbers of hours/days as programmed for parameter **23-50 Energy Log Resolution**. The logging starts on the date programmed in parameter **23-51 Period Start** and continues until 1 day/week/month has passed. The counters contain data for 1 day, 1 week, or 5 weeks back in time and up to the actual time. The logging starts at the date programmed in parameter **23-51 Period Start**. In all cases, the period split refers to operating hours (time where the drive is powered up).

Option	Name	Description
[0]	Hour of day	
[1]	Day of week	
[2]	Day of month	
[5]*	Last 24 hours	

Option	Name	Description
[6]	Last 7 days	
[7]	Last 5 weeks	

23-51 Period Start

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	2 setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True



NOTE: When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Set the date and time at which the energy log starts updating the counters. First, data is stored in counter [00] and starts at the time/date programmed in this parameter. Date format depends on the setting in parameter **0-71 Date Format** and time format on the setting in parameter **0-72 Time Format**.

23-53 Energy Log

Default value:	0	Parameter type:	Readout, Array [31]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True



NOTE: All counters are automatically reset when changing the setting in parameter **23-50 Energy Log Resolution**. At overflow, the update of the counters stops at maximum value.



NOTE: When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Array with several elements equal to the number of counters ([00]-[xx] below parameter numbers in display). Press [OK] and step between elements with [▲] [▼]. Array elements:

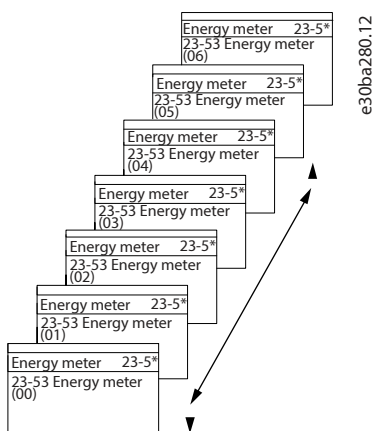


Figure 110: Energy Log

Data from the latest period is stored in the counter with the highest index. At power-down, all counter values are stored and resumed at next power-up.

23-54 Reset Energy Log

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select **[1] Do reset** to reset all values in the energy log counters shown in parameter **23-53 Energy Log**. After pressing **[OK]**, the setting of the parameter value automatically changes to **[0] Do not reset**.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

5.22.5 23-6* Trending

Trending is used to monitor a process variable over time and record how often the data falls into each of 10 user-defined data ranges. This is a convenient tool to obtain a quick overview indicating where to focus on improvement of operation.

Two sets of data for trending can be created to make it possible to compare current values for a selected operating variable with data for a certain reference period for the same variable. This reference period can be preprogrammed (parameter **23-63 Timed Period Start** and **23-64 Timed Period Stop**). The 2 sets of data can be read from parameter **23-61 Continuous Bin Data** (current) and parameter **23-62 Timed Bin Data** (reference).

It is possible to create trending for the following operation variables:

- Power
- Current
- Output frequency
- Motor speed

The trending function includes 10 counters (forming a bin) for each set of data containing the numbers of registrations reflecting how often the operating variable is within each of 10 predefined intervals. The sorting is based on a relative value of the variable.

The relative value for the operating variable is determined as:

- Actual/rated x 100% - for power and current.
- Actual/max x 100% - for output frequency and motor speed.

The size of each interval can be adjusted individually, but is 10% for each as default. Power and current can exceed rated value, but those registrations are included in 90–100% (MAX) counter.

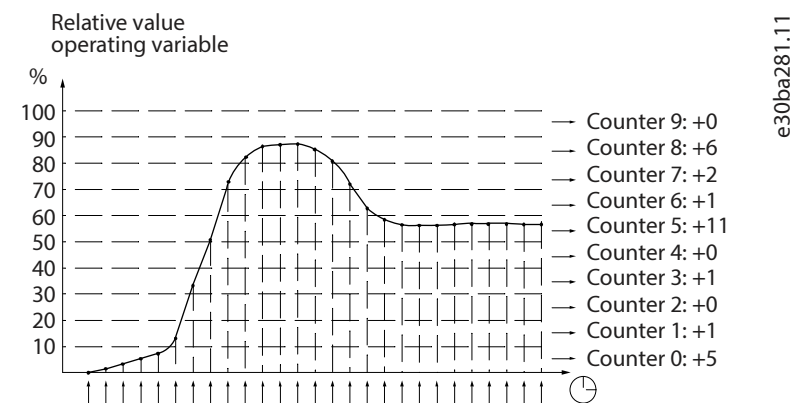


Figure 111: Time and Relative Values

Once per second, the value of the operating variable selected is registered. If a value has been registered to equal 13%, the counter 10 to <20% is updated with the value 1. If the value stays at 13% for 10 s, 10 is added to the counter value.

The contents of counters can be shown as bars on the LCP. Select *Quick Menu*⇒*Loggings: Trending Continued Bin/Trending Timed Bin/Trending Comparison*.



NOTE: The counters start counting whenever the drive is powered up. A power cycle shortly after a reset resets the counters. EEPROM data is updated once per hour.

23-60 Trend Variable

Default value:	[2] Frequency [Hz]	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the required operating variable to be monitored for trending.

Option	Name	Description
[0]	Power [kW]	Power yielded to the motor. Reference for the relative value is the rated motor power programmed in parameter 1-20 Motor Power [kW] or parameter 1-21 Motor Power [hp] . The actual value can be read in parameter 16-10 Power [kW] or parameter 16-11 Power [hp] .
[1]	Current [A]	Output current to the motor. Reference for the relative value is the rated motor current in parameter 1-24 Motor Current . The actual value can be read in parameter 16-14 Motor Current .
[2]*	Frequency [Hz]	Output frequency to the motor. Reference for the relative value is the maximum output frequency programmed in parameter 4-14 Motor Speed High Limit [Hz] . The actual value can be read in parameter 16-13 Frequency .
[3]	Motor speed [RPM]	Reference for the relative value is the maximum motor speed programmed in parameter 4-13 Motor Speed High Limit [RPM] .

23-61 Continuous Bin Data

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between the elements with [▲] and [▼]. 10 counters with the frequency of occurrence for the operating variable monitored, sorted according to the following intervals:

- Counter [0]: 0%...<10%
- Counter [1]: 10%...<20%
- Counter [2]: 20%...<30%
- Counter [3]: 30%...<40%
- Counter [4]: 40%...<50%
- Counter [5]: 50%...<60%
- Counter [6]: 60%...<70%

- Counter [7]: 70%...<80%
- Counter [8]: 80%...<90%
- Counter [9]: 90%...100% or maximum

The above minimum limits for the intervals are the default limits. These can be changed in parameter **23-65 Minimum Bin Value**. Starts to count when the drive is powered up for the 1st time. All counters can be reset to 0 in parameter **23-66 Reset Continuous Bin Data**.

23-62 Timed Bin Data

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between the elements with [▲] and [▼]. 10 counters with the frequency of occurrence for the operating variable monitored, sorted according to the following intervals:

- Counter [0]: 0...<10%
- Counter [1]: 10...<20%
- Counter [2]: 20...<30%
- Counter [3]: 30...<40%
- Counter [4]: 40...<50%
- Counter [5]: 50...<60%
- Counter [6]: 60...<70%
- Counter [7]: 70...<80%
- Counter [8]: 80...<90%
- Counter [9]: 90...100% or maximum

Starts to count at the date/time programmed in parameter **23-63 Timed Period Start**, and stops at the date/time programmed in parameter **23-64 Timed Period Stop**. All counters can be reset to 0 in parameter **23-67 Reset Timed Bin Data**.

23-63 Timed Period Start

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	2 setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True



NOTE: The drive has no backup of the clock function. The set date/time resets to default (2000-01-01 00:00) after a power-down unless a real-time clock module with backup is installed. Therefore, the logging is stopped until date/time is readjusted in parameter **0-70 Date and Time**. In parameter **0-79 Clock Fault**, it is possible to program a warning if the clock has not been set properly, for example, after a power-down.



NOTE: When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Set the date and time at which the trending starts the update of the timed bin counters. Date format depends on the setting in parameter **0-71 Date Format**, and time format depends on the setting in parameter **0-72 Time Format**.

23-64 Timed Period Stop

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	2 setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True



NOTE: When mounting VLT® Analog I/O Option MCB 109, a battery backup of the date and time is included.

Set the date and time at which the trend analyses must stop updating the timed bin counters. Date format depends on the setting in parameter **0-71 Date Format**, and time format depends on the setting in parameter **0-72 Time Format**.

23-65 Minimum Bin Value

Default value:	Size related	Parameter type:	Array [10]
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Array with 10 elements ([0]–[9] below parameter number in display). Press [OK] and step between the elements with [▲] and [▼]. Set the minimum limit for each interval in parameter **23-61 Continuous Bin Data** and parameter **23-62 Timed Bin Data**. Example: If selecting **[1] counter** and changing setting from 10% to 12%, **[0] counter** is based on the interval 0 to <12% and **[1] counter** on interval 12 to <20%.

23-66 Reset Continuous Bin Data

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select **[1] Do reset** to reset all values in the energy log counters shown in parameter **23-61 Continuous Bin Data**. After pressing [OK], the setting of the parameter value automatically changes to **[0] Do not reset**.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

23-67 Reset Timed Bin Data

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select **[1] Do reset** to reset all values in the energy log counters shown in parameter **23-62 Timed Bin Data**. After pressing [OK], the setting of the parameter value automatically changes to **[0] Do not reset**.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

5.22.6 23-8* Payback Counter

The drive includes a feature which can give a rough calculation on payback in cases where the drive has been installed in an existing plant to ensure energy savings. Reference for the savings is a set value representing the average power yielded before the upgrade with variable-speed control.

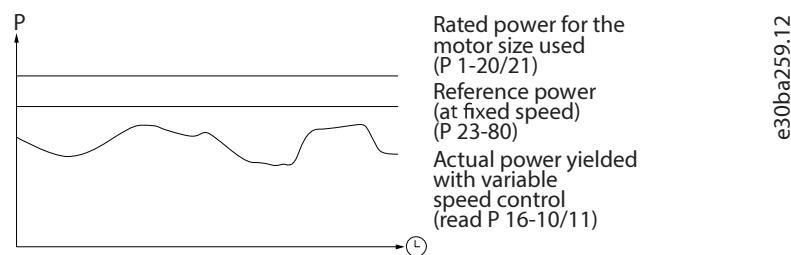


Figure 112: Comparison of Reference Power and Actual Power

The difference between the reference power at fixed speed and the actual power yielded with speed control represents the actual saving.

As value for the fixed speed case, the rated motor size (kW) is multiplied with a factor (set in %) representing the power produced at fixed speed. The difference between this reference power and the actual power is accumulated and stored. The difference in energy can be read in parameter **23-83 Energy Savings**. The accumulated value for the difference in power consumption is multiplied with the energy cost in local currency and the investment is subtracted. This calculation for cost savings can also be read in parameter **23-84 Cost Savings**. Breakeven (payback) occurs when the value read in the parameter turns from negative to positive.

Costsavings=

$$\left\{ \sum_{t=0}^t [(\text{motor rated power} \times \text{power reference factor}) - \text{actual power consumption}] \times \text{energy cost} \right\} - \text{investment cost}$$

It is not possible to reset the energy savings counter, but the counter can be stopped any time by setting parameter **23-80 Power Reference Factor** to 0.

Table 49: Parameter Overview

Parameter for settings		Parameters for readout	
Rated motor power	Parameter 1-20 Motor Power [kW] /1-21 Motor Power [hp]	Energy savings	Parameter 23-83 Energy Savings
Power reference factor in %	Parameter 23-80 Power Reference Factor	Actual power	Parameter 16-10 Power [kW] /Parameter 16-11 Power [hp]
Energy cost per kWh	Parameter 23-81 Energy Cost	Cost savings	Parameter 23-84 Cost Savings
Investment	Parameter 23-82 Investment	–	–

23-80 Power Reference Factor

Default value:	100%	Parameter type:	Range, 0 - 100%
Setup:	2 setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Set the percentage of the rated motor size (set in parameter **1-20 Motor Power [kW]** or parameter **1-21 Motor Power [HP]**), which shows the average power yielded at the time running with fixed speed (before upgrade with variable-speed control). Set a value different from 0 to start counting.

23-81 Energy Cost

Default value:	1	Parameter type:	Range, 0 - 999999.99

Setup:	2 setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the actual cost for a kWh in local currency. If the energy cost is changed later on, it impacts the calculation for the entire period.

23-82 Investment

Default value:	0	Parameter type:	Range, 0 - 999999999
Setup:	2 setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Set the value of the investment spent on upgrading the plant with speed control. Use the same currency as in parameter **23-81 Energy Cost**.

23-83 Energy Savings

Default value:	0 kWh	Parameter type:	Readout
Setup:	All setups	Conversion index:	75
Data type:	Int32	Change during operation:	True

This parameter allows a readout of the accumulated difference between the reference power and the actual output power. If motor size is set in hp (parameter **1-21 Motor Power [hp]**), the equivalent kW value is used for the energy savings.

23-84 Cost Savings

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

This parameter allows a readout of the calculation based on the above formula (in local currency).

23-85 CO2 Conversion Factor

Default value:	500g	Parameter type:	Range, 0 - 1000 g
Setup:	2 setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True

Enter the CO₂ emission in grams per 1 kWh of electrical energy produced. Typical life-cycle greenhouse-gas emission values for different power sources are:

- Renewable: 25 g.
- Nuclear: 70 g.
- Natural gas: 350 g.
- Oil: 800 g.
- Coal: 1000 g

For more precise emission values in local regions, contact the regional environment agency.

23-86 CO2 Reduction

Default value:	0 kg	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	Int32	Change during operation:	True

Shows the CO₂ depletion in kg based on the CO₂ conversion factor (parameter **23-85 CO₂ Conversion Factor**) and saved energy (parameter **23-83 Energy Savings**).

5.23 Parameter Group 24-** Application Functions 2

5.23.1 24-0* Emergency Mode



NOTE: The drive is only 1 component of an entire application system. The correct function of emergency mode depends on the correct design and selection of system components. A non-interruption of the drive due to emergency-mode operation could cause overpressure and damage the system and components. The drive itself could be damaged, or may cause damage or fire. Danfoss accepts no responsibility for errors, malfunctions, personal injury, or any damage to the drive itself or the components herein, application systems and components herein, or other property when the drive has been programmed for emergency mode. In no event shall Danfoss be liable to the end user or any other party for any direct or indirect, special, or consequential damage, or loss suffered by such party, which has occurred due to the drive being programmed and operated in emergency mode. Danfoss warranty is only affected or reduced if a critical alarm occurs during emergency-mode operation, and the drive is programmed to continue even though the application system would be damaged eventually.

If critical alarms have been activated during emergency mode operation, the drive informs the user that its performance and expected lifetime may be affected (*W280*), where an inspection of the drive may be needed to secure maximum operation in a new critical situation.

Background

Emergency mode is for use in critical situations where it is imperative for the motor to keep running, regardless of the normal protective functions of the drive. These situations could be ventilation fans in tunnels or stairwells, for instance, where continued operation of fan facilitates safe evacuation of personnel and protection of inventory if a fire occurs. Some selections of the emergency-mode function cause alarms and trip conditions to be disregarded, enabling the motor to run without interruption.

Activation

Emergency mode can be activated via digital input and/or over the fieldbus network. In digital activation, normal or inverse signals levels can be selected as continual fixed signals or as trigger pulse activation to fit the overall fire control system. It can operate in open loop with up to 8 different preset speeds or in closed loop with an external signal reference and feedback source. See parameter group **5-1* Digital Inputs** and parameter **24-43 Emergency Mode Signal Operation**.

Messages in display

When emergency mode is activated, the display shows a status message *Emergency Mode* and a warning *Emergency Mode*. Once the emergency mode is deactivated, the status messages disappear and the warning is replaced by the warning *Emergency M Was Active*.

Digital and relay outputs can be configured for the status emergency mode messages, see parameter group **5-3* Digital Outputs** and parameter group **5-4* Relays**. Emergency mode messages can also be accessed in the warning word via serial communication (see relevant documentation). Access the status messages *Emergency Mode* via the extended status word.

Table 50: Messages in Display

Messages	Type	LCP	Messages in display	Alarm word 1–3	Warning word 2	Warning word 3	Ext. status word 2
<i>W200 Emergency Mode</i>	Warning	+	+	–	–	+ (bit 7)	+ (bit 25)
<i>W201 Emerg. M Was Active</i>	Warning	+	+	–	+ (bit 3)	+ (bit 8)	–
<i>W202 Emerg. M Limits Exceeded</i>	Alarm (log)	+	+	–	–	+ (bit 9)	+ (bit 27)
<i>W280 Emcy M Service Warning</i>	Alarm (log)	+	+	–	–	+ (bit 10)	–
<i>W281 Emcy OPR unexpected</i>	Warning	+	+	–	–	+ (bit 11)	–

Log

To see an overview of the emergency mode-related events, view the emergency mode log, parameter group **18-1* Emergency Mode Log**, or press [Alarm Log] on the LCP. The log includes up to 10 of the latest events. Warranty-affecting alarms have a higher priority than the other 2 types of events.

The emergency mode alarm log can only be reset by a Danfoss authorized service partner. To secure the emergency mode operation documentation, the 1st critical alarms can never be removed.

The following events are logged:

- W200 - Emergency mode.
- W201 - Emerg. M mode was act. (deactivated).
- W202 - Emerg. M limits exceeded covered by the activated critical alarm number.
- (W280) - Emcy M service warning - service is needed.
- (W281) - Emcy OPR unexpected - emergency mode does not work as expected.

All alarms are logged as usual, and critical emergency mode alarms are logged in the emergency mode log in parameter group **18-1* Emergency Mode Log**.



NOTE: During emergency-mode operation, all stop commands to the drive are ignored, including coast/coast inverse and external interlock. The keypad is also locked during emergency mode to prevent user interference during operation of the safety system. However, if Safe Torque Off is available in the drive, this function is still active.



NOTE: Emergency mode has a special live zero function for handling lost analog signal inputs used for emergency mode setpoint/feedback, for example, for handling a burnt cable. How emergency mode should continue in these live zero situations is configured in parameter **6-02 Emergency Mode Live Zero Timeout Function**. If live zero is activated, *Emergency mode not working as expected* is activated so that a redundant system can take over or a setup change can be activated. A warning for live zero has a higher priority than the warning *Emergency mode* and will replace that information in the display.



NOTE: If setting the command [11] *Start Reversing* on a digital input terminal in parameter **5-10 Terminal 18 Digital Input**, the drive understands this as a reversing command.

24-00 Emergency Mode Function

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Alarms are produced or ignored in accordance with the selection in parameter **24-09 Emergency Mode Alarm Handling**.

Option	Name	Description
[0]*	Disabled	The emergency-mode function is not active.
[1]	Enabled-run forward	In this mode, the motor continues to operate in a clockwise direction. Works only in open loop. Set parameter 24-01 Emergency Mode Configuration to [0] <i>Open Loop</i> .
[2]	Enable-run reverse	In this mode, the motor continues to operate in a counterclockwise direction. Works only in open loop. Set parameter 24-01 Emergency Mode Configuration to [0] <i>Open Loop</i> .
[3]	Enabled-coast	In this mode, the output is disabled, and the motor is allowed to coast to stop.
[4]	Enable-run Fwd/Rev	
[8]	Alarm suppression	In this mode, the drive continues operation as normal, meaning on standard parameters and control operation, but where the alarms are suppressed as in normal emergency mode. The emcy LCP information and status word is updated as the emergency mode operation is logged in the emergency mode log.

24-01 Emergency Mode Configuration

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Before adjusting the PID controller, set parameter **24-09 Emergency Mode Alarm Handling** to [9] *Trip, all alarms/test*.



NOTE: If [2] *Enable-run reverse* is selected in parameter **24-00 Emergency Mode Function**, [3] *Closed loop* cannot be selected in parameter **24-01 Emergency Mode Configuration**.

The emergency mode can be controlled in open loop with up to 8 different preset values (zones), or in closed loop by a reference and feedback signal. The reference and feedback signal can come via drive input signals or over the fieldbus.

Option	Name	Description
[0]	Open loop	When emergency mode is active, the motor runs with a fixed speed based on a reference set. The unit is the same as selected in parameter 0-02 Motor Speed Unit .
[3]	Closed loop	When emergency mode is active, the built-in PID controller controls the speed based on the setpoint and a feedback signal selected in parameter 24-07 Emergency Mode Feedback Source . Select the unit in parameter 24-02 Emergency Mode Unit . For PID controller settings, use parameter group 20-** FC Closed Loop as for normal operation. The same PID configuration can be selected for both normal and emergency mode, and the operation can be continued as setup 1–4.

24-02 Emergency Mode Unit

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

By default, emergency mode is configured for open-loop control where only the motor unit is selected in parameter **0-02 Motor Speed Unit**. For closed-loop operation, select any of the following options.

Option	Name	Description
[0]	None	
[1]	%	
[2]	RPM	
[3]	Hz	
[4]	Nm	
[5]	PPM	
[10]	1/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	

Option	Name	Description
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm HG	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /min	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	
[174]	in HG	
[180]	HP	

24-03 Emergency Mode Min Reference

Default value:	Size related	Parameter type:	Range, -999999.999 - par. 24-04 EmergencyModeMaxReference
Setup:	All setups	Conversion index:	-3

Data type:	Int32	Change during operation:	True

The minimum value to the reference/setpoint (limiting the sum of values in parameter **24-05 Emergency Mode Preset Reference** and value of signal on input selected in parameter **24-06 Emergency Mode Reference Source**). If running in open loop when emergency mode is active, the unit is selected by the setting parameter **0-02 Motor Speed Unit**. For closed loop, select the unit in parameter **24-02 Emergency Mode Unit**.

24-04 Emergency Mode Max Reference

Default value:	Size related	Parameter type:	Range, par. 24-03 - 999999.999 EmergencyModeMinReference
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter defines the maximum speed reference which the emergency mode can operate to, although the motor limits in parameter **4-10 Motor Speed Direction** have the highest priority. This maximum value is also used as reference value for the 8 preset values calculations in %. If running in open loop when emergency mode is active, the unit is selected by setting parameter **0-02 Motor Speed Unit**. For closed loop, select the unit in parameter **24-02 Emergency Mode Unit**.

24-05 Emergency Mode Preset Reference

Default value:	0%	Parameter type:	Array [8]
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

A parameter array with 8 elements (0–7). The 8 present values (zones) are for open-loop control. Index [0] is used for basic emergency mode control. Indexes 1–7 are used to enhance emergency mode control, which also overwrites the basic control. More reference value can be added via parameter group **24-** Application Functions 2**.

24-06 Emergency Mode Reference Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the external reference input to be used for emergency mode. In open-loop mode, this signal value is added to the preset values in parameter **24-05 Emergency Mode Preset Reference**. There may be a different units scaling between preset and external values.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[7]	Pulse input 29	
[8]	Pulse input 33	
[11]	Local bus reference	Serial inputs from internal COM interfaces.
[20]	Digital pot.meter	
[21]	Analog input X30/11	
[22]	Analog input X30/12	

Option	Name	Description
[23]	Analog input X42/1	
[24]	Analog input X42/3	
[25]	Analog input X42/5	
[29]	Analog input X48/2	
[33]	PCD bus	
[37]	Analog input X49/1	
[38]	Analog input X49/3	
[39]	Analog input X49/5	
[133]	Fieldbus REF 1	A reference value can also come via selected fieldbus.

24-07 Emergency Mode Feedback Source

Default value:	[0] No function	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

In emergency mode closed-loop operation, feedback is requested for the internal PID controller. Select the feedback input to be used for the feedback signal.

Option	Name	Description
[0]*	No function	
[1]	Analog input 53	
[2]	Analog input 54	
[3]	Pulse input 29	
[4]	Pulse input 33	
[7]	Analog input X30/11	
[8]	Analog input X30/12	
[9]	Analog input X42/1	
[10]	Analog input X42/3	
[11]	Analog input X42/5	
[16]	Analog input X49/1	
[17]	Analog input X49/3	
[18]	Analog input X49/5	
[99]	Normal feedback	
[100]	Bus feedback 1	Different feedback channels can be selected via fieldbus network.
[101]	Bus feedback 2	Different feedback channels can be selected via fieldbus network.
[102]	Bus feedback 3	Different feedback channels can be selected via fieldbus network.

24-09 Emergency Mode Alarm Handling

Default value:	[0] Trip+reset, critical alarms	Parameter type:	Option

Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: Warranty-affecting alarms. Certain alarms can affect the lifetime of the drive. Should 1 of these ignored alarms occur while in emergency mode, the alarms are logged and stored in the emergency-mode log.



NOTE: The setting in parameter **14-20 Reset Mode** is disregarded if emergency mode is active (see parameter group **24-0* Emergency Mode**).

Select an option to define the response to alarms when emergency mode is active and an alarm is issued.

Option	Name	Description
[0]*	Trip+reset, critical alarms	Alarms are ignored even though damage may be caused, except for the critical alarms mentioned in the following table. When these alarms occur, the drive trips immediately, followed by an automatic reset and restarts even if the operation leads to an infinite loop of trip and restart.
[1]	Trip, critical alarms	Alarms are ignored even though damage may be caused, except for the critical alarms mentioned in the following table. For the critical alarms, a trip is caused. A manual reset is required before restart. A manual restart requires disabling emergency mode and enabling emergency mode again.
[2]	Trip, all alarms/test	Option for testing emergency mode operation without compromising the normal handling of warnings and alarms. All alarms are handled as normally defined in the Warning/Alarm Code List in the chapter <i>Troubleshooting</i> .

Table 51: Emergency Mode Alarm Handling

Alarm number	Description	Emergency mode alarm handling selected in parameter 24-09 <i>Emergency Mode Alarm Handling</i> . Critical alarms cause a trip.			Warranty-affecting alarms in emergency mode
		[0] Trip+reset	[1] Trip	[2] Test	
4	Mains phase loss	Ignore	Ignore	(Warning/trip)	X
7	DC voltage high	Trip+reset	Trip	Warning/trip	
8	DC voltage low	Trip+reset	Trip	Warning/trip	
9	Inverter overld.	Ignore	Ignore	(Warning/trip)	X
13	Over current	Trip+reset	Trip	(Warning/trip/trip lock)	
14	Ground fault	Trip+reset	Trip	(Warning/trip/trip lock)	
16	Short circuit	Trip+reset	Trip	(Trip/trip lock)	
29	Power module temp	Ignore	Ignore	(Warning/trip/trip lock)	X
33	Inrush fault	Ignore	Ignore	Trip/trip lock	X
38	Internal fault	Ignore	Ignore	Trip/trip lock	X

Table 51: Emergency Mode Alarm Handling - (continued)

Alarm number	Description	Emergency mode alarm handling selected in parameter 24-09 <i>Emergency Mode Alarm Handling</i> . Critical alarms cause a trip.			Warranty-affect- ing alarms in emer- gency mode
		[0] Trip+reset	[1] Trip	[2] Test	
39	Heatsink sensor	Ignore	Ignore	(Trip/trip lock)	X
45	Ground fault 2	Ignore	Ignore		
65	Ctrl. card temp	Ignore	Ignore	Warning/trip/(trip lock)	X
68	Safe stop	Trip	Trip	Trip	
69	Pwr card temp.	Ignore	Ignore	Trip/(trip lock)	X
79	Illegal PS config	Ignore	Ignore		
101	Speed monitor (FC 302)	Ignore	Ignore		
200	Emergency mode	Ignore	Ignore		
201	Emerg. M was active	Ignore	Ignore		
202	Emerg. M limits ex- ceeded	Ignore	Ignore		
244	Heatsink temp	Ignore	Ignore	(Trip/trip lock)	X
245	Heatsink sensor	Ignore	Ignore	(Trip/trip lock)	X
247	Pwr.card temp	Ignore	Ignore	(Trip/trip lock)	X
280	Emergency m ser- vice warning	Ignore	Ignore		
281	Emcy OPR unex- pected	Ignore	Ignore		

5.23.2 24-1* Drive Bypass

The drive includes a feature which can be used to automatically activate an external electro-mechanical bypass if the drive trips or if there is an emergency-mode coast (see parameter **24-00 Emergency Mode Function**).

The bypass switches the motor top operation direct on line. The external bypass is activated by 1 of the digital outputs or relays in the drive when programmed in parameter group **5-3* Digital Outputs** or parameter group **5-4* Relays**.



NOTE: After enabling the drive bypass function, the drive is no longer safety certified (for using the Safe Torque Off in versions, where included).

To deactivate the drive bypass at normal operation (emergency mode not activated), carry out 1 of the following actions:

- Press [Off] on the LCP, or program 2 of the digital inputs for Hand On-Off-Auto.
- Activate external interlock via digital input.
- Carry out a power cycle.



NOTE: The drive bypass cannot be deactivated if in emergency mode. It can be deactivated only by either removing the emergency mode command signal or the power supply to the drive.

When the drive bypass function is activated, the display on the LCP shows the status message *Drive Bypass*. This message has a higher priority than the emergency mode status messages. When the automatic drive bypass function is enabled, it cuts in the external bypass according to the sequence shown in [Figure 113](#).

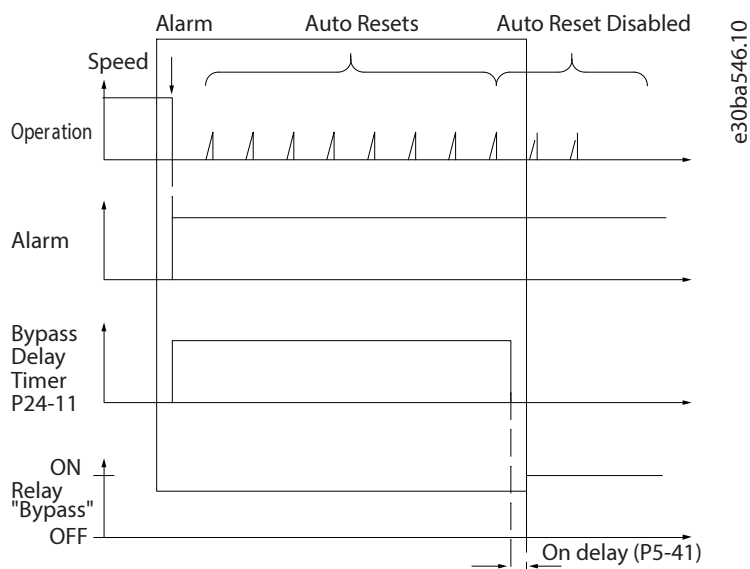


Figure 113: Drive Bypass

The status can be read in the extended status word 2, bit number 24.

24-10 Drive Bypass Function

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: After enabling the drive bypass function, the Safe Torque Off function (where included) does not comply with standard EN 954-1, Cat. 3 installations.

This parameter determines the circumstances that activate the drive bypass function.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	If in normal operation, the drive bypass function is activated under the following conditions: • If there is a trip lock or a trip. • After the number of reset attempts programmed in parameter 14-20 Reset Mode. • If the bypass delay timer (parameter 24-11 Drive Bypass Delay) expires before reset attempts have been completed.
[2]	Enabled (Emergency M Only)	

24-11 Drive Bypass Delay Time

Default value:	0 s	Parameter type:	Range, 0 - 600 s
Setup:	2 setups	Conversion index:	0

Data type:	Uint16	Change during operation:	True

Programmable in 1 s increments. Once the bypass function is activated in accordance with the setting in parameter **24-10 Drive Bypass Function**, the bypass delay timer begins to operate. If the drive has been set for several restart attempts, the timer continues to run while the drive tries to restart. Should the motor have restarted within the time period of the bypass delay timer, the timer is reset. Should the motor fail to restart at the end of the bypass delay time, the drive bypass relay programmed for bypass in parameter **5-40 Function Relay** is activated. If a relay delay has also been programmed in parameter **5-41 On Delay, Relay** or parameter **5-42 Off Delay, Relay**, this time must also elapse before the relay action is performed. Where no restart attempts are programmed, the timer runs for the delay period set in this parameter and activates the drive bypass relay, which has been programmed for bypass in parameter **5-40 Function Relay**. If a relay delay has also been programmed in parameter **5-41 On Delay, Relay** or parameter **5-42 Off Delay, Relay**, this time must also elapse before the relay action is performed.

5.23.3 24-4* Emergency Mode 2

Configure the ramp parameters for emergency mode:

- Ramp type
- Ramping times (duration of acceleration and deceleration)
- Level of jerk compensation for S-ramps

Start by setting the linear ramping times corresponding to [Figure 114](#) and [Figure 115](#).

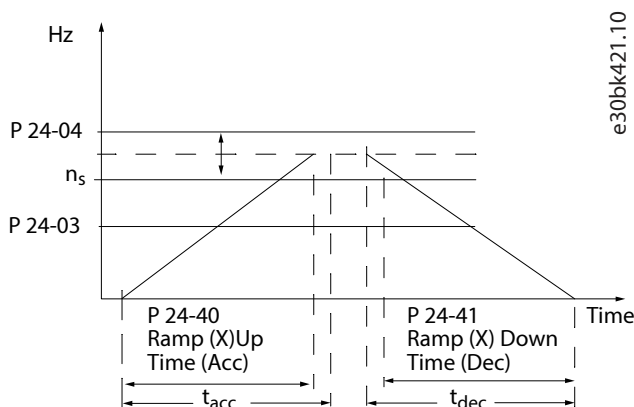


Figure 114: Linear Ramping Times

If S-ramps are selected, set the level of non-linear jerk compensation required. Set jerk compensation by defining the proportion of ramp-up and ramp-down times where acceleration and deceleration are variable (that is, increasing or decreasing). The S-ramp acceleration and deceleration settings are defined as a percentage of the actual ramp time.

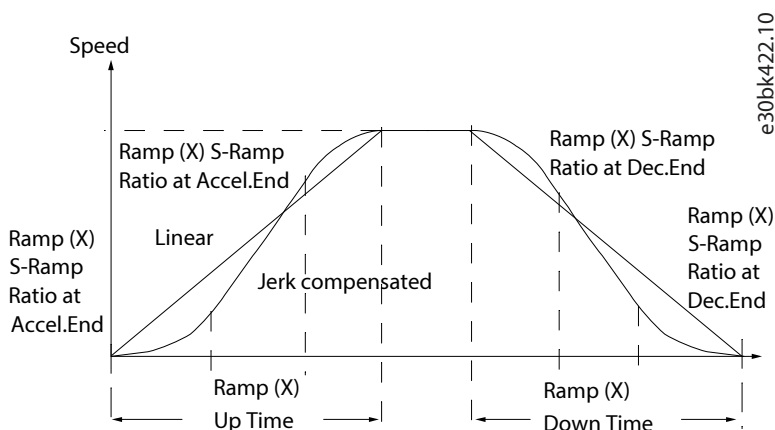


Figure 115: Non-linear Ramping Times

24-40 Emergency Mode Ramp Up Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

This ramp time is used for acceleration while emergency mode is active.

24-41 Emergency Mode Ramp Down Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Changes during operation:	True

This ramp time is used for deceleration while emergency mode is active.

24-41 Emergency Mode Ramp Down Time

Default value:	Size related	Parameter type:	Range, 0.10 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Changes during operation:	True

This ramp time is used for deceleration while emergency mode is active.

24-42 Timeout for Emergency Mode Test

Default value:	10 min	Parameter type:	Range, 1 - 60 min
Setup:	All setups	Conversion index:	70
Data type:	Uint8	Change during operation:	True

A digital impulse triggers the emergency mode operation with stop on all alarms as option **[2] Trip, all alarms/test** in parameter **24-09 Emergency Mode Alarms Handling**. This test impulse signal can only activate 1 test time period and the normal emergency mode operation takes over as soon as the test time ends, or it stops the test period if the emergency mode signal disappears. Only "normal high impulse" signals can trigger the test timer and test information is included in the LCP and status word, as emergency mode output "not operating as expected" is activated.

24-43 Emergency Mode Signal Operation

Default value:	–	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Ensure that the correct input selections and connections are in place as it is not possible to operation the LCP while emergency mode is activated.



NOTE: If signal handling is set to inverse, a low **[196] EM active** and a low **[197] EM was active** indicate that the drive is off or power cycling, which can be used to activate a redundant system.

Select how emergency mode input and output signals are handled. Before changing this parameter, disable parameter **24-00 Emergency Mode Function**.

Option	Name	Description
[0]	Standard, active-high	Normal high input and output signals operate the emergency mode function as long as they are active (high).
[1]	Inverse, active-low	This option adds safety rules to ensure that emergency mode still operates if a signal is lost.
[2]	Impulse, set-reset	This option activates and stops the emergency mode operation on high signal impulse. Operation mode is defined and activated by selected input signals and is frozen 2 s after the 1st signal activation. Reset signal has the highest priority and is required to stop operation or switch to a new operation configuration. A valid signal impulse has to be active for minimum 2 s.



NOTE: LCP copy and software download only accept parameter changes if parameter **24-00 Emergency Mode** is set to **[0] Disabled**.

5.24 Parameter Group 25-** Cascade Controller

5.24.1 Introduction to Cascade Controller Parameters

Parameters for configuring the basic cascade controller for sequence control of multiple pumps. For a more application-oriented description and wiring examples, see the section *Application Examples, Cascade Controller* in the design guide. For more information on using the advanced cascade controller options, refer to Parameter Group **27-** Cascade CTL Option**.

To configure the cascade controller to the actual system and the required control strategy, follow the sequence starting with parameter group **25-0* System Settings** and next parameter group **25-5* Alternation Settings**. These parameters can normally be set in advance. Parameters in parameter groups **25-2* Bandwidth Settings** and **25-4* Staging Settings** often depend on the dynamic of the system and final adjustment to be done at the commissioning of the plant.



NOTE: The cascade controller is supposed to operate in closed loop controlled by the built-in PI controller (**[3] Closed loop** selected in parameter **1-00 Configuration Mode**). If **[0] Open loop** is selected in parameter **1-00 Configuration Mode**, all fixed-speed pumps are destaged, but the variable-speed pump is still controlled by the drive, now as an open-loop configuration.

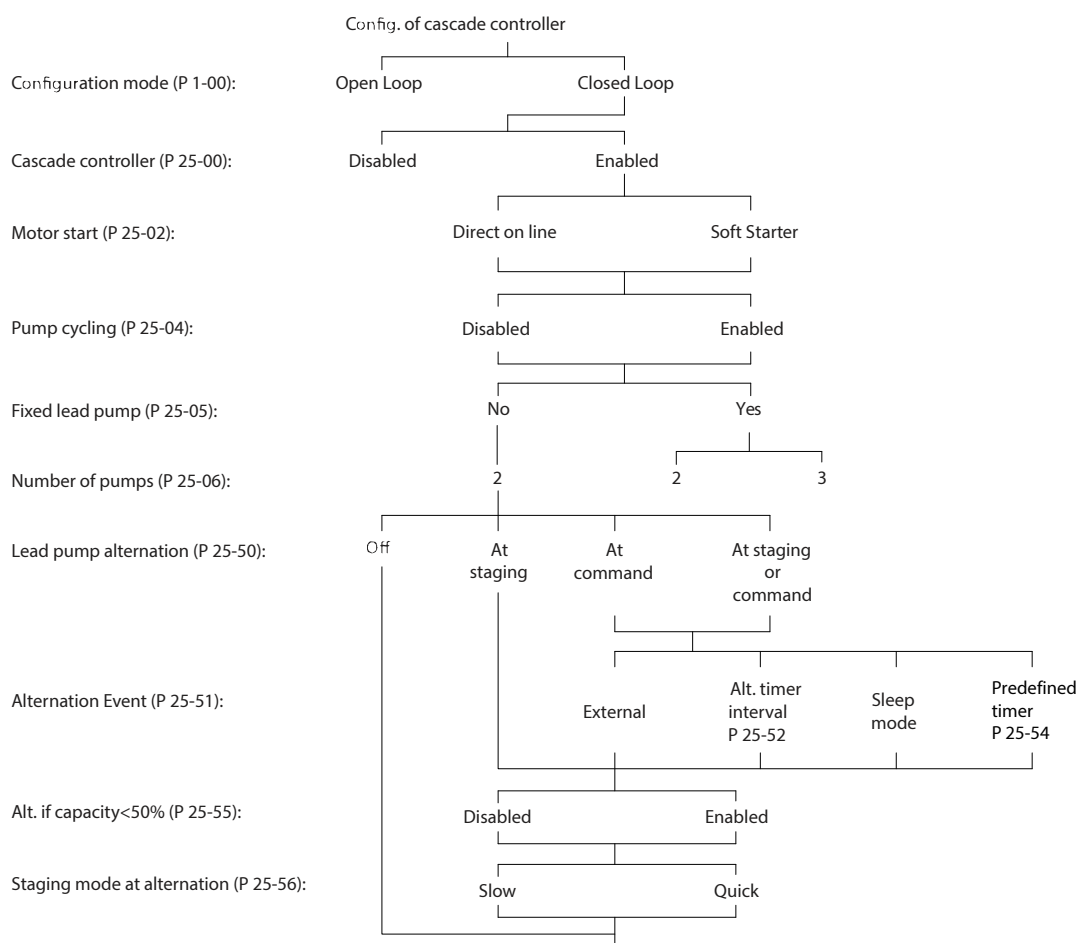


Figure 116: Cascade Controller Sample Setup

5.24.2 25-0* System Settings

The parameters in this parameter group are related to the control principles and the configuration of the system.

25-00 Cascade Controller

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

For operation of multiple devices (pump/fan) systems where capacity is adapted to actual load with speed control combined with on/off control of the devices. For simplicity, only pump systems are described. To enable the cascade controller functionality, set parameter **1-00 Configuration Mode** to [3] **Closed loop**.

Option	Name	Description
[0]*	Disabled	The cascade controller is not active. All built-in relays assigned to pump motors in the cascade function are de-energized. If a variable-speed pump is connected to the drive directly (not controlled by a built-in relay), this pump/fan is controlled as a single-pump system.
[1]	Basic cascade ctrl	The cascade controller is active and stages/destages the pump according to the load on the system.
[2]	Motor alternation only	

25-02 Motor Start

Default value:	[0] Direct on line	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Motors are connected to mains directly with a contactor or with a soft starter. When the value of parameter **25-02 Motor Start** is set to an option other than **[0] Direct on line**, parameter **25-50 Lead Pump Alternation** is automatically set to the default of **[0] Direct on line**.

Option	Name	Description
[0]*	Direct on line	Each fixed-speed pump is connected to mains directly via a contactor.
[1]	Soft starter	Each fixed-speed pump is connected to mains via a soft starter.
[2]	Star-Delta	Fixed pumps connected with star-delta starters are staged in the same way as pumps connected with soft starters. They are destaged in the same way as pumps connected directly to mains.

25-04 Pump Cycling

Default value:	–	Parameter type:	Option
Size related:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

To provide equal hours of operation with fixed-speed pumps, the pump used can be cycled. The selection of pump cycling is either first in-last out or equal running hours for each pump.

Option	Name	Description
[0]	Disabled	The fixed-speed pumps are connected in the order 1–2 and disconnected in the order 2–1 (last in-first out).
[1]	Enabled	The fixed-speed pumps are connected/disconnected to have equal running hours for each pump.

25-05 Fixed Lead Pump

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Fixed lead pump is a configuration when the variable-speed pump is connected directly to the drive. If a contactor is applied between the drive and the pump, this contactor is not controlled by the drive. If operating with parameter **25-50 Lead Pump Alternation** set to other than **[0] Off**, set this parameter to **[0] No**.

Option	Name	Description
[0]	No	The lead-pump function can alternate between the pumps controlled by the 2 built-in relays. Connect 1 pump to the built-in relay 1 and the other pump to relay 2. The pump function (cascade pump1 and cascade pump2) is automatically assigned to the relays (maximum 2 pumps can be controlled by the drive in this case).
[1]	Yes	The lead pump is fixed (no alternation) and connected directly to the drive. Parameter 25-50 Lead Pump Alternation is automatically set to [0] Off . Built-in relays, relay 1 and relay 2, can be assigned to separate fixed-speed pumps. In total, the drive can control 3 pumps.

25-06 Number of Pumps

Default value:	2	Parameter type:	Range, 2 - 9
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

The number of pumps connected to the cascade controller including the variable-speed pump. If the variable-speed pump is connected directly to the drive, and the other fixed-speed pumps (lag pumps) are controlled by the 2 built-in relays, 3 pumps can be controlled. If both the variable-speed and fixed-speed pumps are to be controlled by built-in relays, only 2 pumps can be connected. If parameter **25-05 Fixed Lead Pump** is set to **[0] No**: 1 variable-speed pump and 1 fixed-speed pump, both controlled by built-in relay. If parameter **25-05 Fixed Lead Pump** is set to **[1] Yes**: 1 variable-speed pump and 1 fixed-speed pump controlled by built-in relays. 1 lead pump, see parameter **25-05 Fixed Lead Pump**. 2 fixed-speed pumps controlled by built-in relays.

5.24.3 25-2* Bandwidth Settings

Parameters for setting the bandwidth within which the pressure is allowed to operate before staging/destaging fixed speed pumps. These parameters also include various timers to stabilize the control.

25-20 Staging Bandwidth

Default value:	Size related	Parameter type:	Range, 1 - par. 25-21 [%]
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Set the staging bandwidth (SBW) percentage to accommodate normal system pressure fluctuation. In cascade control systems, to avoid frequent switching of fixed speed pumps, the desired system pressure is typically kept within a bandwidth rather than at a constant level. The SBW is programmed as a percentage of parameter **20-13 Minimum Reference/Feedb.** and parameter **20-14 Maximum Reference/Feedb.** For example, if the setpoint is 5 bar and the SBW is set to 10%, a system pressure between 4.5 and 5.5 bar is tolerated. No staging or destaging occurs within this bandwidth.

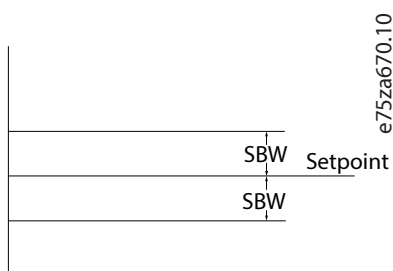


Figure 117: Staging Bandwidth

25-21 Override Bandwidth

Default value:	100%	Parameter type:	Range, par. 25-20 - 100 %
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

When a large and quick change in the system demand occurs (such as a sudden water demand), the system pressure rapidly changes and an immediate staging or destaging of a fixed-speed pump becomes necessary to match the requirement. The override bandwidth (OBW) is programmed to override the staging/destaging timer (parameter **25-23 SBW Staging Delay** and parameter **25-24 SBW Destaging Delay**) for immediate response. Always program the OBW to a higher value than the value set in parameter **25-20 Staging Bandwidth**. The OBW is a percentage of parameter **3-02 Minimum Reference** and parameter **3-03 Maximum Reference**.

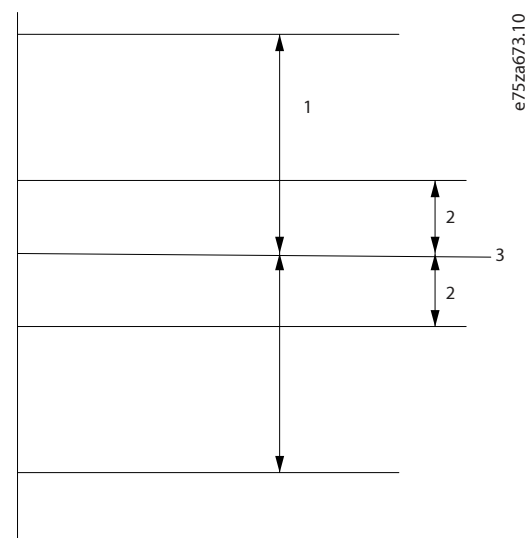


Figure 118: Override Bandwidth

1	Override bandwidth	2	SBW
3	Setpoint		

Setting the OBW too close to the SBW could defeat the purpose with frequent staging at momentary pressure changes. Setting the OBW too high might lead to unacceptably high or low pressure in the system while the SBW timers are running. The value can be optimized with increased familiarity with the system. See parameter **25-25 OBW Time**. To avoid unintended staging during the commissioning phase and fine-tuning of the controller, initially leave the OBW at the factory setting of 100% (Off). When the fine-tuning is completed, set the OBW to the required value. Initial value of 10% is suggested.

25-22 Fixed Speed Bandwidth

Default value:	10%	Parameter type:	Range, par. 25-20 - par. 25-21 %
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

When the cascade control system runs normally and the drive issues a trip alarm, it is important to maintain the system head. The cascade controller does this by continuing to stage/destage the fixed-speed pump on and off. As keeping the head at the setpoint would require frequent staging and destaging when only a fixed-speed pump is running, a wider fixed-speed bandwidth (FSBW) is used instead of SBW. In alarm situations, or if the start signal on the digital input goes low, it is possible to stop the fixed-speed pumps by pressing [Off] or [Hand On]. If the issued alarm is a trip lock alarm, the cascade controller stops the system immediately by cutting out all the fixed-speed pumps. This is basically the same as emergency stop (coast/coast inverse command) for the cascade controller.

25-23 SBW Staging Delay

Default value:	15 s	Parameter type:	Range, 0 - 3000 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Immediate staging of a fixed-speed pump is not desirable when a momentary pressure drop in the system exceeds the staging bandwidth (SBW). Staging is delayed by the length of the time programmed. If the pressure increases within the SBW before the timer has elapsed, the timer is reset.

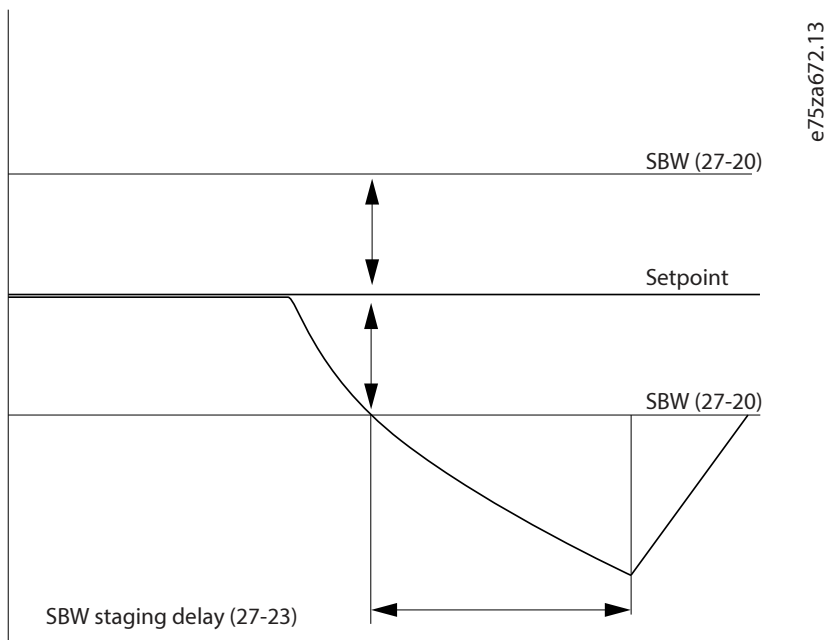


Figure 119: SBW Staging Delay

25-24 SBW Destaging Delay

Default value:	15 s	Parameter type:	Range, 0 - 3000 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Immediate destaging of a fixed-speed pump is not recommended when a momentary pressure increases in the system that exceeds the staging bandwidth (SBW). Destaging is delayed by the length of time programmed. If the pressure decreases within the SBW before the timer has elapsed, the timer is reset.

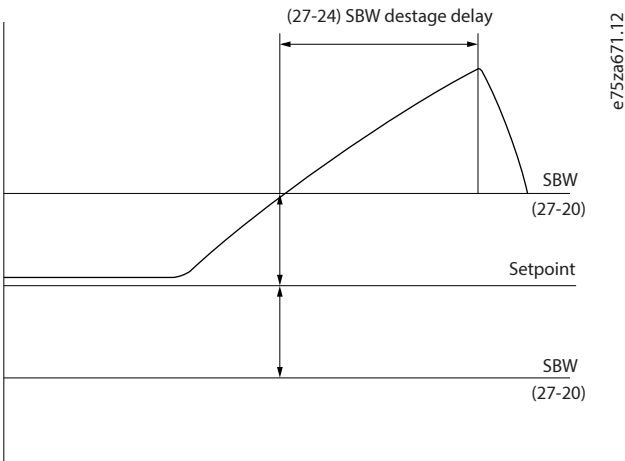


Figure 120: SBW Destaging Delay

25-25 OBW Time

Default value:	10 s	Parameter type:	Range, 0 - 300 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Staging a fixed-speed pump creates a momentary pressure peak in the system, which might exceed the override bandwidth (OBW). It is not recommended to destage a pump in response to a staging pressure peak. The OBW time can be programmed to prevent staging until the system pressure has stabilized and normal control established. Set the timer to a value that allows the system to stabilize after staging. The 10 s factory setting is appropriate in most applications. In highly dynamic systems, a shorter time may be wanted.

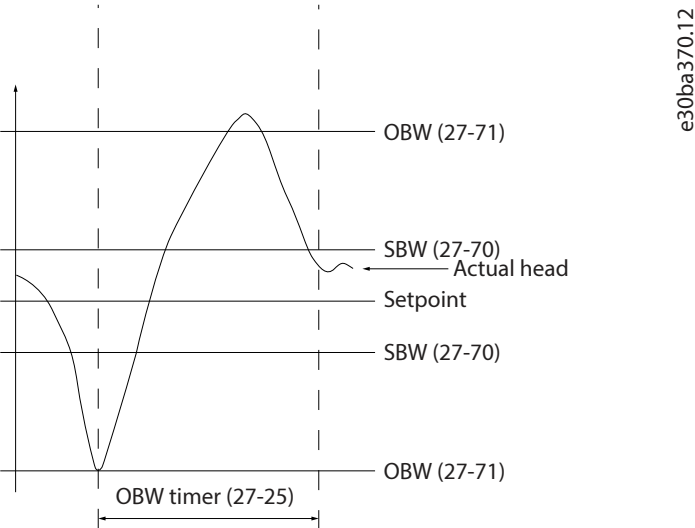


Figure 121: Override Bandwidth Time

25-26 Destage at No-Flow

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter ensures that when a no-flow situation occurs, the fixed-speed pumps are destaged 1 by 1 until the no-flow signal disappears. This requires that no-flow detection is active. See parameter group **22-2* No-Flow Detection**. If **[0] Disabled** is selected, the cascade controller does not change the normal behavior of the system.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

25-27 Stage Function

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

If the stage function is set to **[0] Disabled**, parameter **25-28 Stage Function Time** is not activated.

Option	Name	Description
[0]	Disabled	
[1]	Enabled	

25-28 Stage Function Time

Default value:	15 s	Parameter type:	Range, 0 - 300 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The stage function time is programmed to avoid frequent staging of the fixed-speed pumps. The stage function time starts if **[1] Enabled** is selected in parameter **25-27 Stage Function**, and the variable-speed pump runs at motor speed high limit (parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**) with at least 1 fixed-speed pump in the stop position. When the programmed value of the timer expires, a fixed-speed pump is staged.

25-29 Destage Function

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The destage function ensures that the lowest numbers of pumps are running to save energy and to avoid dead-head water circulation in the variable-speed pump. If the destage function is set to **[0] Disabled**, parameter **25-30 Destage Function Time** is not activated.

Option	Name	Description
[0]	Disabled	
[1]	Enabled	

25-30 Destage Function Time

Default value:	15 s	Parameter type:	Range, 0 - 300 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The destage function timer is programmable to avoid frequent staging/destaging of the fixed-speed pumps. The destage function time starts when the adjustable-speed pump is running at parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]**, with 1 or more fixed-speed pumps in operation and system requirements satisfied. In this situation, the adjustable-speed pump contributes a little to the system. When the programmed value of the timer expires, a stage is removed, avoiding dead-head water circulation in the adjustable-speed pump.

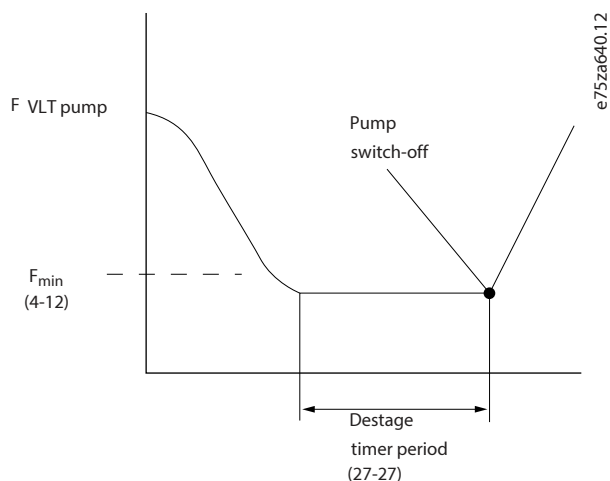


Figure 122: Destage Function Time

5.24.4 25-4* Staging Settings

Parameters determining the conditions for staging/destaging of the pumps.

25-40 Ramp Down Delay

Default value:	10 s	Parameter type:	Range, 0 - 120 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: Use this option only if [1] *Soft starter* or [2] *Star-Delta* is selected in parameter **25-02 Motor Start**.

When adding a fixed-speed pump controlled by a soft starter or a star-delta starter, it is possible to delay the ramp down of the lead pump until a preset time after the start of the fixed-speed pump. This delay eliminates pressure surges or water hammer in the system.

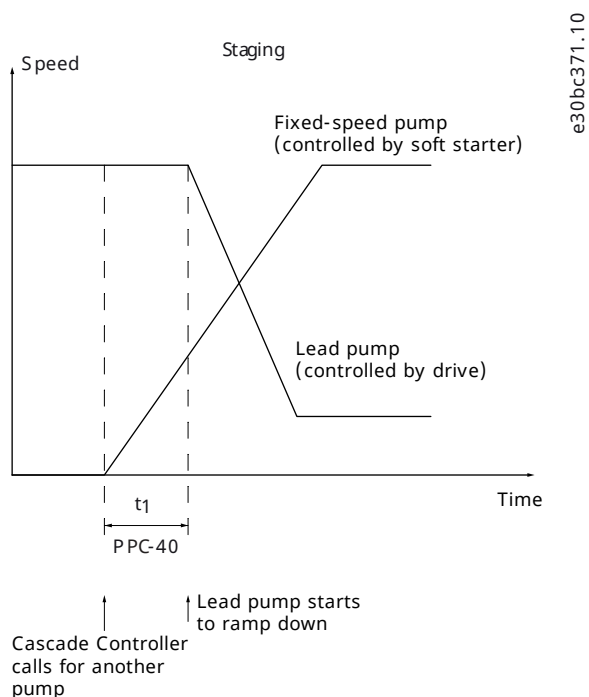


Figure 123: Staging with Ramp-down Delay

25-41 Ramp Up Delay

Default value:	2 s	Parameter type:	Range, 0 - 12 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: Use this option only if [1] **Soft starter** is selected in parameter **25-02 Motor Start**.

When removing a fixed-speed pump controlled by a soft starter, it is possible to delay the ramp up of the lead pump until a preset time after the stop of the fixed-speed pump. This delay eliminates pressure surges or water hammer in the system.

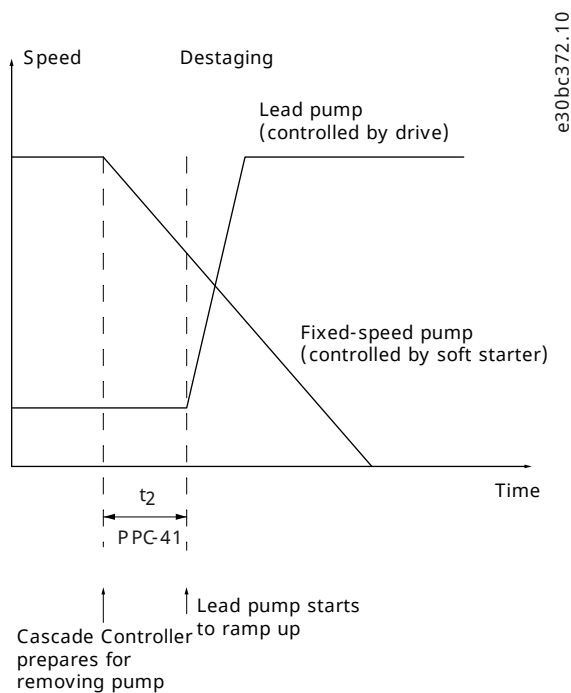


Figure 124: Destaging with Ramp-up Delay

25-42 Staging Threshold

Default value:	Size related	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

When adding a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps down to a lower speed. When the variable-speed pump reaches the staging speed, the fixed-speed pump is staged on. The staging threshold is used to calculate the speed of the variable-speed pump when the “cut-in point” of the fixed-speed pump occurs. The calculation of the staging threshold is the ratio of parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]**, to parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**, expressed in percent. Staging threshold must range from $\text{Stage \%} = \frac{\text{LOW}}{\text{HIGH}} \times 100\%$ to 100%, where n_{HIGH} is motor speed high limit.



NOTE: If the setpoint is reached after staging before the variable speed pump reaches its minimum speed, the system enters the state closed loop when the feedback pressure is crossing the setpoint.

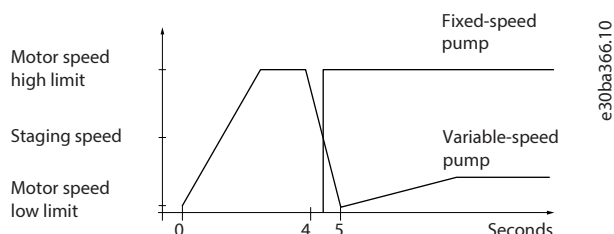


Figure 125: Staging Threshold

25-43 Destaging Threshold

Default value:	Size related	Parameter type:	Range, 0 - 100%

Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

When removing a fixed-speed pump to prevent an undershoot of pressure, the variable-speed pump ramps up to a higher speed. When the variable-speed pump reaches the destaging speed, the fixed-speed pump is destaged. The destaging threshold is used to calculate the speed of the variable-speed pump when the destaging of the fixed-speed pump occurs. The calculation of the destaging threshold is the ratio of parameter **4-11 Motor Speed Low Limit [RPM]** or parameter **4-12 Motor Speed Low Limit [Hz]**, to parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**, expressed in percent. Destaging threshold must range from Stage % = $\frac{n_{LOW}}{n_{HIGH}} \times 100\%$ to 100%, where n_{LOW} is motor speed low limit and n_{HIGH} is motor speed high limit.

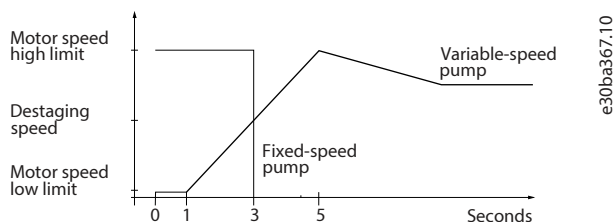


Figure 126: Destaging Threshold

25-44 Staging Speed [RPM]

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Readout of the calculated value for staging speed. When adding a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps down to a lower speed. When the variable-speed pump reaches the staging speed, the fixed-speed pump is staged on. Staging speed calculation is based on parameter **25-42 Staging Threshold** and parameter **4-13 Motor Speed High Limit [RPM]**. Staging speed is calculated with the following formula:

$$n_{STAGE} = n_{HIGH} \times \frac{\eta_{STAGE\%}}{100} \text{ where } n_{HIGH} \text{ is motor speed high limit and } n_{STAGE100\%} \text{ is the value of the staging threshold.}$$

25-45 Staging Speed [Hz]

Default value:	0 Hz	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Readout of the calculated value for staging speed. When adding a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps down to a lower speed. When the variable-speed pump reaches the staging speed, the fixed-speed pump is staged on. Staging speed calculation is based on parameter **25-42 Staging Threshold** and parameter **4-14 Motor Speed High Limit [Hz]**.

The staging speed is calculated with the following formula:

$$STAGE = HIGH \times \frac{STAGE\%}{100} \text{ where } n_{HIGH} \text{ is motor speed high limit, and } n_{STAGE100\%} \text{ is the value of the staging threshold.}$$

25-46 Destaging Speed [RPM]

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Readout of the calculated value for destaging speed. When removing a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps up to a higher speed. When the variable-speed pump reaches the destaging speed, the fixed-speed pump is destaged. Destaging speed calculation is based on parameter **25-43 Destaging Threshold** and parameter **4-13 Motor Speed High Limit [RPM]**.

The staging speed is calculated with the following formula:

$DESTAGE = HIGH \frac{DESTAGE\%}{100}$ where n_{HIGH} is motor speed high limit, and $n_{DESTAGE100\%}$ is the value of the destaging threshold.

25-47 Destaging Speed [Hz]

Default value:	0 Hz	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Readout of the calculated value for destaging speed. When removing a fixed-speed pump to prevent an overshoot of pressure, the variable-speed pump ramps up to a higher speed. When the variable-speed pump reaches the destaging speed, the fixed-speed pump is destaged. Destaging speed calculation is based on parameter **25-43 Destaging Threshold** and parameter **4-14 Motor Speed High Limit [Hz]**.

The staging speed is calculated with the following formula:

$DESTAGE = HIGH \frac{DESTAGE\%}{100}$ where n_{HIGH} is motor speed high limit, and $n_{DESTAGE100\%}$ is the value of the destaging threshold.

25-49 Staging Principle

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Select the staging principle for the staging of fixed-speed pumps (direct online models). To configure the drive to return to closed-loop operation immediately after a pump was staged or destaged, select **[1] Rapid staging**. Use **[1] Rapid staging** in systems with rapid demand changes.

Option	Name	Description
[0]*	Normal	
[1]	Rapid staging	

5.24.5 25-5* Alternation Settings

Parameters for defining the conditions for alternation of variable-speed pump (lead) if selected as control strategy.

25-50 Lead Pump Alternation

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: If parameter **25-05 Fixed Lead Pump** is set to **[1] Yes**, it is only possible to select **[0] Off**.

Lead pump alternation equalizes the use of pumps by periodically changing the pump that is speed-controlled. This ensures that pumps are equally used over time. Alternation equalizes the usage of pumps by always selecting the pump with the lowest number of hours run to stage on next.

Option	Name	Description
[0]	Off	No alternation of lead-pump function takes place. If parameter 25-02 Motor Start is set to other than [0] Direct on line , it is not possible to set this parameter to options other than [0] Off .
[1]	At staging	Alternation of the lead-pump function takes place when staging another pump.
[2]	At command	Alternation of the lead-pump function takes place at an external command signal or a preprogrammed event. See parameter 25-51 Alternation Event for available options.
[3]	At staging or command	Alternation of the lead pump takes place at staging or according to [2] At command .

25-51 Alternation Event

Default value:	[0] External	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter is only active if the options **[2] At command** or **[3] At staging or command** have been selected in parameter **25-50 Lead Pump Alternation**. If an alternation event is selected, the alternation of lead pump takes place every time the event occurs.

Option	Name	Description
[0]*	External	Alternation takes place when a signal is applied to 1 of the digital inputs on the terminal strip and this input has been assigned to [121] Lead Pump Alternation in parameter group 5-1* Digital Inputs .
[1]	Alternation time interval	Alternation takes place every time parameter 25-52 Alternation Time Interval expires.
[2]	Sleep mode	Alternation takes place each time the lead pump goes into sleep mode. Set parameter 20-23 Setpoint 3 to [1] Sleep Mode or apply an external signal for this function.
[3]	Predefined time	Alternation takes place at a defined time of the day. If parameter 25-54 Alternation Predefined Time is set, the alternation is carried out every day at the specified time. Default time is midnight (00:00 or 12:00AM depending on the time format).

25-52 Alternation Time Interval

Default value:	24 h	Parameter type:	Range, 1 - 999 h
Setup:	All setups	Conversion index:	74
Data type:	Uint16	Change during operation:	True

If selecting **[1] Alternation time interval** in parameter **25-51 Alternation Event**, the alternation of the variable-speed pump takes place every time the alternation time interval expires (can be checked in parameter **25-53 Alternation Time Value**). The timer pauses when the drive is not running.

25-53 Alternation Timer Value

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[7]	Change during operation:	True

Readout parameter for the alternation time interval value set in parameter **25-52 Alternation Time Interval**.

25-54 Alternation Predefined Time

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDaywoDate	Change during operation:	True

If selecting **[3] Predefined Time** in parameter **25-51 Alternation Event**, the variable-speed pump alternation is carried out every day at the specified time set in alternation predefined time. Default time is midnight (00:00 or 12:00AM depending on the time format).

25-55 Alternation if Load <50%

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Only valid if parameter **25-50 Lead Pump Alternation** is different from **[0] Off**.

If selecting **[1] Enabled**, the pump alternation can only occur if the capacity is equal to or below 50%. The capacity calculation is the ratio of running pumps (including the variable-speed pump) to the total number of available pumps (including variable-speed pump, but not those that are interlocked). For the basic cascade controller, all pumps are of equal size.

$$\text{Capacity} = \frac{N_{\text{RUNNING}}}{N_{\text{TOTAL}}} \times 100\%$$

Option	Name	Description
[0]	Disabled	The lead-pump alternation takes place at any pump capacity.
[1]*	Enabled	The lead-pump function is alternated only if the number of pumps running are providing less than 50% of total pump capacity.

25-56 Staging Mode at Alternation

Default value:	[0] Slow	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True



NOTE: Only valid if parameter **25-50 Lead Pump Alternation** is different from **[0] Off**.

This parameter is only active if the option selected in parameter **25-50 Lead Pump Alternation** is different from **[0] Off**. 2 types of staging and destaging of pumps are possible. Slow transfer makes staging and destaging smooth. Quick transfer makes staging and destaging as fast as possible; the variable-speed pump is just cut out (coasted).

The following illustration is an example of the slow transfer-staging. The variable-speed pump (top graph) and 1 fixed-speed pump (bottom graph) run before the staging command. When the [0] **Slow transfer command** is activated, an alternation is carried out by ramping the variable-speed pump to parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**, and then decelerated to zero speed. After a delay before starting the next pump (parameter **25-58 Run Next Pump Delay**), the next lead pump (middle graph) is accelerated and another original lead pump (top graph) is added after the delay before running on mains (parameter **25-59 Run on Mains Delay**) as a fixed-speed pump. The next lead pump (middle graph) is decelerated to motor speed low limit and then allowed to vary speed to maintain system pressure.

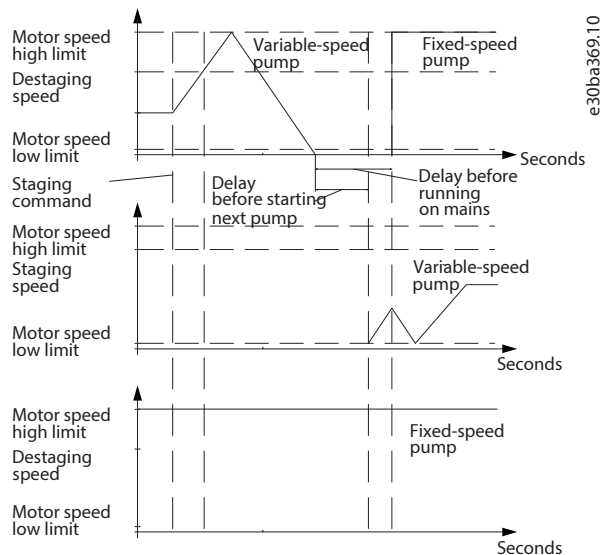


Figure 127: Staging Mode at Alternation

Option	Name	Description
[0]*	Slow	At alternation, the variable-speed pump is ramped up to maximum speed and then ramped down to a standstill.
[1]	Quick	At alternation, the variable-speed pump is ramped up to maximum speed and then coasted to a standstill.
[2]	Slow down	At alternation, the variable-speed pump is ramped down to a standstill.

25-58 Run Next Pump Delay

Default value:	0.1 s	Parameter type:	Range, 0.1 - 5 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

This parameter is only active if the option selected in parameter **25-50 Lead Pump Alternation** is different from [0] **Off**. This parameter sets the time between stopping the old variable-speed pump and starting another pump as a new variable-speed pump. Refer to parameter **25-56 Staging Mode at Alternation** for a description of staging and alternation.

25-59 Run on Mains Delay

Default value:	0.5 s	Parameter type:	Range, Par. 25-58 - 5 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is only active if the option selected in parameter **25-50 Lead Pump Alternation** is different from **[0] Off**.

This parameter sets the time between stopping the old variable-speed pump and starting this pump as a new fixed-speed pump. Refer to parameter **25-56 Staging Mode at Alternation** for a description of staging and alternation.

5.24.6 25-8* Status

This parameter group contains readout parameters providing information about the operating status of the cascade controller and the pumps installed.

25-80 Cascade Status

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

Readout of the status of the cascade controller.

25-81 Pump Status

Default value:	0	Parameter type:	Range, 0 - 25
Setup:	All setups	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

Pump status shows the status for the number of pumps selected in parameter **25-06 Number of Pumps**. It is a readout of the status for each of the pumps showing a string, which consists of the pump number and the status of the pump. Example: Readout is with the abbreviation like "1:D 2:O" This means that pump 1 is running and the speed is controlled by the drive, and pump 2 is stopped.

25-82 Lead Pump

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Readout parameter for the actual variable-speed pump in the system. The lead-pump parameter is updated to reflect the current variable-speed pump in the system when an alternation takes place. If no lead pump is selected (cascade controller disabled or all pumps interlocked), the display shows N1.

25-83 Relay Status

Default value:	0	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[4]	Change during operation:	True

Readout of the status for each of the relays assigned to control the pumps. Every element in the array shows a relay. If a relay is activated, the corresponding element is set to On. If a relay is deactivated, the corresponding element is set to Off.

25-84 Pump ON Time

Default value:	0 h	Parameter type:	Array [10]

Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	True

Readout of the value for pump ON time. The cascade controller has separate counters for the pumps and for the relays that control the pumps. Pump ON time monitors the operating hours of each pump. The value of each pump ON time counter can be reset to 0 by writing in the parameter, for example, if the pump is replaced at a service.

25-85 Relay ON Time

Default value:	0 h	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	True

Readout of the value for relay ON time. The cascade controller has separate counters for the pumps and for the relays that control the pumps. Pump cycling is always done based on the relay counters, otherwise it would always use the new pump if a pump is replaced and its value in parameter **25-84 Pump ON Time** is reset. To use parameter **25-04 Pump Cycling**, the cascade controller is monitoring the relay ON time.

25-86 Reset Relay Counters

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Resets all elements in parameter **25-85 Relay ON Time** counters.

Option	Name	Description
[0]*	Do not reset	
[1]	Reset	

25-87 Inverse Interlock

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

View the interlock status of the connected compressors.

5.24.7 25-9* Service

The parameters in this group are used if there is a service on 1 or more of the pumps controlled.

25-90 Pump Interlock

Default value:	[0] Off	Parameter type:	Option, Array [10]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

In this parameter, it is possible to disable 1 or more of the fixed lead pumps. For example, the pump is not selected for staging on even if it is the next pump in the operation sequence. It is not possible to disable the lead pump with the pump interlock command. The digital input interlocks are selected as **[130] Pump 1 interlock – [132] Pump 3 interlock** in parameter group **5-1* Digital In/Out**.

Option	Name	Description
[0]*	Off	The pump is active for staging/destaging.
[1]	On	The pump interlock command is given. If a pump runs, it is immediately destaged. If the pump does not run, it is not allowed to stage on.

25-91 Manual Alternation

Default value:	0	Parameter type:	Range, 0 - par. 25-06
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Readout parameter for the actual variable-speed pump in the system. When an alternation takes place, the lead pump parameter is updated to reflect the current variable-speed pump in the system. If no lead pump is selected (cascade controller disabled or all pumps interlocked), the display shows N1.

5.25 Parameter Group 26-** Analog I/O Option MCB 109

5.25.1 Introduction to Parameters Related to the VLT® Analog I/O Option MCB 109

VLT® Analog I/O Option MCB 109 extends the functionality of VLT® drives by adding some more, programmable analog inputs and outputs. This could be especially useful in building management system installations where the drive may be used as decentral I/O, obviating the need for an outstation and thus reducing cost.



NOTE: The maximum current for the analog outputs 0–10 V is 1 mA.



NOTE: Where live zero monitoring is used, it is important that any analog inputs not being used for the drive, that is, being used as part of the building management system decentral I/O, have their live zero-function disabled.

Table 52: Relevant Parameters for Analog Inputs, Outputs, and Relays

Terminal	Parameters
Analog inputs	
X42/1	Parameter 26-00 terminal X42/1 Mode , parameter 26-10 Terminal X42/1 Low Voltage .
X42/3	Parameter 26-01 terminal X42/3 Mode , parameter 26-20 Terminal X42/3 Low Voltage .
X42/5	Parameter 26-02 terminal X42/5 Mode , parameter 26-30 Terminal X42/5 Low Voltage .
Analog outputs	
X42/7	Parameter 26-40 Terminal X42/7 Output .
X42/9	Parameter 26-50 Terminal X42/9 Output .
X42/11	Parameter 26-60 Terminal X42/11 Output .
Analog inputs	
53	Parameter group 6-1* Analog Input 1 .
54	Parameter group 6-2* Analog Input 2 .

Table 52: Relevant Parameters for Analog Inputs, Outputs, and Relays - (continued)

Terminal	Parameters
Analog outputs	
42	Parameter group 6-5* <i>Analog Output 1</i> .
Relays	
Relay 1, terminals 1, 2, 3	Parameter group 5-4* <i>Relays</i> .
Relay 2, terminals 4, 5, 6	Parameter group 5-4* <i>Relays</i> .

It is also possible to read the analog inputs, write to the analog outputs, and control the relays, using communication via the fieldbus. See the relevant parameters in [Table 53](#).



NOTE: Enable the relay outputs via control word bit 11 (relay 1) and bit 12 (relay 2).

Table 53: Relevant Parameters for Analog Inputs, Outputs, and Relays When Using Fieldbus

Terminal	Parameters
Analog inputs (read)	
X42/1	Parameter 18-30 <i>Analog Input X42/1</i> .
X42/3	Parameter 18-31 <i>Analog Input X42/3</i> .
X42/5	Parameter 18-32 <i>Analog Input X42/5</i> .
Analog outputs (write)	
X42/7	Parameter 18-33 <i>Analog Out X42/7 [V]</i> .
X42/9	Parameter 18-34 <i>Analog Out X42/9 [V]</i> .
X42/99	Parameter 18-35 <i>analog Out X42/11 [V]</i> .
Analog inputs (read)	
53	Parameter 16-62 <i>Analog Input 53</i> .
54	Parameter 16-64 <i>Analog Input 54</i> .
Analog output	
42	Parameter 6-63 <i>Terminal X30/8 Output Bus Control</i> .
Relays	
Relay 1, terminals 1, 2, 3	Parameter 16-71 <i>Relay Output [bin]</i> .
Relay 2, terminals 4, 5, 6	Parameter 16-71 <i>Relay Output [bin]</i> .

Setting of on-board real-time clock

The analog I/O option incorporates a real-time clock with battery backup. This can be used as backup of the clock function included in the drive as standard. See parameter group 0-7* *Clock Settings*.

The analog I/O option can be used for the control of devices such as actuators or valves, using the extended closed-loop facility, thus removing control from the building management system. See parameter group 21-**Extended Closed Loop*. There are 3 independent closed-loop PID controllers.

5.25.2 26-0* Analog I/O Mode

Parameter group for setting up the analog I/O configuration. The option is equipped with 3 analog inputs. These analog inputs can be freely allocated to either voltage (0–10 V), pt 1000, or Ni 1000 temperature sensor input.

26-00 Terminal X42/1 Mode

Default value:	[1] Voltage	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Terminal X42/1 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C (32 °F)) or Ni 1000 (1000 Ω at 0 °C (32 °F)) temperature sensors. Select the mode: **[2] Pt 1000 [°C]** and **[4] Ni 1000 [°C]** if operating in Celsius, or **[3] Pt 1000 [°F]** and **[5] Ni 1000 [°F]** if operating in Fahrenheit.



NOTE: If the input is not in use, set it for voltage.

If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

- Parameter **20-12 Reference/ Feedback Unit**.
- Parameter **21-10 Ext. 1 Ref./ Feedback Unit**.
- Parameter **21-30 Ext. 2 Ref./ Feedback Unit**.
- Parameter **21-50 Ext. 3 Ref./ Feedback Unit**.

Option	Name	Description
[1]*	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

26-01 Terminal X42/3 Mode

Default value:	[1] Voltage	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Terminal X42/3 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C (32 °F)) or Ni 1000 (1000 Ω at 0 °C (32 °F)) temperature sensors. Select the mode: **[2] Pt 1000 [°C]** and **[4] Ni 1000 [°C]** if operating in Celsius, or **[3] Pt 1000 [°F]** and **[5] Ni 1000 [°F]** if operating in Fahrenheit.



NOTE: If the input is not in use, set it for voltage.

If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

- Parameter **20-12 Reference/ Feedback Unit**.
- Parameter **21-10 Ext. 1 Ref./ Feedback Unit**.
- Parameter **21-30 Ext. 2 Ref./ Feedback Unit**.

- Parameter **21-50 Ext. 3 Ref./Feedback Unit**.

Option	Name	Description
[1]*	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

26-02 Terminal X42/5 Mode

Default value:	[1] Voltage	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Terminal X42/5 can be programmed as an analog input accepting a voltage or input from either Pt 1000 (1000 Ω at 0 °C (32 °F)) or Ni 1000 (1000 Ω at 0 °C (32 °F)) temperature sensors. Select the mode: **[2] Pt 1000 [°C]** and **[4] Ni 1000 [°C]** if operating in Celsius, or **[3] Pt 1000 [°F]** and **[5] Ni 1000 [°F]** if operating in Fahrenheit.



NOTE: If the input is not in use, set it for voltage.

If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

- Parameter **20-12 Reference/Feedback Unit**.
- Parameter **21-10 Ext. 1 Ref./Feedback Unit**.
- Parameter **21-30 Ext. 2 Ref./Feedback Unit**.
- Parameter **21-50 Ext. 3 Ref./Feedback Unit**.

Option	Name	Description
[1]*	Voltage	
[2]	Pt 1000 [°C]	
[3]	Pt 1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

5.25.3 26-1* Analog Input X42/1

Parameters for configuring the scaling and limits for analog input terminal X42/1.

26-10 Terminal X42/1 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - par. 26-11
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in parameter **26-14 Term. X42/1 Low Ref./Feedb. Value**.

26-11 Terminal X42/1 High Voltage

Default value:	10 V	Parameter type:	Range, Par. 26-10 - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the high-voltage value. This analog input scaling value should correspond to the high reference/ feedback value set in parameter **26-15 Term. X42/1 High Ref./Feedb. Value**.

26-14 Term. X42/1 Low Ref./Feedb. Value

Default value:	0	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the low-voltage value set in parameter **26-10 Terminal X42/1 Low Voltage**.

26-15 Term. X42/1 High Ref./Feedb. Value

Default value:	100	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the high-voltage value set in parameter **26-11 Terminal X42/1 High Voltage**.

26-16 Term. X42/1 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	-3
Data type:	UInt16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/1. A high value of time constant improves dampening, but also increases the time delay through the filter.

26-17 Term. X42/1 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the drive control, rather than being used as a decentral I/O system, such as a building management system. If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.25.4 26-2* Analog Input X42/3

Parameters for configuring the scaling and limits for analog input terminal X42/3.

26-20 Terminal X42/3 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - par. 26-21
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in parameter **26-24 Term. X42/3 Low Ref./Feedb. Value**.

26-21 Terminal X42/3 High Voltage

Default value:	10 V	Parameter type:	Range, Par. 26-20 - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in parameter **26-25 Term. X42/3 High Ref./Feedb. Value**.

26-24 Term. X42/3 Low Ref./Feedb. Value

Default value:	0	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the low-voltage value set in parameter **26-20 Terminal X42/3 Low Voltage**.

26-25 Term. X42/3 High Ref./Feedb. Value

Default value:	100	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the high-voltage value set in parameter **26-21 Terminal X42/3 High Voltage**.

26-26 Term. X42/3 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	-3
Data type:	UInt16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/3. A high value of time constant improves dampening, but also increases the time delay through the filter.

26-27 Term. X42/3 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the drive control, rather than being used as a decentral I/O system, such as a building management system. If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.25.5 26-3* Analog Input X42/5

Parameters for configuring the scaling and limits for analog input terminal X42/5.

26-30 Terminal X42/5 Low Voltage

Default value:	0.007 V	Parameter type:	Range, 0 - par. 26-31
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the low-voltage value. This analog input scaling value should correspond to the low reference/feedback value set in parameter **26-34 Term. X42/5 Low Ref./Feedb. Value**.

26-31 Terminal X42/5 High Voltage

Default value:	10 V	Parameter type:	Range, Par. 26-30 - 10 V
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Enter the high-voltage value. This analog input scaling value should correspond to the high reference/feedback value set in parameter **26-35 Term. X42/5 High Ref./Feedb. Value**.

26-34 Term. X42/5 Low Ref./Feedb. Value

Default value:	0	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the low-voltage value set in parameter **26-30 Terminal X42/5 Low Voltage**.

26-35 Term. X42/5 High Ref./Feedb. Value

Default value:	100	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the analog input scaling value that corresponds to the high-voltage value set in parameter **26-31 Terminal X42/5 High Voltage**.

26-36 Term. X42/5 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True



NOTE: This parameter cannot be adjusted while the motor is running.

This is a first-order digital low-pass filter time constant for suppressing noise in terminal X42/5. A high value of time constant improves dampening, but also increases the time delay through the filter.

26-37 Term. X42/5 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter makes it possible to enable the live zero monitoring, for example, where the analog input is the drive control, rather than being used as a decentral I/O system, such as a building management system. If set for temperature and used as feedback, set the unit for either Celsius or Fahrenheit.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.25.6 26-4* Analog Out X42/7

Parameters for configuring the scaling and output function for analog output terminal X42/7.

26-40 Terminal X42/7 Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Set the function of terminal X42/7 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	

Option	Name	Description
[100]	Output freq. 0–100	0–100 Hz, (0–10 V)
[101]	Reference Min-Max	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback +–200%	–200%...+200% of parameter 3-03 Maximum Reference (0–10 V)
[103]	Motor cur. 0–Imax	0–inverter maximum current (parameter 16-37 Inv. Max. Current), (0–10 V).
[104]	Torque 0–Tlim	0–torque limit (parameter 4-16 Torque Limit Motor Mode), (0–10 V).
[105]	Torque 0–Tnom	0–motor rated torque, (0–10 V).
[106]	Power 0–Pnom	0–motor rated power, (0–10 V).
[107]	Speed 0–HighLim	0–speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit [Hz]), (0–10 V).
[108]	Torque +–160%	
[109]	Out frq 0-Fmax	
[113]	Ext. closed loop 1	0–100%, (0–10 V).
[114]	Ext. closed loop 2	0–100%, (0–10 V).
[115]	Ext. closed loop 3	0–100%, (0–10 V).
[117]	Shaft power	
[139]	Bus ctrl	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

26-41 Terminal X42/7 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the minimum output of the selected analog signal at terminal X42/7 as a percentage of the maximum signal level. For example, if 0 V (or 0 Hz) is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in parameter **26-42 Terminal X42/7 Max. Scale**.

26-42 Terminal X42/7 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the maximum output of the selected analog signal at terminal X42/7. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage 0–10 V is required at maximum output, calculate the percentage as follows:

$$\left(\frac{10V}{\text{Desired maximum voltage}} \right) \times 100\% \text{ that is } 5V : \frac{10V}{5V} \times 100\% = 200\%$$

26-43 Terminal X42/7 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Holds the level of terminal X42/7 if controlled by bus.

26-44 Terminal X42/7 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Holds the preset level of terminal X42/7. If a fieldbus and a timeout function are selected in parameter **26-50 Terminal X42/9 Output**, the output presets to this level.

5.25.7 26-5* Analog Out X42/9

Parameters for configuring the scaling and output function for analog output X42/9.

26-50 Terminal X42/9 Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Set the function of terminal X42/9 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[100]	Output freq. 0–100	0–100 Hz, (0–10 V)
[101]	Reference Min-Max	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback +–200%	–200%...+200% of parameter 3-03 Maximum Reference (0–10 V)
[103]	Motor cur. 0–Imax	0–inverter maximum current (parameter 16-37 Inv. Max. Current), (0–10 V).
[104]	Torque 0–Tlim	0–torque limit (parameter 4-16 Torque Limit Motor Mode), (0–10 V).
[105]	Torque 0–Tnom	0–motor rated torque, (0–10 V).
[106]	Power 0–Pnom	0–motor rated power, (0–10 V).
[107]	Speed 0–HighLim	0–speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter 4-14 Motor Speed High Limit [Hz]), (0–10 V).
[108]	Torque +–160%	
[109]	Out frq 0–Fmax	
[113]	Ext. closed loop 1	0–100%, (0–10 V).

Option	Name	Description
[114]	Ext. closed loop 2	0–100%, (0–10 V).
[115]	Ext. closed loop 3	0–100%, (0–10 V).
[117]	Shaft power	
[139]	Bus ctrl	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

26-51 Terminal X42/9 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the minimum output of the selected analog signal at terminal X42/9 as a percentage of the maximum signal level. For example, if 0 V (or 0 Hz) is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in parameter **26-52 Terminal X42/9 Max. Scale**.

26-52 Terminal X42/9 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the maximum output of the selected analog signal at terminal X42/9. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage 0–10 V is required at maximum output, calculate the percentage as follows:

$$\left(\frac{10V}{\text{Desired maximum voltage}} \right) \times 100\% \text{ that is } 5V : \frac{10V}{5V} \times 100\% = 200\%$$

26-53 Terminal X42/9 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Holds the level of terminal X42/9 if controlled by bus.

26-54 Terminal X42/9 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Holds the preset level of terminal X42/9. If a fieldbus and a timeout function are selected in parameter **26-60 Terminal X42/11 Output**, the output presets to this level.

5.25.8 26-6* Analog Out X42/11

Parameter for configuring the scaling and output function for analog output terminal X42/11.

26-60 Terminal X42/11 Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Set the function of terminal X42/11 as an analog current output.

Option	Name	Description
[0]*	No operation	
[52]	MCO	
[100]	Output freq. 0–100	0–100 Hz, (0–10 V)
[101]	Reference Min-Max	Minimum reference–maximum reference, (0–10 V).
[102]	Feedback +-200%	-200%...+200% of parameter 3-03 Maximum Reference (0–10 V)
[103]	Motor cur. 0–Imax	0–inverter maximum current (parameter 16-37 Inv. Max. Current), (0–10 V).
[104]	Torque 0–Tlim	0–torque limit (parameter 4-16 Torque Limit Motor Mode), (0–10 V).
[105]	Torque 0–Tnom	0–motor rated torque, (0–10 V).
[106]	Power 0–Pnom	0–motor rated power, (0–10 V).
[107]	Speed 0–HighLim	0–speed high limit (parameter 4-13 Motor Speed High Limit [RPM] and parameter Motor Speed High Limit [Hz]), (0–10 V).
[108]	Torque +-160%	
[109]	Out frq 0-Fmax	
[113]	Ext. closed loop 1	0–100%, (0–10 V).
[114]	Ext. closed loop 2	0–100%, (0–10 V).
[115]	Ext. closed loop 3	0–100%, (0–10 V).
[117]	Shaft power	
[139]	Bus ctrl	0–100%, (0–10 V).
[141]	Bus ctrl t.o.	0–100%, (0–10 V).
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

26-61 Terminal X42/11 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2

Data type:	Int16	Change during operation:	True

Scale the minimum output of the selected analog signal at terminal X42/11 as a percentage of the maximum signal level. For example, if 0 V (or 0 Hz) is required at 25% of the maximum output value, program 25%. Scaling values up to 100% can never be higher than the corresponding setting in parameter **26-62 Terminal X42/11 Max. Scale**.

26-62 Terminal X42/11 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Scale the maximum output of the selected analog signal at terminal X42/11. Set the value to the maximum value of the voltage signal output. Scale the output to give a voltage lower than 10 V at full scale; or 10 V at an output below 100% of the maximum signal value. If 10 V is the required output current at a value between 0–100% of the full-scale output, program the percentage value in the parameter, that is 50%=10 V. If a voltage 0–10 V is required at maximum output, calculate the percentage as follows:

$$\left(\frac{10V}{\text{Desired maximum voltage}} \right) \times 100\% \text{ that is } 5V : \frac{10V}{5V} \times 100\% = 200\%$$

26-63 Terminal X42/11 Bus Control

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

Holds the level of terminal X42/11 if controlled by bus.

26-64 Terminal X42/11 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Holds the preset level of terminal X42/11. If a fieldbus and a timeout function are selected, the output presets to this level.

5.26 Parameter Group 27-** Cascade CTL Option

5.26.1 Introduction to Cascade Controller Option Parameters

Parameter group 27-** Cascade CTL Option is available if 1 of the following conditions is met:

- VLT® Extended Cascade Controller MCO 101 is installed.
- VLT® Advanced Cascade Controller MCO 102 is installed.
- The drive was ordered with type code LXX1.

Relay wiring configuration using MCO 101 or MCO 102

For a detailed description of commissioning for mixed pump and master/follower applications (using relay operation), refer to VLT® Cascade Controller Options MCO 101/102 Operating Instructions.

Serial communication wiring configuration

The serial communication wiring configuration supports the master/follower cascade controller setup controlling up to 8 pumps in total. Basic functionality and staging principles are programmed via parameter group **27-** Cascade CTL Option** supporting configurations of up to 8 drives/pumps.

In water distributions systems, it is usually a requirement that the cascade system has a redundant master functionality. This functionality can be achieved by having a cascade controller enabled in multiple drives in the same system.

At least 1 of the drives in the setup must have parameter group **27-** Cascade CTL Option** enabled. When this parameter group is available, **[23] Modbus multi master** is enabled in parameter **8-30 Protocol**.

When master functionality is used with **[23] Modbus multi master** in parameter **8-30 Protocol**, this will take up setup 1 and setup 2. The remaining setups can be used for other purposes. All drives capable of being assigned as master power up as being a follower. The drive with the lowest address in the system will be the first to be assigned as master, and thereby keeping the remaining drives in follower setup. If an assigned master fails, or is powered off due to maintenance, the next lowest address is assigned automatically as master. If the drive with a lower address is reinserted into the system, the lowest address will be reinserted as a follower. Assignment of master functionality to the lowest address in the system, does NOT happen automatically. When appropriate, for example during night time, the assigned master drive must be power-cycled. The lowest address will then be assigned master of the system.



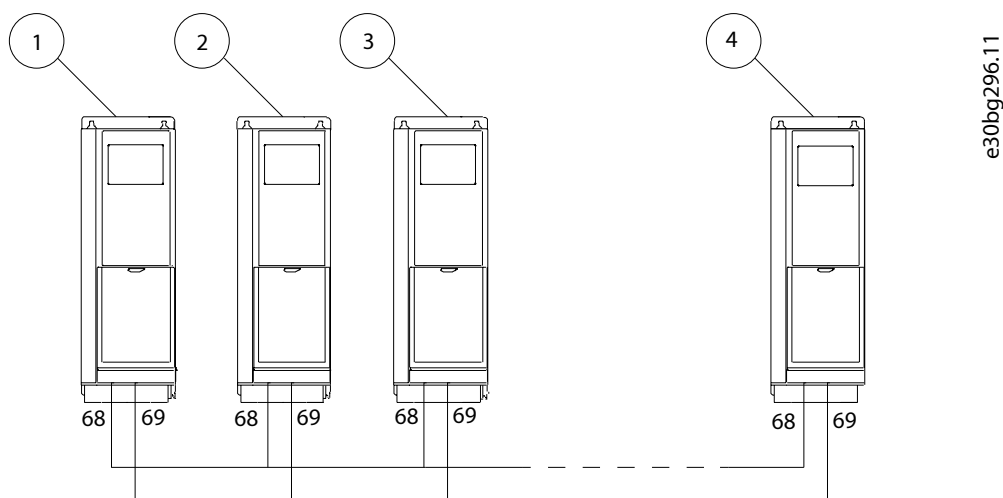
NOTE: Each possible master must have its own feedback signal.

If a drive must act differently when being assigned as master compared to being assigned as follower, this difference can be programmed as parameter differences between setup 1 (master closed loop) and setup 2 (follower open loop).

Drives must be addressed with a unique address or forward-running number. For follower drives, set **[2] Modbus RTU** in parameter **8-30 Protocol**. Reaction at communication loss can be set in parameter **8-03 Control Timeout Time** and parameter **8-04 Control Timeout Function**. Apply this setting to all drives in the system. This configuration only supports the master/follower mode.



NOTE: Terminate the RS-485 bus with a resistor at both ends. For this purpose, set switch S801 on the control card to ON.



1	Primary master 1	2	Follower 1
3	Follower 2	4	Follower X (up to 7 followers)

Figure 128: Serial Communication Wiring

5.26.2 Master/Follower Configuration

The master/follower cascade control mode offers the best performance, the most precise control, and maximum energy savings. This mode controls multiple equally-sized pumps in parallel, runs all pumps at the same speed, and stages the pumps on and off according to system requirements.

Compared to the closed-loop cascade control using feedback, the master drive uses the speed values from the follower drives for controlling when to either stage or destage pumps.

Set the stage-on and destage speed according to the system requirements to obtain the highest energy savings. In the master/follower configuration, the master drive runs in closed loop, while the follower drives run in open loop. All follower drives are connected to mains and the motor in the same way as the master drive. In this configuration, each pump is controlled by a drive. All pumps and drives must be of the same size.

5.26.3 Mixed-pump Configuration

This configuration combines some of the benefits of the master/follower configuration with some of the initial cost savings of the fixed-speed configuration. Use this configuration when the extra capacity of the fixed pump is rarely needed.

The mixed-pump configuration supports a mix of variable-speed pumps connected to the drives with extra fixed-speed pumps. First, the variable-speed pumps are staged on and destaged based on the drive speed. After that, the fixed-speed pumps are staged on and destaged based on the feedback pressure.



NOTE: All drives must have the same power range. All variable-speed pumps must be of the same size. Fixed-speed pumps can be of different sizes.

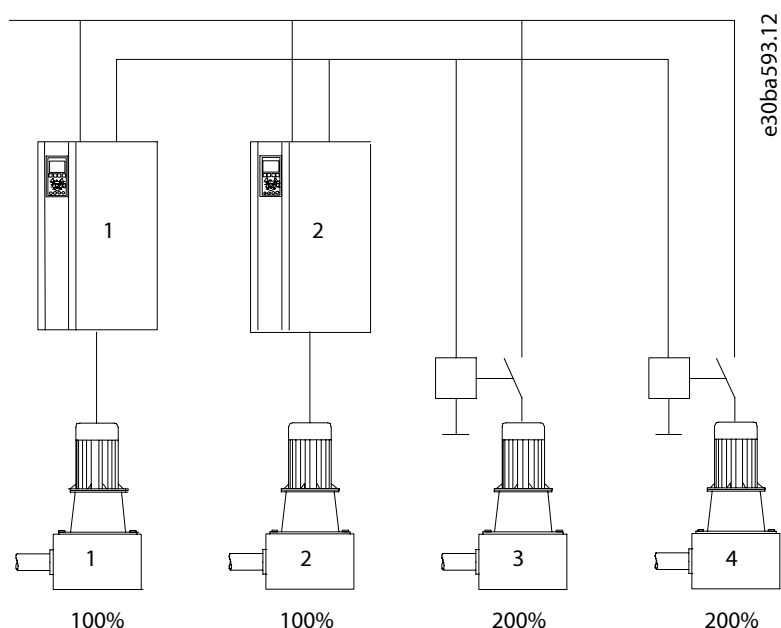


Figure 129: Mixed-pump Configuration

5.26.4 Unequal Pump Size Configuration

The unequal pump size configuration supports a limited mix of fixed-speed pumps in different sizes. This configuration provides the largest range of system output with the smallest number of pumps.

5.26.5 Using Soft Starters for Fixed-speed Pumps

In a mixed-pump configuration, contactors can be replaced with soft starters.



NOTE: Mixing soft starters and contactors hinders the control of the output pressure during the staging and destaging transitions. The use of soft starters delays staging due to the ramp time of a fixed-speed pump.

5.26.6 27-0* Control & Status

The parameters in this parameter group are used for monitoring and controlling pumps.

27-01 Pump Status

Default value:	[0] Ready	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter shows the status of each pump in the system.

Index	Status	Description
[0]*	Ready	The pump is available for use by the Cascade Controller.
[1]	On drive	The pump is: • running. • connected to the drive. • controlled by the Cascade Controller.

Index	Status	Description
[2]	On mains	The pump is: • running. • connected to mains. • controlled by the Cascade Controller.
[3]	Offline - off	The pump is off and not available for use by the Cascade Controller.
[4]	Offline - on mains	The pump is: • running. • connected to mains. • not available for use by the Cascade Controller.
[5]	Offline - on drive	The pump is: • running. • connected to the drive. • Not available for use by the Cascade Controller.
[6]	Offline - fault	The pump is: • running. • connected to mains. • not available for use by the Cascade Controller.
[7]	Offline - hand	The pump is: • running. • connected to mains. • Not available for use by the Cascade Controller.
[8]	Offline - external interlock	The pump is off and is externally interlocked.
[9]	Spinning	The Cascade Controller is off and is externally interlocked.
[10]	No relay connection	The pump is not directly connected to the drive, and a relay is not assigned to the pump.

27-02 Manual Pump Control

Default value:	[0] No operation	Parameter type:	Option, Array [9]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter is a command parameter that allows manual control of individual pump states. Selecting 1 of the options executes the command in the option and then returns to option **[0] No operation**.

Option	Name	Description
[0]*	No operation	The drive does not issue any commands.
[1]	Online	The pump is available to the Cascade Controller.
[2]	Alternate - on	The drive forces the selected pump to be the lead pump.
[3]	Offline - off	The drive turns off the pump and makes it unavailable for cascading.

Option	Name	Description
[4]	Offline - on	The drive turns on the pump and makes it unavailable for cascading.
[5]	Offline - spin	The drive initiates a pump spin.

27-03 Current Runtime Hours

Default value:	0 h	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	True

This parameter shows the total number of hours that each pump has run since the last reset. This value is used to balance the running hours between pumps. To reset the value to 0, use parameter **27-91 Cascade Reference**.

27-04 Pump Total Lifetime Hours

Default value:	0 h	Parameter type:	Array [9]
Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	True



NOTE: Do not use this parameter to set a certain value for maintenance purposes.

This parameter shows the total hours run for each connected pump.

5.26.7 27-1* Configuration

Use the parameters in this group for configuring the Cascade Controller option.

27-10 Cascade Controller

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Select the operating mode for the Cascade Controller. To enable the cascade controller functionality, set parameter **1-00 Configuration Mode** to **[3] Closed loop**.

Option	Name	Description
[0]	Disabled	Turns off the Cascade Controller option.
[1]	Master/follower	Select this option to use only variable-speed pumps connected to drives. Selecting this option sets parameter 8-30 Protocol to [23] Modbus multi master .
[2]	Mixed pumps	Select this option to use both variable and fixed-speed pumps.
[3]	Basic cascade control	Turns off the Cascade Controller option and reverts to basic cascade operation (see parameter group 25-** Cascade Controller for more information). Selecting this option increases the number of pumps that the basic Cascade Controller can control. The extra relays on the option can be used to extend the basic Cascade Controller with 3 relays.

27-11 Number of Drives

Default value:	Size related	Parameter type:	Range, 1 - 8
Setup:	2 setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False

This parameter shows how many drives the Cascade Controller controls. Depending on the option installed, the Cascade Controller can control the following number of drives:

- VLT® Extended Cascade Controller MCO 101: 1–6
- VLT® Advanced Cascade Controller MCO 102: 1–8
- Cascade CTL License software (type code LXX1): 1–8

27-12 Number of Pumps

Default value:	Size related	Parameter type:	Range, 2 - 8
Setup:	2 setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False

This parameter shows how many pumps the Cascade Controller controls. Depending on the configuration, the Cascade Controller can control the following number of pumps:

- VLT® Extended Cascade Controller MCO 101: 0–6
- VLT® Advanced Cascade Controller MCO 102: 0–8
- Cascade CTL License software (type code LXX1): 1–8

27-13 Max Number of Pumps Running

Default value:	Size related	Parameter type:	Range, 1 - 8
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

This parameter shows the number of pumps that are currently running.

27-14 Pump Capacity

Default value:	Size related	Parameter type:	Array [9]
Setup:	2 setups	Conversion index:	0
Data type:	UInt16	Change during operation:	False

Enter the capacity of each pump in the system relative to the 1st pump. This is an indexed parameter with 1 entry per pump. The capacity of the 1st pump is 100%.

27-16 Runtime Balancing

Default value:	[0] Balanced priority 1	Parameter type:	Option, Array [9]
Setup:	2 setups	Conversion index:	–
Data type:	UInt8	Change during configuration:	True

Set the priority of each pump for balancing its running hours. Pumps with the same priority are staged/destaged based on the running hours.

Option	Name	Description
[0]*	Balanced priority 1	Turned on first, turned off last.
[1]	Balanced priority 2	Turned on if no priority 1 pumps are available. Turned off before priority 1 pumps are turned off.
[2]	Spare pump	Turned on last, turned off first.

27-17 Motor Starters

Default value:	[0] Direct online	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Select the type of the mains starter for the fixed-speed pumps. All fixed-speed pumps must have the same starter type.

Option	Name	Description
[0]*	Direct online	
[1]	Soft starter	This option adds a delay when staging and destaging pumps. The delay is defined in parameter 27-41 Ramp Down Delay and parameter 27-42 Ramp Up Delay .
[2]	Star/delta	This option adds a delay when staging pumps. The delay is defined in parameter 27-42 Ramp Up Delay .

27-18 Spin Time for Unused Pumps

Default value:	Size related	Parameter type:	Range, 0=Off - 99 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True



NOTE: Ensure that the value in this parameter does not cause overpressure in the system.

Enter the time to spin unused pumps. If a fixed-speed pump has not run in the last 72 hours, it is turned on for this time. This function prevents the damage caused by leaving the pump off for too long. To disable the function, set the value of this parameter to 0.

27-19 Reset Current Runtime Hours

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select **[1] Do reset** to reset all current run-time hours to 0. The run-time hours value is used for run-time balancing.

Option	Name	Description
[0]*	Do not reset	
[1]	Do reset	

5.26.8 27-2* Bandwidth Settings

Parameters for configuring the control response.

27-20 Normal Operating Range

Default value:	Size related	Parameter type:	Range, 1 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the maximum offset from the setpoint before a pump may be added or removed. The value is a percentage of parameter **21-12 Ext. 1 Maximum Reference**. The system must be outside the normal operating range for the time specified in parameter **27-23 Staging Delay** or parameter **27-24 Destaging Delay** before a cascade operation takes place. Normal operation is operation with at least 1 variable-speed pump available.

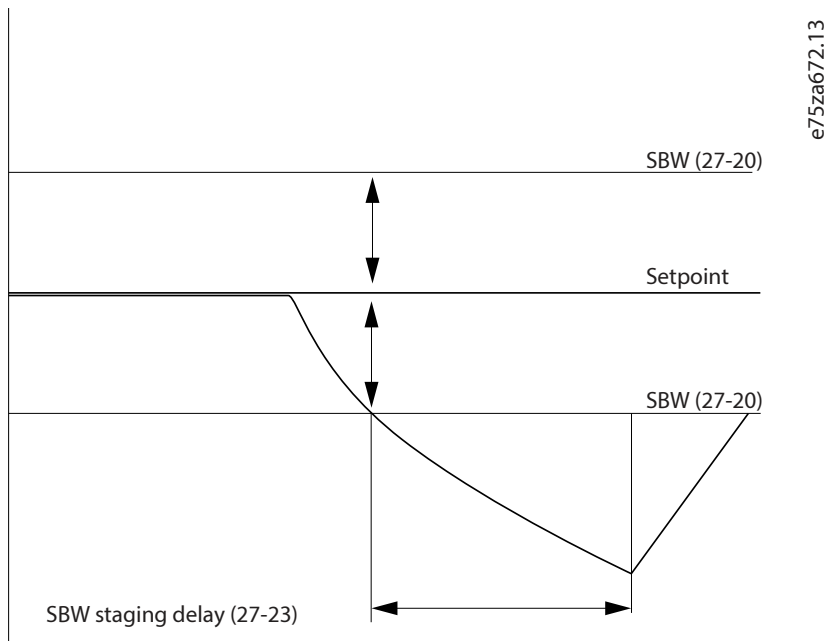


Figure 130: SBW Staging Delay

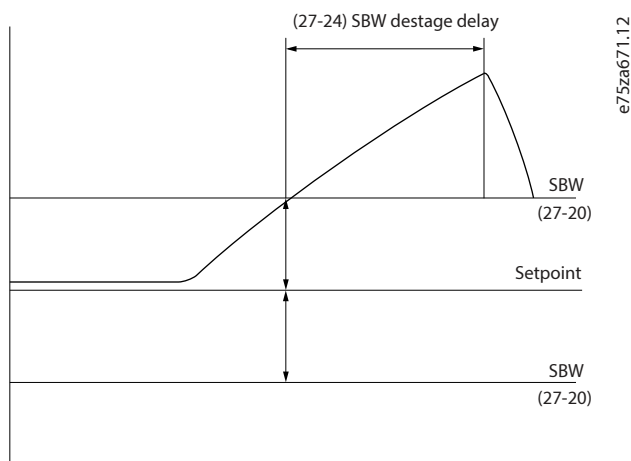


Figure 131: SBW Destaging Delay

27-21 Override Limit

Default value:	100%	Parameter type:	Range, 0 - 100=Disabled %
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the maximum offset from the setpoint before a pump is added or removed immediately, for example, if there was a sudden water demand. The value is a percentage of parameter **21-12 Ext. 1 Maximum Reference**. This parameter allows responding to sudden changes in demand without a delay. The override functionality can be disabled by setting this parameter to 100%.



NOTE: In master/follower applications, the override limit is used as the wake-up condition.

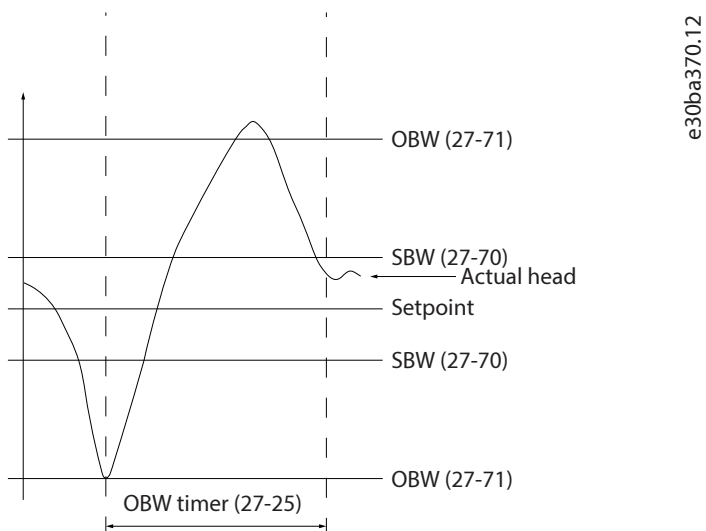


Figure 132: OBW Time

27-22 Fixed Speed Only Operating Range

Default value:	Size related	Parameter type:	Range, 0 - par. 27-21
Conversion index:	0	Data type:	UInt8
Change during operation:	True		

Enter the allowed offset from the setpoint at which a fixed-speed pump is added or removed when there are no operational variable-speed pumps. The value is a percentage value of parameter **21-12 Ext. 1 Maximum Reference**. The system must be outside this limit for the time specified in parameter **27-23 Staging Delay** or parameter **27-24 Destaging Delay** before a cascade operation takes place.

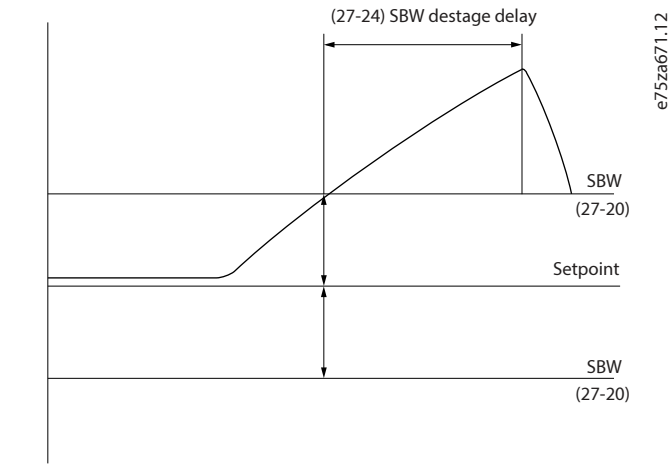
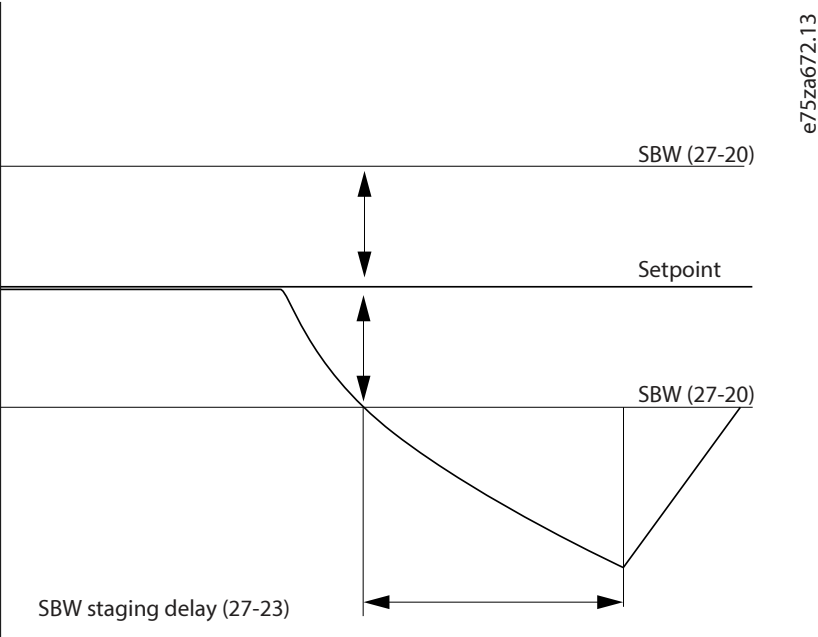


Figure 134: SBW Destaging Delay

27-23 Staging Delay

Default value:	15 s	Parameter type:	Range, 0 - 3000 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the time during which the system feedback must remain below the operating range before a fixed-speed pump is turned on. If the system is operating with at least 1 variable-speed pump available, parameter **27-20 Normal Operating Range** is used. If no variable-speed pumps are available, parameter **27-22 Fixed Speed Only Operating Range** is used.

27-24 Destaging Delay

Default value:	15 s	Parameter type:	Range, 0 - 3000 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the time during which the system feedback must remain above the operating range before a pump is turned off. If the system is operating with at least 1 variable-speed pump available, parameter **27-20 Normal Operating Range** is used. If no variable-speed pumps are available, parameter **27-22 Fixed Speed Only Operating Range** is used.

27-25 Override Hold Time

Default value:	10 s	Parameter type:	Range, 0 - 300 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the minimum time that must elapse after staging or destaging before another staging or destaging may take place due to the system exceeding the value in parameter **27-21 Override Limit**. This value allows the system to stabilize after a pump is turned on or off. If this delay is not long enough, the transients caused by turning a pump on or off may cause the system to add or remove another pump unnecessarily.

27-27 Min Speed Destage Delay

Default value:	Size related	Parameter type:	Range, 0 - 300=Disabled s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the time that the lead pump must run at minimum speed while the system feedback is still inside the normal operating band before a pump is turned off to save energy. Energy savings are achieved by turning off a pump if all variable-speed pumps are operating at minimum speed, but the feedback is still within the specified band. Under these conditions, a pump may be turned off and the system is still able to maintain control. The pumps that remain on operate more efficiently.

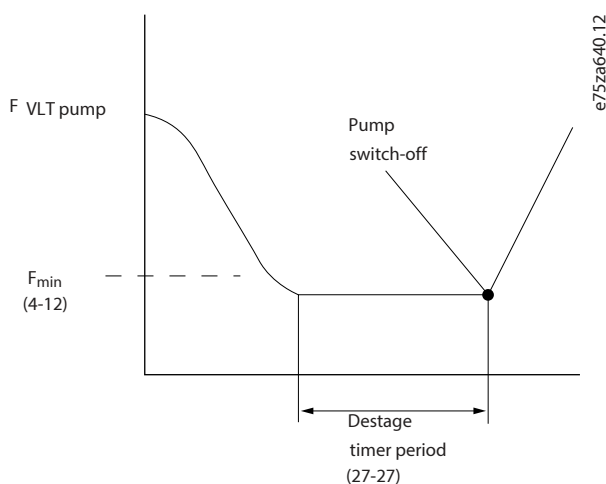


Figure 135: Destage Function Time

5.26.9 27-3* Staging Speed

The parameters in this group are used for configuring the master/follower control response.

27-30 Auto Tune Staging Speeds

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	When this option is selected, the drive calculates and keeps parameters 27-31 to 27-34 up to date. If any of these 4 parameters are modified via fieldbus or LCP, the new values are used but are continuously tuned automatically. The drive recalculates and updates the parameters when staging occurs and optimizes the settings to ensure high performance and low energy consumption.

27-31 Stage On Speed [RPM]

Default value:	Size related	Parameter type:	Array [11]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

To be used if RPM is selected. If the lead pump is operating above Stage On Speed for the time specified in parameter 27-23 *Staging Delay* and a variable-speed pump is available, it is turned on.

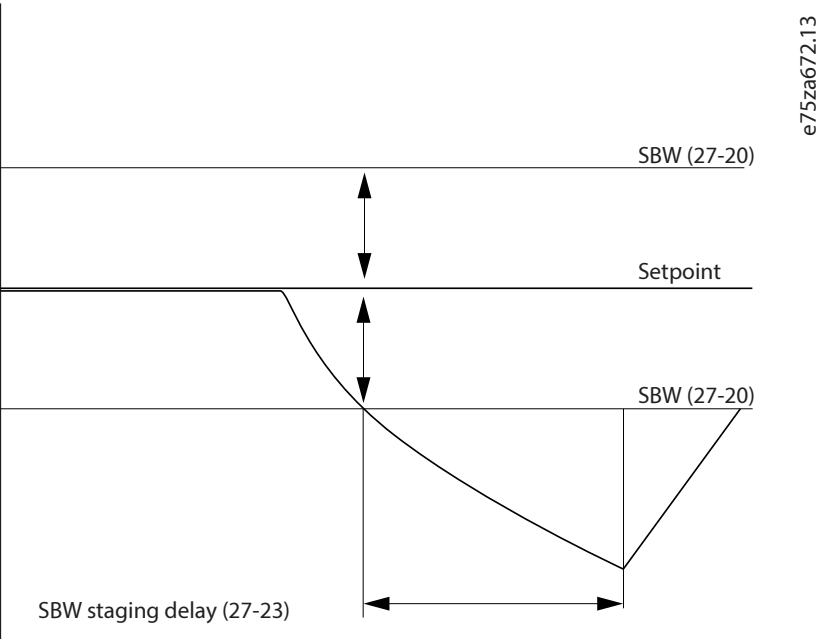


Figure 136: SBW Staging Delay

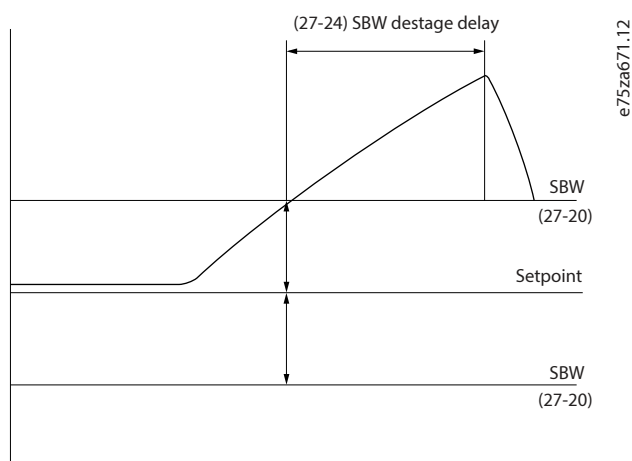


Figure 137: SBW Destaging Delay

27-32 Stage On Speed [Hz]

Default value:	Size related	Parameter type:	Array [11]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

If the lead pump speed is exceeding the value in this parameter for the time specified in parameter **27-23 Staging Delay**, and a variable-speed pump is available, the variable-speed pump is turned on.

27-33 Stage Off Speed [RPM]

Default value:	Size related	Parameter type:	Array [11]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

If the lead pump speed is lower than the value in this parameter for the time specified in parameter **27-24 Destaging Delay**, and more than 1 variable-speed pump is on, a variable-speed pump is turned off.

27-34 Stage Off Speed [Hz]

Default value:	Size related	Parameter type:	Array [11]
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

If the lead pump speed is lower than the value in this parameter for the time specified in parameter **27-24 Destaging Delay**, and more than 1 variable-speed pump is on, a variable-speed pump is turned off.

5.26.10 27-4* Staging Settings

Parameters in this group are used for configuring the staging transition.

27-40 Auto Tune Staging Settings

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	-
Data type:	Uint8	Change during operation:	True

When this parameter is enabled, the staging and destaging thresholds are auto tuned during operation. The settings are optimized to prevent the pressure from overshooting or undershooting when staging and destaging pumps.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

27-41 Ramp Down Delay

Default value:	10 s	Parameter type:	0 - 120 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Enter the delay between turning on a pump controlled by a soft starter and ramping down a pump controlled by the drive. This parameter is only used for soft starter and start/delta-controlled pumps.

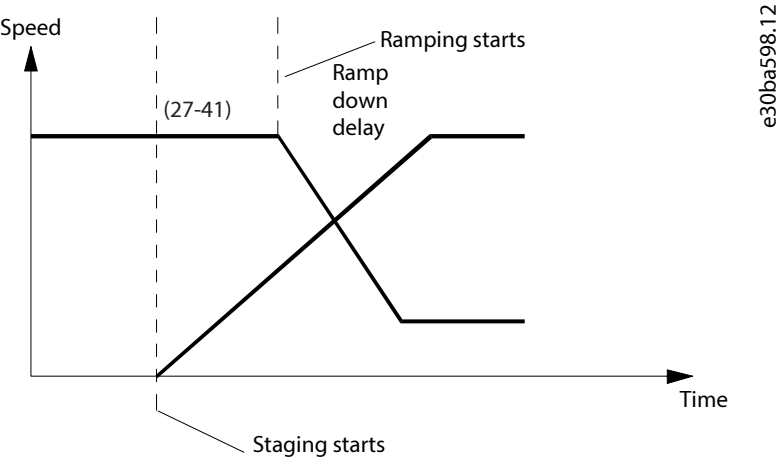


Figure 138: Ramp Down Delay

27-42 Ramp Up Delay

Default value:	2 s	Parameter type:	Range, 0 - 12 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Enter the delay between turning off a pump controlled by a soft starter and ramping up a soft starter and ramping up a pump controlled by the drive. This parameter is only used for soft starter-controlled pumps, and not for star/delta-controlled pumps.

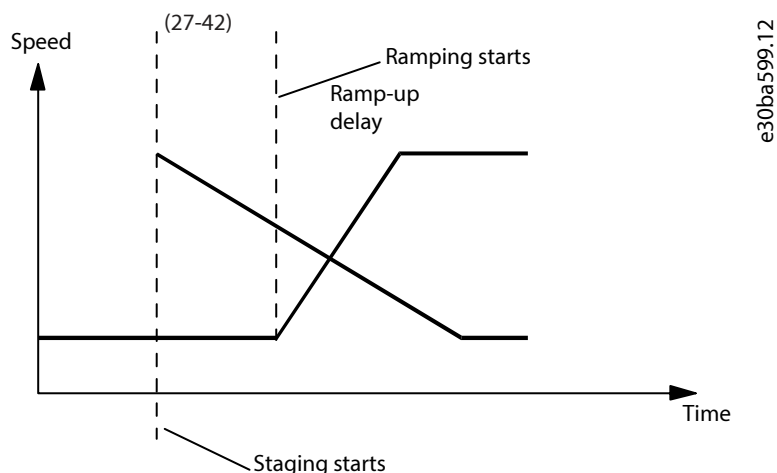


Figure 139: Ramp-up Delay

27-43 Staging Threshold

Default value:	Size related	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the speed in the staging ramp at which the fixed-speed pump is turned on. The value is a percentage of the maximum pump speed. If parameter **27-0 Auto Tune Staging Settings** is set to [1] **Enabled**, parameter **27-43 Staging Threshold** and parameter **27-44 Destaging Threshold** are kept up to date with the new calculated values. If parameters **27-43** and **27-44** are modified via the fieldbus or the LCP, the new values are used but are continuously tuned automatically.

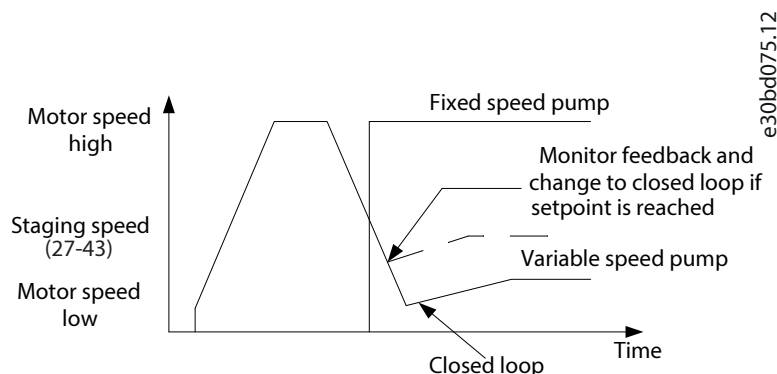


Figure 140: Staging Threshold

27-44 Destaging Threshold

Default value:	Size related	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Enter the speed in the staging ramp at which the fixed-speed pump is turned off. The value is a percentage of the maximum pump speed. If parameter **27-40 Auto Tune Staging Settings** is set to [1] **Enabled**, parameter **27-43 Staging Threshold** and **27-44 Destaging Threshold** are kept up to date with the new calculated values. If parameters **27-43** and **27-44** are modified via the fieldbus or the LCP, the new values are used but are continuously tuned automatically.

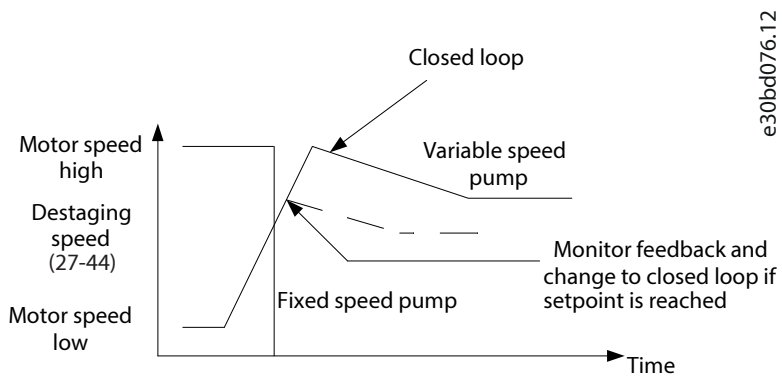


Figure 141: Destaging Threshold

27-45 Staging Speed [RPM]

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the actual staging speed based on the staging threshold.

27-46 Staging Speed [Hz]

Default value:	0 Hz	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Shows the actual staging speed based on the staging threshold.

27-47 Destaging Speed [RPM]

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the actual destaging speed based on the destaging threshold.

27-48 Destaging Speed [Hz]

Default value:	0 Hz	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the actual destaging speed based on the destaging threshold.

27-49 Staging Principle

Default value:	[0] Normal	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Using the Rapid Staging function is convenient in systems with rapid demand changes. When **[1] Rapid staging** is selected, the drive returns to closed-loop operation immediately after a pump was either staged or destaged.

Option	Name	Description
[0]*	Normal	
[1]	Rapid staging	The drive returns to closed-loop operation immediately after staging or destaging a pump.

5.26.11 27-5* Alternate Settings

The parameters in this group are for configuring alternation.

27-50 Automatic Alternation

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

When this parameter is enabled, the Cascade Controller selects the best time to alternate the lead pump.

Option	Name	Description
[0]*	Disabled	The Cascade Controller is not allowed to select the best time to alternate the lead pump.

27-51 Alternation Event

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select if alternation at destaging should be allowed.

Option	Name	Description
[0]	Off	Alternation at destaging is not possible.
[1]	At destage	Alternation at destaging is possible.

27-52 Alternation Time Interval

Default value:	0 min	Parameter type:	Range, 0=Disabled - 10080 min
Setup:	All setups	Conversion index:	70
Data type:	Uint16	Change during operation:	True

Enter the time between alternations. Disable the alternation by entering the value 0. Parameter **27-53 Alternation Timer Value** shows the time remaining until the next alternation occurs.

27-53 Alternation Time Value

Default value:	0 min	Parameter type:	Readout
Setup:	All setups	Conversion index:	70
Data type:	Uint16	Change during operation:	True

Shows the time remaining before an interval-based alternation occurs. Parameter **27-52 Alternation Time Interval** defines the time interval.

27-54 Alternation At Time of Day

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Enable alternating pumps at a specific time of day. The time is set in parameter **27-55 Alternation Predefined Time**. This parameter requires a real-time clock.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

27-55 Alternation Predefined Time

Default value:	Size related	Parameter type:	Range, 0 - 0
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDayWoDate	Change during operation:	True

Enter the time of day for pump alternation. This parameter is only available if parameter **27-54 Alternation At Time of Day** is set to **[1] Enabled**.

27-56 Alternate Capacity is <

Default value:	0%	Parameter type:	Range, 0=Off - 100%
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

This parameter ensures that the lead pump is operating at a speed lower than a certain value before the time-based alternation takes place. This behavior ensures that alternation only takes place when the interruption in operation does not affect the quality of the process and minimizes the system disturbance caused by alternations. The value is a percentage of the capacity of pump 1. Setting this parameter to 0% disables it.

27-58 Run Next Pump Delay

Default value:	0.1 s	Parameter type:	Range, 0.1 - 5 s
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	True

Enter the delay between stopping the current lead pump and starting the next lead pump during alternation. This parameter gives the contactors time to switch while both pumps are stopped.

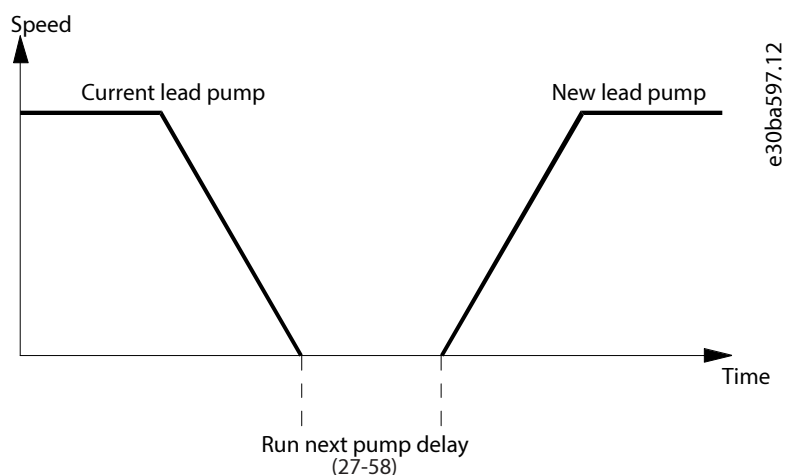


Figure 142: Run Next Pump Delay

5.26.12 27-6* Digital Inputs

The parameters in this group are for configuring digital inputs. The parameters are only available if VLT® Advanced Cascade Controller MCO 102 is installed.

27-60 Terminal X66/1 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the function for this digital input.

Option	Name	Description
[0]	No function	
[1]	Reset	
[2]	Coast inverse	
[3]	Coast and reset inv	
[5]	DC-brake inverse	
[6]	Stop inverse	
[7]	External interlock	
[8]	Start	
[9]	Latched start	
[10]	Reversing	
[11]	Start reversing	
[14]	Jog	
[15]	Preset reference on	
[16]	Preset ref bit 0	
[17]	Preset ref bit 1	
[18]	Preset ref bit 2	
[19]	Freeze reference	

Option	Name	Description
[20]	Freeze output	
[21]	Speed up	
[22]	Speed down	
[23]	Set-up select bit 0	
[24]	Set-up select bit 1	
[34]	Ramp bit 0	
[36]	Mains failure inverse	
[37]	Emergency mode	
[42]	Ref source bit 0	
[51]	hand/auto start	
[52]	Run permissive	
[53]	Hand start	
[54]	Auto start	
[55]	DigiPot increase	
[56]	DigiPot decrease	
[57]	DigiPot clear	
[62]	Reset counter A	
[65]	Reset counter B	
[66]	Sleep mode	
[75]	MCO specific	
[78]	Preset preventive maintenance word	
[80]	PTC card 1	
[85]	Latched pump derag	
[86]	Flow confirmation	
[87]	Reset flow totalized volume counter	
[88]	Reset flow actual volume counter	
[89]	Reset derag counter	
[120]	Lead pump start	
[121]	Lead pump alternation	
[130]	Pump 1 interlock	
[131]	Pump 2 interlock	
[132]	Pump 3 interlock	
[133]	Pump 4 interlock	
[134]	Pump 5 interlock	
[135]	Pump 6 interlock	
[136]	Pump 7 interlock	
[137]	Pump 8 interlock	

Option	Name	Description
[138]	Pump 9 interlock	
[139]	Pump 1 inverse interlock	
[140]	Pump 2 inverse interlock	
[141]	Pump 3 inverse interlock	
[142]	Pump 4 inverse interlock	
[143]	Pump 5 inverse interlock	
[144]	Pump 6 inverse interlock	
[145]	Pump 7 inverse interlock	
[146]	Pump 8 inverse interlock	
[147]	Pump 9 inverse interlock	
[190]	Emcy mode ref bit 0	
[191]	Emcy mode ref bit 1	
[192]	Emcy mode ref bit 2	
[193]	Emergency setup bit 0	
[194]	Emergency setup bit 1	
[195]	Test emcy mode	
[196]	Reset emcy mode	

27-61 Terminal X66/3 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *27-60 Terminal X66/1 Digital Input*.

27-62 Terminal X66/5 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *27-60 Terminal X66/1 Digital Input*.

27-63 Terminal X66/7 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *27-60 Terminal X66/1 Digital Input*.

27-64 Terminal X66/9 Digital Input

Default value:	–	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *27-60 Terminal X66/1 Digital Input*.

27-65 Terminal X66/11 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *27-60 Terminal X66/1 Digital Input*.

27-66 Terminal X66/13 Digital Input

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The options for this parameter are the same as those listed for parameter *27-60 Terminal X66/1 Digital Input*.

5.26.13 27-7* Connections

The parameters in this group are for configuring relay connections.

27-70 Relay

Default value:	[0] Standard relay	Parameter type:	Option, Array [20]
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

This parameter is only relevant for a relay wiring configuration. Use this parameter to set up the function of the option relays. This parameter is an array. The visibility of options depends on the MCO option installed in the drive.

- VLT® Extended Cascade Controller MCO 101: Relays 10–12 are available.
- VLT® Advanced Cascade Controller MCO 102: Relays 13–20 are available.

In any case, the standard relays (Relay 1 and relay 2), and the relays in the VLT® Relay Option MCB 105 are available. To set the function of a specific relay, select the relay and then select the function. If the option *[0] Standard relay* is selected, the relay can be used as a general-purpose relay and the function can be set in parameter group *5-4* Relays*.

Option	Navn	Description
[0]*	Standard relay	Enable follower drive X.
[1]	Drive 2 enable	
[2]	Drive 3 enable	
[3]	Drive 4 enable	
[4]	Drive 5 enable	
[5]	Drive 6 enable	
[6]	Drive 7 enable	
[7]	Drive 8 enable	

Option	Navn	Description
[8]	Pump 1 to drive 1	
[9]	Pump 1 to drive 2	
[10]	Pump 1 to drive 3	
[11]	Pump 1 to drive 4	
[12]	Pump 1 to drive 5	
[13]	Pump 1 to drive 6	
[14]	Pump 1 to drive 7	
[15]	Pump 1 to drive 8	
[16]	Pump 2 to drive 1	
[17]	Pump 2 to drive 2	
[18]	Pump 2 to drive 3	
[19]	Pump 2 to drive 4	
[20]	Pump 2 to drive 5	
[21]	Pump 2 to drive 6	
[22]	Pump 2 to drive 7	
[23]	Pump 2 to drive 8	
[24]	Pump 3 to drive 1	
[25]	Pump 3 to drive 2	
[26]	Pump 3 to drive 3	
[27]	Pump 3 to drive 4	
[28]	Pump 3 to drive 5	
[29]	Pump 3 to drive 6	
[30]	Pump 3 to drive 7	
[31]	Pump 3 to drive 8	
[32]	Pump 4 to drive 1	
[33]	Pump 4 to drive 2	
[34]	Pump 4 to drive 3	
[35]	Pump 4 to drive 4	
[36]	Pump 4 to drive 5	
[37]	Pump 4 to drive 6	
[38]	Pump 4 to drive 7	
[39]	Pump 4 to drive 8	
[40]	Pump 5 to drive 1	
[41]	Pump 5 to drive 2	
[42]	Pump 5 to drive 3	
[43]	Pump 5 to drive 4	
[44]	Pump 5 to drive 5	

Option	Navn	Description
[45]	Pump 5 to drive 6	
[46]	Pump 5 to drive 7	
[47]	Pump 5 to drive 8	
[48]	Pump 6 to drive 1	
[49]	Pump 6 to drive 2	
[50]	Pump 6 to drive 3	
[51]	Pump 6 to drive 4	
[52]	Pump 6 to drive 5	
[53]	Pump 6 to drive 6	
[54]	Pump 6 to drive 7	
[55]	Pump 6 to drive 8	
[56]	Pump 7 to drive 1	
[57]	Pump 7 to drive 2	
[58]	Pump 7 to drive 3	
[59]	Pump 7 to drive 4	
[60]	Pump 7 to drive 5	
[61]	Pump 7 to drive 6	
[62]	Pump 7 to drive 7	
[63]	Pump 7 to drive 8	
[64]	Pump 8 to drive 1	
[65]	Pump 8 to drive 2	
[66]	Pump 8 to drive 3	
[67]	Pump 8 to drive 4	
[68]	Pump 8 to drive 5	
[69]	Pump 8 to drive 6	
[70]	Pump 8 to drive 7	
[71]	Pump 8 to drive 8	
[72]	Pump 1 to mains	
[73]	Pump 2 to mains	
[74]	Pump 3 to mains	
[75]	Pump 4 to mains	
[76]	Pump 5 to mains	
[77]	Pump 6 to mains	
[78]	Pump 7 to mains	
[79]	Pump 8 to mains	

5.26.14 27-8* Advanced Settings

The parameters in this group contain the advanced settings for the Cascade Controller.

27-80 MultiMaster Primary Restore

Default value:	[0] Resume	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Option	Name	Description
[0]*	Resume	With this option selected, the mastership returns to the primary master.
[1]	Hold	This option retains the backup master even when a response from the primary master is received.

27-81 Master Setup

Default value:	[1] Set-up 1	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Use this parameter for configuring the setup to be used by the master when working in a multi-master system.

Option	Name	Description
[1]*	Set-up 1	
[2]	Set-up 2	
[3]	Set-up 3	
[4]	Set-up 4	

5.26.15 27-9* Readouts

This parameter group contains readout parameters for the Cascade CTL Option.

27-91 Cascade Reference

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	True

This parameter shows the reference output for the follower drives. This reference is available even when the master drive is stopped. This is the speed that the drive operates at or would be operating at if it was on. The value is a percentage of parameter **4-13 Motor Speed High Limit [RPM]** or parameter **4-14 Motor Speed High Limit [Hz]**.

27-92 % Of Total Capacity

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows the operating point as a percentage value of the total system capacity. 100% means that all pumps are on at full speed.

27-93 Cascade Option Status

Default value:	[0] Disabled	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter shows the status of the cascade system.

Index	Status	Description
[0]*	Disabled	The cascade option is not used.
[1]	Off	The cascade function is turned off.
[2]	Running	The cascade function is running normally.
[3]	Running at FSBW	The cascade function is running in the fixed-speed mode. No variable-speed pumps are available.
[4]	Jogging	The system is running at the jog speed set in parameter 3-11 Jog Speed [HZ] .
[5]	In open loop	The control principle is set to open loop.
[6]	Freezed	The system is frozen in the current state. No changes take place.
[7]	Coast	The system is stopped due to coasting.
[8]	Alarm	The system is operating with an alarm.
[9]	Staging	A staging operation is in progress.
[10]	Destaging	A destaging operation is in progress.
[11]	Alternating	An alternation operation is in progress.
[12]	All offline	
[13]	Cascade CTL sleep	

27-94 Cascade System Status

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	VisStr[25]	Change during operation:	True

This parameter shows the status of each individual pump. The value depends on the wiring configuration.

- Relay wiring configuration:
 - The parameter shows the status of all relays configured in the system. The value has the format PUMP_NUMBER:PUMP_STATUS. PUMP_STATUS can have 1 of the following values: 0, R, D, X. For example, 1:D 2:R 3:0 4:X
D: Variable-speed pump. R: Fixed-speed pump. 0: Not running. X: Interlock
- Serial communication wiring configuration:
 - The parameter shows the system status. The value has the format MASTER/FOLLOWER:PUMP_STATUS. PUMP_STATUS can have 1 of the following values: 0, D, X. For example, M:D F:0 F:X
D: Variable-speed pump. 0: Not running. X: Interlock or OFF mode. x: Tripped or no communication.

27-95 Advanced Cascade Relay Output [bin]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows the status of each individual relay. From left to right, the bits correspond to 13, 14, 15, 16, 17, 18, 19, 20.

27-96 Extended Cascade Relay Output [bin]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

This parameter shows the status of the relay outputs. From left to right, the bits correspond to relay outputs 12, 11, and 10.

5.27 Parameter Group 29-** Water Application Functions

5.27.1 29-0* Pipe Fill Function

In water supply systems, water hammering can occur when filling the pipes too fast. It is therefore recommended to limit the filling rate. Pipe fill mode eliminates the occurrence of water hammering associated with the rapid exhausting of air from the piping system by filling the pipes at a low rate.

This function is used in horizontal, vertical, and mixed piping systems. As the pressure in horizontal pipe systems does not climb as the system fills, filling horizontal pipe systems requires a user-specified speed to fill for a user-specified time and/or until a user-specified pressure setpoint is reached.

The best way to fill a vertical pipe system is to use the PID function to ramp the pressure at a user-specified rate between the motor speed low limit and a user-specified pressure.

The pipe fill function uses a combination of the above to ensure a safe filling of any system.

No matter which system, the pipe fill mode starts using the constant speed set in parameter **29-01 Pipe Fill Speed [RPM]** until the pipe fill time in parameter **29-03 Pipe Fill Time** has expired. Filling then continues with the filling ramp set in parameter **29-04 Pipe Fill Rate** until the filling setpoint specified in parameter **29-05 Filled Setpoint** is reached.

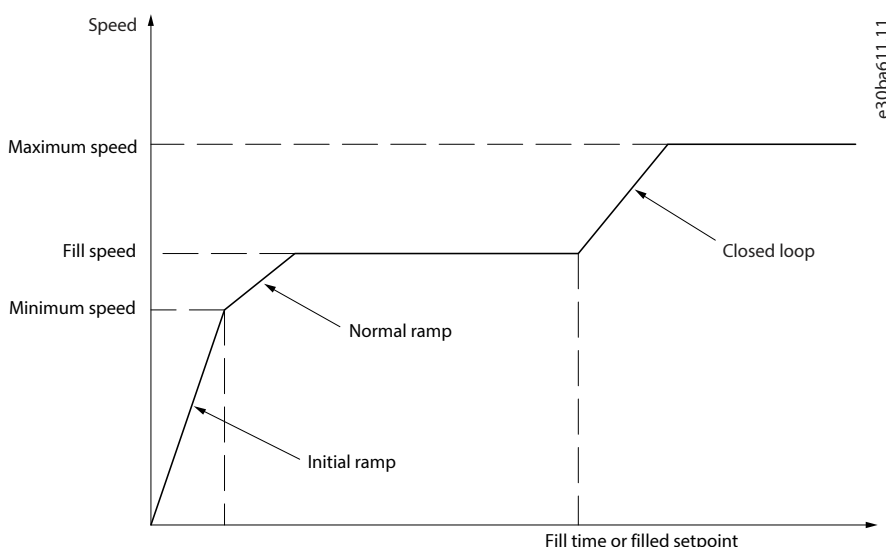


Figure 143: Horizontal Pipe System

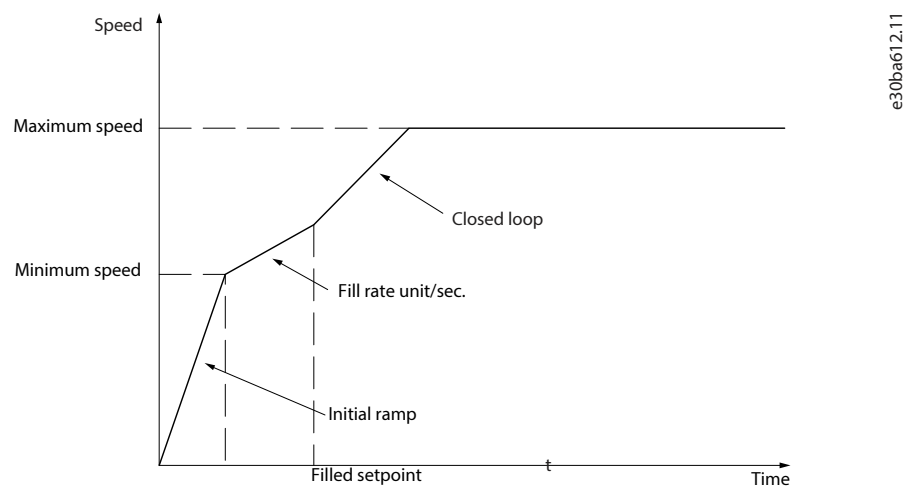


Figure 144: Vertical Pipe System

29-00 Pipe Fill Enable

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Option	Name	Description
[0]*	Disabled	The pipes are not filled at a user-specified rate.
[1]	Enabled	The pipes are filled at a user-specified rate.

29-01 Pipe Fill Speed [RPM]

Default value:	Size related	Parameter type:	Range, par. 4-11 - par. 4-13 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the selection made in parameter *4-11 Motor Speed Low Limit [RPM]*/parameter *4-13 Motor Speed High Limit [RPM]* or in parameter *4-12 Motor Speed Low Limit [Hz]*/parameter *4-13 Motor Speed High Limit [Hz]*.

29-02 Pipe Fill Speed [Hz]

Default value:	Size related	Parameter type:	Range, par. 4-12 - par. 4-14
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the filling speed for filling horizontal pipe systems. The speed can be selected in Hz or RPM depending on the selection made in parameter *4-11 Motor Speed Low Limit [RPM]*/parameter *4-13 Motor Speed High Limit [RPM]* or in parameter *4-12 Motor Speed Low Limit [Hz]*/parameter *4-13 Motor Speed High Limit [Hz]*.

29-03 Pipe Fill Time

Default value:	0 s	Parameter type:	Range, 0 - 3600 s

Setup:	All setups	Conversion index:	-2
Data type:	UInt32	Change during operation:	True

Set the specified time for filling of horizontal pipe systems.

29-04 Pipe Fill Rate

Default value:	0.001 ProcessCtrlUnit	Parameter type:	Range, 0.001 - 999999.999 ProcessCtrlUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter specifies the fill rate in units using the PI controller. Fill-rate units use feedback functionality. This function is used for filling up vertical pipe systems. The function is active when the filling time has expired, until the pipe fill setpoint set in parameter **29-05 Filled Setpoint** is reached.

29-05 Filled Setpoint

Default value:	0 ProcessCtrlUnit	Parameter type:	Range, -999999.999 - 999999.999 ProcessCtrlUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Specifies the filled setpoint at which the pipe fill function is disabled, and then PID controller takes control. This function can be used both for horizontal and vertical pipe systems.

29-06 No-flow Disable Timer

Default value:	0 s	Parameter type:	Range, 0 - 3600 s
Setup:	All setups	Conversion index:	-2
Data type:	UInt32	Change during operation:	True

Set the timer for detection of no flow during pipe fill. The timer defines for how long the low power no-flow detection must be disabled after pipe filling starts. When the timer expires, the delay timer in parameter **22-24 No-Flow Delay** activates the no-flow function.

29-07 Filled Setpoint Delay

Default value:	0 s	Parameter type:	Range, 0 - 10 s
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	True

Select the delay before the drive considers the filled setpoint to be reached if a fill rate in units per second is used.

5.27.2 29-1* Deragging Function

The purpose of the deragging feature is to free the pump blade of debris in wastewater applications so that the pump operates normally.

A deragging event is defined as the time from when the drive starts to drag to when the deragging finishes. When a drag is started, the drive first ramps to a stop and then an off-delay expires before the 1st cycle begins.

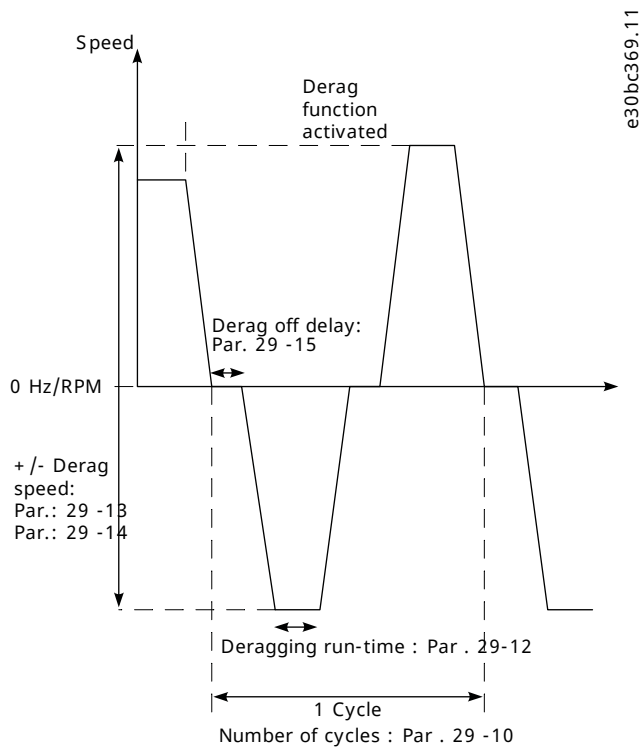


Figure 145: Derag Function

If a derag is triggered from a drive-stopped state, the 1st off delay is skipped. The deragging event may consist of several cycles: one cycle consisting of 1 pulse in the reverse direction followed by 1 pulse in the forward direction. Deragging is considered finished after the specified number of cycles have been completed. More specifically, on the last pulse (it is always forward) of the last cycle, the deragging is considered finished after the deragging run-time expires (the drive is running at derag speed). In between the pulses, the drive output coasts for a specified off-delay time to let debris in the pump settle.



NOTE: Do not enable deragging if the pump cannot operate in reverse direction.

There are 3 different notifications for an ongoing deragging event:

- Status in the LCP: *Auto Remote Derag*.
- A bit in the extended status word (bit 23, 80 0000 hex).
- A digital output can be configured to reflect the active deragging status.

Depending on the application and the purpose of using it, this feature can be used as a preventive or reactive measure and can be triggered/started in the following ways:

- On each start command (parameter **29-11 Derag at Start/Stop**).
- On each stop command (parameter **29-11 Derag at Start/Stop**).
- On each start/stop command (parameter **29-11 Derag at Start/Stop**).
- On digital input (parameter group **5-1* Digital Inputs**).
- On drive action with the smart logic controller (parameter **13-52 SL Controller Action**).
- As timed action (parameter group **23-** Time-based Functions**).
- On high power (parameter group **29-2* Derag Power Tuning**).

29-10 Derag Cycles

Default value:	Size related	Parameter type:	Range, 0=Off - 10

Setup:	2 setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

The number of cycles the drive derags.

29-11 Derag at Start/Stop

Default value:	[0] Off	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select when to use the derag function.

Option	Name	Description
[0]*	Off	The derag function is not used.
[1]	Start	The drive derags at start.
[2]	Stop	The drive derags at stop.
[3]	Start and stop	The drive derags at start and stop.

29-12 Deragging Run Time

Default value:	0 s	Parameter type:	Range, 0 - 3600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The time that the drive stays at the derag speed.

29-13 Derag Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

The speed at which the drive derags measured in RPM.

29-14 Derag Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0.0 - par. 4-14
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

The speed at which the drive derags measured in Hz.

29-15 Derag Off Delay

Default value:	10 s	Parameter type:	Range, 1 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The time that the drive remains off before starting another derag pulse. Allows contents of the pump to settle.

29-16 Derag Counter

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	True

Shows the number of deragging events.

29-17 Reset Derag Counter

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Do not reset	This option does not reset deragging counter.
[1]	Reset counter	This option resets the deragging counter.

29-18 Rev. Derag Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 4-13
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Set the speed limit in RPM at which the drive starts deragging in reverse direction.

29-19 Rev. Derag Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0.0 - par. 4-14
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the speed limit in Hz at which the drive starts deragging in reverse direction.

5.27.3 29-2* Derag Power Tuning

The derag feature monitors drive power in a similar way to no flow. Based on 2 user-defined setpoints and an offset value, the monitor calculates a derag power curve. It uses the exact same calculations as no flow with the difference being that the derag monitors for high power and not lower power.

Configuring the no-flow user points via the no-flow auto setup also sets the points of the derag curve to the same value.

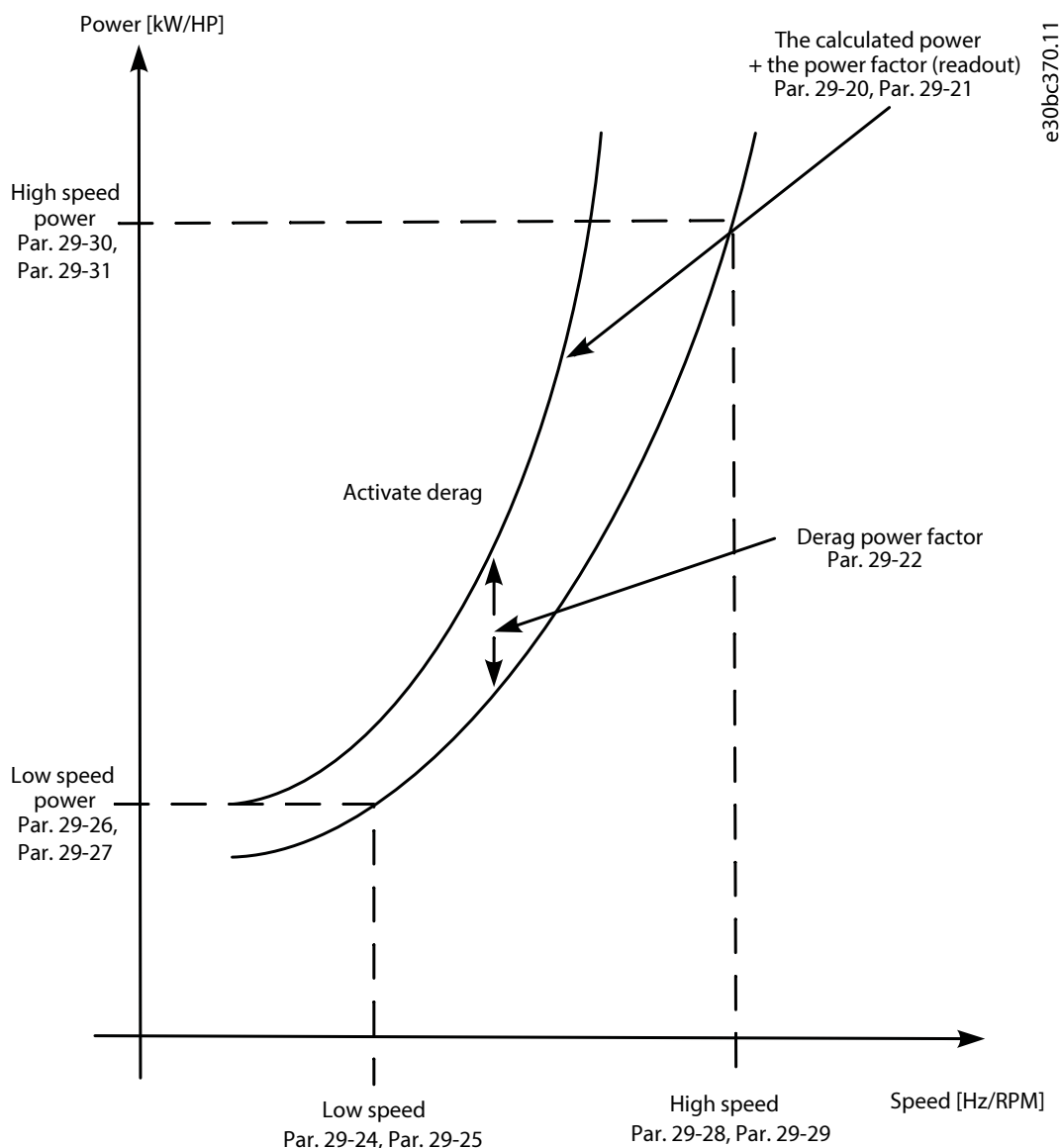


Figure 146: Derag Power Tuning

29-20 Derag Power [kW]

Default value:	0 kW	Parameter type:	Readout
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	True

Readout of calculated derag power at actual speed.

29-21 Derag Power [HP]

Default value:	0 hp	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Readout of calculated derag power at actual speed.

29-22 Derag Power Factor

Default value:	200%	Parameter type:	Range, 1 - 400%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set a correction if derag detection reacts on a power value that is too low.

29-23 Derag Power Delay

Default value:	601 s	Parameter type:	Range, 1 - 601=Off s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set the time that the drive must remain on reference and a high-power condition for a derag to occur.

29-24 Low Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0 - par. 29-28
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Set the output speed used for registration of derag power at low speed in RPM.

29-25 Low Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0 - Par. 29-29
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the output speed used for registration of derag power at low speed in Hz.

29-26 Low Speed Power [kW]

Default value:	Size related	Parameter type:	Range, 0 - 5.50 [kW]
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	True

Set the derag power at low speed in kW.

29-27 Low Speed Power [HP]

Default value:	Size related	Parameter type:	Range, 0 - 7.5 [hp]
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the derag power at low speed in hp.

29-28 High Speed [RPM]

Default value:	Size related	Parameter type:	Range, 0.0 - par. 4-13
Setup:	All setups	Conversion index:	67

Data type:	Uint16	Change during operation:	True

Set the output speed used for registration of derag power at high speed in RPM.

29-29 High Speed [Hz]

Default value:	Size related	Parameter type:	Range, 0.0 - par. 4-14
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the output speed used for registration of derag power at high speed in Hz.

29-30 High Speed Power [kW]

Default value:	Size related	Parameter type:	Range, 0 - 5.50 [kW]
Setup:	All setups	Conversion index:	1
Data type:	Uint32	Change during operation:	True

Set derag power at high speed in kW.

29-31 High Speed Power [HP]

Default value:	Size related	Parameter type:	Range, 0 - 7.50 [hp]
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the derag power at high speed in hp.

29-32 Derag On Ref Bandwidth

Default value:	5%	Parameter type:	Range, 1 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Set the bandwidth percentage of motor speed high limit to accommodate system pressure fluctuation.

29-33 Power Derag Limit

Default value:	3	Parameter type:	Range, 0 - 10
Setup:	2 setups	Conversion index:	0
Data type:	Uint8	Change during operation:	False

Set the number of time the power monitor can trigger consecutive derags before a fault is reported.

29-34 Consecutive Derag Interval

Default value:	Size related	Parameter type:	Range, 0 - 3600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

Derags are considered to be consecutive if they happen within the interval specified in this parameter.

29-35 Derag at Locked Rotor

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter for selecting whether or not the derag should be triggered at high power if there is a locked rotor condition.

Option	Name	Description
[0]*	Disabled	A derag is not triggered at a locked rotor condition at high power.
[1]	Enabled	A derag is triggered at a locked rotor condition at high power.

5.27.4 29-4* Pre/Post-Lube Function

Use the pre/post-lube function in the following applications:

- To avoid damage and wear, a motor requires lubrication of its mechanical parts before and while it runs. This is especially the case when the motor has not been running for a long time.
- When the application requires external fans to run.

The function makes the drive signal an external device for a user-defined period. A start delay can be configured in parameter **1-71 Start Delay**. With this delay, the pre-lube function runs while the motor is stopped.

For information about the pre/post-lube function options, see the following parameters:

- Parameter **29-40 Pre/Post Lube Function**
- Parameter **29-41 Pre Lube Time**
- Parameter **29-42 Post Lube Time**

Consider the following use case:

- A lubricating device starts the lubrication at the time when the drive receives the start command.
- The drive starts the motor. The lubrication device is still running.
- After a certain time, the drive stops the lubrication device.

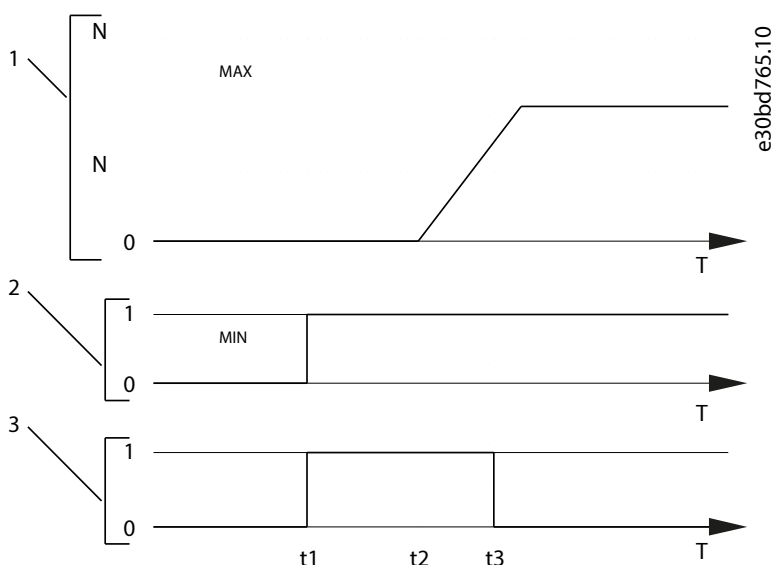


Figure 147: Pre/Post-Lube Function, Example

1	Speed curve.	2	Start command (for example, terminal 18).
3	Pre-lube output signal.	t ₁	Start command issued (for example, terminal 18 activated). The start delay timer (parameter 1-71 Start Delay) and the pre-lube timer (parameter 29-41 Pre Lube Time) start running.
t ₂	The start delay timer expires. The drive starts to ramp up.	t ₃	The pre-lube timer expires.

29-40 Pre/Post Lube Function

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select when the pre/post-lube function is to be active. Use parameter **1-71 Start Delay** to set the delay before the drive starts to ramp up.

Option	Name	Description
[0]*	Disabled	The pre/post-lube function is disabled.
[1]	Pre lube only	The pre-lube function is active before the drive ramps up.
[2]	Pre & running	The pre-lube function is active before the drive starts up and while the drive is running.
[3]	Pre & running & post	The pre/post-lube function is active before the drive starts up, while the drive is running, and when the drive has stopped.

29-41 Pre Lube Time

Default value:	10 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter for how long the pre-lube function is to be active. Only use this parameter, when **[1] Pre Lube Only** is selected in parameter **29-40 Pre/Post Lube Function**.

29-42 Post Lube Time

Default value:	10 s	Parameter type:	Range, 0 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter for how long the post-lube function is to be on after the motor stops. Only use this parameter, when **[3] Pre & running & post** is selected in parameter **29-40 Pre/Post Lube Function**.

5.27.5 29-5* Flow Confirmation

The flow confirmation feature is designed for applications where there is a need for the motor/pump to run while waiting for an external event. The flow confirmation monitor expects to receive a digital input from a sensor on a gate valve, flow switch, or a similar device, indicating that the device is in the open position and flow is possible. In parameter **29-50 Validation Time**, define for how long the VLT® AQUA Drive FC 202 waits for the digital input signal from the external device to confirm the flow. After the flow is confirmed, the drive checks the signal again after the flow verification time and then runs normally. The LCP status reads *Verifying flow* while the flow monitor is active.

The drive trips with the alarm **Flow Not Confirmed** if the expected digital input signal becomes inactive before either the flow validation time or the flow verification time expires.

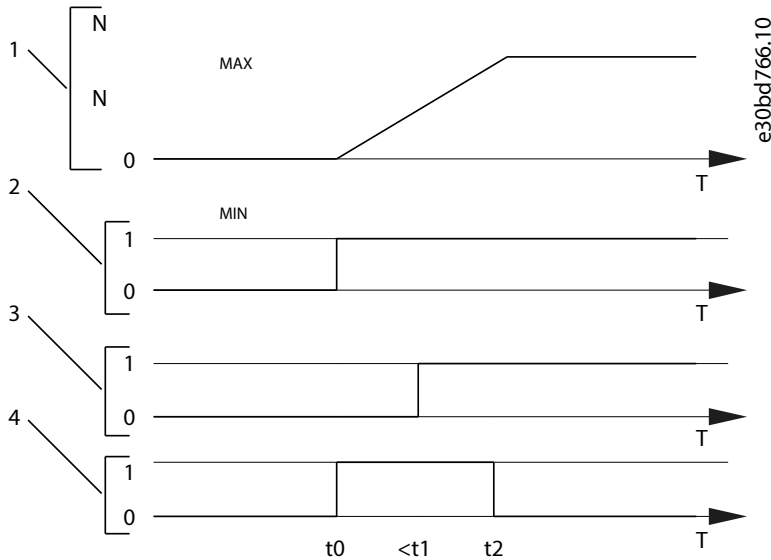


Figure 148: Flow Confirmation

1	Speed curve.	2	Start command (for example, terminal 18).
3	Digital signal from an external device that confirms that the flow is possible.	4	Flow verification
t_0	Start command issued (for example, terminal 18 is set to active).	t_1	Digital signal from an external device becomes active before parameter 29-50 Validation Time expires.
t_2	When parameter 29-51 Verification Time passes, the drive checks the signal from the external device again and then runs normally.		

29-50 Validation Time

Default value:	Size related	Parameter type:	Range, 0 - 999 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True



NOTE: Parameter **29-50 Validation Time** is only visible in the LCP if a digital input is set to **[86] Flow Confirmation** in parameter group **5-1* Digital Inputs**.

The digital input from an external device must be active during the validation time.

29-51 Verification Time

Default value:	15 s	Parameter type:	Range, 0.10 - 255 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True



NOTE: Parameter **29-51 Verification Time** is only visible in the LCP if a digital input is set to **[86] Flow confirmation** in parameter group **5-1* Digital Inputs**.

When the time set in this parameter has passed, the drive checks the signal from the external device. If the signal is active, the drive runs normally.

29-52 Signal Lost Verification Time

Default value:	1 s	Parameter type:	Range, 0.01 - 255 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Enter the length of the delay after which the signal is considered to be lost. This parameter is ignored if parameter **29-53 Flow Confirmation Mode** is set to **[0] Confirmation only**.

29-53 Flow Confirmation Mode

Default value:	[0] Confirmation only	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

Select the operating mode of the flow monitor function.

Option	Name	Description
[0]*	Confirmation only	The flow confirmation function is only active during the start-up of the pump.
[1]	Monitor and stop	The flow confirmation function is active during and after the pump start-up. If the input signal is lost, the drive ramps down to stop.
[2]	Monitor and coast	The flow confirmation is active during and after the pump start-up. If the input signal is lost, the drive coasts.

5.27.6 29-6* Flow Meter

VLT® AQUA Drive FC 202 can measure the flow in the system. Irrigation applications are the most common use case for parameters in this parameter group. The functionality allows to:

- Measure the flow in the system.
- Calculate the water volume pumped for a certain time period.
- React on flow conditions, for example, low flow rate.
- Control the system using the pumped water volume calculated by the drive, for example, stop pumping when a certain amount of water is pumped, cyclic pumping of water volumes.
- Use the output signal of an external flow meter that is connected to an input of the drive.

Inputs and supported signal types

The flow meter feature can use and scale the output signals of commonly used flow meters. The feature supports the following signal types:

- Current: 0/4–20 mA
- Voltage: 0–10 V
- Pulse signal, for example, paddle-wheel flow meters.

Configure the scaling of the flow meter signal received as input via the available parameters for the input configuration (parameters in parameter groups **6-** Analog In/Out** or **5-5* Pulse Input**). The flow meter feature also supports inputs of hardware options.

Volume counters

The flow meter feature uses 2 different counters for storing calculated volume of pumped water:

- Parameter **29-66 Actual Volume**: See the volume of water pumped since the last counter reset.
- Parameter **29-65: Totalized Volume**: See the volume of water pumped since the last counter reset. Use this parameter for the total volume of water pumped.

The 2 counters can have different units. Use parameter **29-66 Actual Volume** for shorter periods of time.

Each parameter can be reset individually in 1 of the following ways:

- Using parameter **29-67 Reset Totalized Volume** or parameter **29-68 Reset Actual Volume**.
- Using a digital input.
- Using an action of the smart logic controller.

Reading the data

The measured data is available via readout parameters:

- Parameter **29-65 Totalized Volume**.
- Parameter **29-66 Actual Volume**.
- Parameter **29-69 Flow**.

To show the readout parameters on the LCP, configure the display lines. Comparator operands can use the data from readout parameters as conditions for SLC and as triggers for actions. The measured flow can also be used as input for the feedback.



NOTE: This software feature has not been designed as being a part of a calibrated measurement system. The overall accuracy also depends on external factors such as flow conditions and used flow meter. See the VLT® AQUA Drive FC 202 Design Guide for details about analog and digital inputs of the drive.

Examples

- A sequence of SLC is triggered (or stopped) after a specific amount of water is pumped.
- The drive performs 1 or more actions and resets the volume counters within a sequence of SLC.
- An alert shows up after a specific amount of water is pumped.

29-60 Flow Meter Monitor

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select if the flow meter monitor should be disabled or enabled.

Option	Name	Description
[0]*	Disabled	The flow meter monitor is disabled.
[1]	Enabled	The flow meter monitor is enabled.
[2]	Enabled while running	The flow meter monitor is only enabled when the connected pump is running.

29-61 Flow Meter Source

Default value:	[0] Analog input 53	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the source for the flow meter signal. Available options depend on the hardware configuration.

Option	Name	Description
[0]*	Analog input 53	
[1]	Analog input 54	
[2]	Analog input X30/11	
[3]	Analog input X30/12	
[4]	Analog input X42/1	
[5]	Analog input X42/3	
[6]	Analog input X42/5	
[7]	Analog input X48/2	
[8]	Pulse input 29	
[9]	Pulse input 33	
[10]	Bus feedback 1	
[11]	Bus feedback 2	
[12]	Bus feedback 3	

29-62 Flow Meter Unit

Default value:	[0] l/s	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit for the flow meter output.

Option	Name	Description
[0]*	l/s	
[1]	l/min	
[2]	l/h	
[3]	m ³ /s	
[4]	m ³ /min	
[5]	m ³ //h	
[6]	gal/s	
[7]	gal/min	
[8]	gal/h	
[9]	in ³ /s	
[10]	in ³ /min	
[11]	in ³ /h	

Option	Name	Description
[12]	ft ³ /s	
[13]	ft ³ /min	
[14]	ft ³ /h	

29-63 Totalized Volume Unit

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit for parameter **29-65 Totalized Volume**.

Option	Name	Description
[0]*	Disabled	
[1]	l	
[2]	m ³	
[3]	gal	
[4]	in ³	
[5]	ft ³	
[6]	acre-in	
[7]	acre-ft	

29-64 Actual Volume Unit

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit for parameter **29-66 Actual Volume**.

Option	Name	Description
[0]*	Disabled	
[1]	l	
[2]	m ³	
[3]	gal	
[4]	in ³	
[5]	ft ³	
[6]	acre-in	
[7]	acre-ft	

29-65 Totalized Volume

Default value:	0 TotalizedVolumeUnit	Parameter type:	Readout, Array [5]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the total volume of pumped water.

29-66 Actual Volume

Default value:	0.00 ActualVolumeUnit	Parameter type:	Readout, Array [5]
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	False

Shows the volume of pumped water for a certain time period.

29-67 Reset Totalized Volume

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to set parameter **29-65 Totalized Volume** to 0.

Option	Name	Description
[0]*	Do not reset	Parameter 29-65 Totalized Volume is not reset.
[1]	Do reset	Parameter 29-65 Totalized Volume is reset to 0.

29-68 Reset Actual Volume

Default value:	[0] Do not reset	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter to set parameter **29-66 Actual Volume** to 0.

Option	Name	Description
[0]*	Do not reset	Parameter 29-66 Actual Volume is not reset.
[1]	Do reset	Parameter 29-66 Actual Volume is reset to 0.

29-69 Flow

Default value:	0 FlowMeterUnit	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

Shows the actual flow rate.

5.28 Parameter Group 30-** Special Features

5.28.1 30-2* Adv. Start Adjust

30-20 High Starting Torque Time [s]

Default value:	0 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Define for how long the increased high starting torque current defined in parameter **30-21 High Starting Torque Current** should be applied.

30-21 High Starting Torque Current [%]

Default value:	Size related	Parameter type:	Range, 0 - 200.0%
Setup:	All setups	Conversion index:	-1
Data type:	Uint32	Change during operation:	True

Set the high starting current that should be applied for the time specified in parameter **30-20 High Starting Torque Time**. The increased current will improve the starting torque and starting performance in demanding applications. The high starting torque current is valid for VVC+ and flux in speed open loop. The parameter can be used with the following motors:

- SPM
- IPM
- SynRM
- PMaSynRM

30-22 Locked Rotor Protection

Default value:	[0] Off	Parameter type:	Option
Setup:	All setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Available for PM motors only, in flux sensorless mode and VVC+ open-loop mode.

Option	Name	Description
[0]*	Off	
[1]	On	Protects the motor from the locked rotor condition. The control algorithm detects a possible locked rotor condition in the motor and trips the drive to protect the motor.

30-23 Locked Rotor Detection Time [s]

Default value:	0.10 s	Parameter type:	Range, 0.05 - 1 s
Setup:	All setups	Conversion index:	-2
Data type:	Uint8	Change during operation:	True

Time period for detecting the locked rotor condition. A low parameter value leads to faster detection.

30-24 Locked Rotor Detection Speed Error [%]

Default value:	25%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	-1
Data type:	Uint32	Change during operation:	True

Detects locked rotor condition for SPMSM at high speed.

5.28.2 30-5* Unit Configuration

30-50 Heat Sink Fan Mode

Default value:	–	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select how the heat sink fan responds to operating conditions. Use parameter **14-52 Fan Control** to control the minimum fan speed.

Option	Name	Description
[0]	Simple profile	The simple profile is a passive fan control based on the current temperature state of the drive. This option represents the classic operating behavior of fans.
[1]	Reduced acoustics	
[2]	Standard	
[3]	Cooler operation	

5.28.3 30-8* Compatibility (I)

30-81 Brake Resistor (ohm)

Default value:	Size related	Parameter type:	Range, 5 - 65535.00 Ohm
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the brake resistor value in Ω . This value is used for monitoring the power to the brake resistor in parameter **2-13 Brake Power Monitoring**. This parameter is only active in drives with an integral dynamic brake.

30-85 Motor Frequency

Default value:	Size related	Parameter type:	Range, 5.0 - 1000.0 Hz
Setup:	All setups	Conversion index:	-1
Data type:	Uint32	Change during operation:	False



NOTE: Changing this parameter affects the settings of other parameters.

Enter the motor frequency from the motor nameplate data.

5.29 Parameter Group 31-** Bypass Option

Parameter group for configuring the electronically controlled bypass option board, VLT® Bypass Option MCO 104.

31-00 Bypass Mode

Default value:	[0] Drive	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the bypass operating mode.

Option	Name	Description
[0]*	Drive	The drive operates the motor.
[1]	Bypass	The motor is operated at full speed during bypass mode.

31-01 Bypass Start Time Delay

Default value:	30 s	Parameter type:	Range, 0 - 60 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Setting the time delay to pass from the bypass receives a run command until it starts the motor at full speed. A countdown timer shows the remaining time.

31-02 Bypass Trip Time Delay

Default value:	0 s	Parameter type:	Range, 0 - 300 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Setting the time delay to pass from the drive experiences an alarm that stops it and until the motor is automatically switched to bypass control. If the delay is set to 0, a drive alarm does not automatically switch the motor to bypass control.

31-03 Test Mode Activation

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Disabled	Test mode is disabled.
[1]	Enabled	The motor runs in bypass while the drive can be tested into an open circuit. In this mode, keypad does not control start/stop of bypass.

31-10 Bypass Status Word

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	74
Data type:	V2	Change during operation:	False

View the status of the bypass as a hexadecimal value.

31-11 Bypass Running Hours

Default value:	0 h	Parameter type:	Readout
Setup:	All setups	Conversion index:	74
Data type:	Uint32	Change during operation:	False

View the number of hours in which the motor has run in bypass mode. The counter can be reset in parameter **15-07 Reset Running Hours Counter**. The value is saved when the drive is turned off.

31-19 Remote Bypass Activation

Default value:	[0] Disabled	Parameter type:	Option
Setup:	2 setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

5.30 Parameter Group 34-** MCO Data Readouts

5.30.1 34-0* PCD Write Par.

34-01 PCD 1 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD1 of the fieldbus telegram.

34-02 PCD 2 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD2 of the fieldbus telegram.

34-03 PCD 3 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD3 of the fieldbus telegram.

34-04 PCD 4 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	Uint16	Change during operation:	True

Shows the value received in PCD4 of the fieldbus telegram.

34-05 PCD 5 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD5 of the fieldbus telegram.

34-06 PCD 6 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD6 of the fieldbus telegram.

34-07 PCD 7 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD7 of the fieldbus telegram.

34-08 PCD 8 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD8 of the fieldbus telegram.

34-09 PCD 9 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD9 of the fieldbus telegram.

34-10 PCD 10 Write to MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value received in PCD10 of the fieldbus telegram.

5.30.2 34-2* PCD Read Par.

34-21 PCD 1 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD1 of the fieldbus telegram.

34-22 PCD 2 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD2 of the fieldbus telegram.

34-23 PCD 3 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Shows the value sent in PCD2 of the fieldbus telegram.

34-24 PCD 4 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD4 of the fieldbus telegram.

34-25 PCD 5 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD5 of the fieldbus telegram.

34-26 PCD 6 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD6 of the fieldbus telegram.

34-27 PCD 7 Read from MCO

Default value:	0	Parameter type:	Readout

Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD7 of the fieldbus telegram.

34-28 PCD 8 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD8 of the fieldbus telegram.

34-29 PCD 9 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD9 of the fieldbus telegram.

34-30 PCD 10 Read from MCO

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Shows the value sent in PCD10 of the fieldbus telegram.

5.31 Parameter Group 35-** Sensor Input Option

5.31.1 35-0* Temp. Input Mode (MCB 114)

35-00 Term. X48/4 Temperature Unit

Default value:	[60] °C	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the unit to be used with temperature input X48/4 settings and readouts.

Option	Name	Description
[60]*	°C	
[160]	°F	

35-01 Term. X48/4 Input Type

Default value:	[0] Not connected	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

View the temperature sensor type detected at input X48/4.

Index	Name
[0]*	Not connected
[1]	PT100 2-wire
[3]	PT1000 2-wire
[5]	PT100 3-wire
[7]	PT1000 3-wire

35-02 Term. X48/7 Temperature Unit

Default value:	[60] °C	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the unit to be used with temperature input X48/7 settings and readouts.

Option	Name	Description
[60]*	°C	
[160]	°F	

35-03 Term. X48/7 Input Type

Default value:	[0] Not connected	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

View the temperature sensor type detected at input X48/7.

Option	Name
[0]*	Not connected
[1]	PT100 2-wire
[3]	PT1000 2-wire
[5]	PT100 3-wire
[7]	PT1000 3-wire

35-04 Term. X48/10 Temperature Unit

Default value:	[60] °C	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the unit to be used with temperature input X48/10 settings and readouts.

Option	Name	Description
[60]*	°C	
[160]	°F	

35-05 Term. X48/10 Input Type

Default value:	[0] Not connected	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

View the temperature sensor type detected at input X48/10.

Option	Name
[0]*	Not connected
[1]	PT100 2-wire
[3]	PT1000 2-wire
[5]	PT100 3-wire
[7]	PT1000 3-wire

35-06 Temperature Sensor Alarm Function

Default value:	[5] Stop and trip	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Set the alarm function.

Option	Name	Description
[0]	Off	
[2]	Stop	
[5]*	Stop and trip	
[27]	Forced stop and trip	

5.31.2 35-1* Temp. Input X48/4 (MCB 114)

35-14 Term. X48/4 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/4. A high time constant value improves dampening but also increases the time delay through the filter.

35-15 Term. X48/4 Temp. Monitor

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. Set the temperature limits in parameter *35-16 Term. X48/4 Low Temp. Limit* and parameter *35-17 Term. X48/4 High Temp. Limit*.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

35-16 Term. X48/4 Low Temp. Limit

Default value:	Size related	Parameter type:	Range, -50 - par. 35-17
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4.

35-17 Term. X48/4 High Temp. Limit

Default value:	Size related	Parameter type:	Range, par. 35-16 - 204
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/4.

5.31.3 35-2* Temp. Input X48/7 (MCB 114)

35-24 Term. X48/7 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/7. A high time constant value improves dampening but also increases the time delay through the filter.

35-25 Term. X48/7 Temp. Monitor

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. Set the temperature limits in parameter **35-26 Term. X48/7 Low Temp. Limit** and parameter **35-27 Term. X48/7 High Temp. Limit**.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

35-26 Term. X48/7 Low Temp. Limit

Default value:	Size related	Parameter type:	Range, -50 - par. 35-27
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7.

35-27 Term. X48/7 High Temp. Limit

Default value:	Size related	Parameter type:	Range, Par. 35-26 - 204
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/7.

5.31.4 35-3* Temp. Input X48/10 (MCB 114)

35-34 Term. X48/10 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/10. A high time constant value improves dampening but also increases the time delay through the filter.

35-35 Term. X48/10 Temp. Monitor

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter facilitates the possibility of enabling or disabling the temperature monitor for terminal X48/4. Set the temperature limits in parameter **35-36 Term. X48/10 Low Temp. Limit** and parameter **35-37 Term. X48/10 High Temp. Limit**.

Option	Name	Description
[0]*	Disabled	
[1]	Enabled	

35-36 Term. X48/10 Low Temp. Limit

Default value:	Size related	Parameter type:	Range, -50 - par. 35-37
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the minimum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10.

35-37 Term. X48/10 High Temp. Limit

Default value:	Size related	Parameter type:	Range, par. 35-36 - 204
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the maximum temperature reading that is expected for normal operation of the temperature sensor at terminal X48/10.

5.31.5 35-4* Analog Input X48/2 (MCB 114)

35-42 Term. X48/2 Low Current

Default value:	4 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

Enter the current (mA) that corresponds to the low reference value set in parameter **35-44 Term. X48/2 Low Ref./Feedb. Value**. The value must be more than 2 mA to activate the live zero timeout function in parameter **6-01 Live Zero Timeout Function**.

35-43 Term. X48/2 High Current

Default value:	20 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) that corresponds to the high reference value set in parameter **35-45 Term. X48/2 High Ref./Feedb. Value**.

35-44 Term. 48/2 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) that corresponds to the voltage or current set in parameter **35-42 Term. X48/2 Low Current**.

35-45 Term. 48/2 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) that corresponds to the voltage or current set in parameter **35-43 Term. X48/2 High Current**.

35-46 Term. X48/2 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X48/2. A high time constant value improves dampening but also increases the time delay through the filter.

35-47 Term. X48/2 Live Zero

Default value:	[1] Enabled	Parameter type:	Option

Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter makes it possible to enable the live zero monitoring.

Option	Name	Description
[0]	Disabled	Live zero monitoring is disabled.
[1]*	Enabled	Live zero monitoring is enabled.

5.32 Parameter Group 36-** Programmable I/O Option

5.32.1 36-0* I/O Mode

36-00 Term. X49/1 Mode

Default value:	[1] Voltage	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the output mode of analog terminal X49/1.

Option	Name	Description
[0]	Current	
[1]*	Voltage	
[2]	PT1000 [°C]	
[3]	PT1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

36-01 Term. X49/3 Mode

Default value:	[1] Voltage	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the output mode of analog terminal X49/3.

Option	Name	Description
[0]	Current	
[1]*	Voltage	
[2]	PT1000 [°C]	
[3]	PT1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

36-02 Term. X49/5 Mode

Default value:	[1] Voltage	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the output mode of analog terminal X49/5.

Option	Name	Description
[0]	Current	
[1]*	Voltage	
[2]	PT1000 [°C]	
[3]	PT1000 [°F]	
[4]	Ni 1000 [°C]	
[5]	Ni 1000 [°F]	

36-03 Term. X49/7 Mode

Default value:	[0] Voltage 0–10V	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the output mode of analog terminal X49/7.

Option	Name	Description
[0]*	Voltage 0–10V	
[1]	Voltage 2–10V	
[2]	Current 0–20mA	
[3]	Current 4–20mA	
[4]	Digital	

36-04 Term. X49/9 Mode

Default value:	[0] Voltage 0–10V	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the output mode of analog terminal X49/9.

Option	Name	Description
[0]*	Voltage 0–10V	
[1]	Voltage 2–10V	
[2]	Current 0–20mA	
[3]	Current 4–20mA	
[4]	Digital	

36-05 Term. X49/11 Mode

Default value:	[0] Voltage 0–10V	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the output mode of analog terminal X49/11.

Option	Name	Description
[0]*	Voltage 0–10V	
[1]	Voltage 2–10V	
[2]	Current 0–20mA	
[3]	Current 4–20mA	
[4]	Digital	

5.32.2 36-1* Analog Input X49/1

36-10 Terminal X49/1 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - 10 V
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the voltage corresponding to the low reference value set in parameter **36-14 Term. X49/1 Low Ref./Feedb. Value**.

36-11 Terminal X49/1 Low Current

Default value:	4 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) corresponding to the low reference value set in parameter **36-14 Term. X49/1 Low Ref./Feedb. Value**.

36-12 Terminal X49/1 High Voltage

Default value:	10 V	Parameter type:	Range, 0 - 10 V
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the voltage corresponding to the high reference value set in parameter **36-15 Term. X49/1 High Ref./Feedb. Value**.

36-13 Terminal X49/1 High Current

Default value:	20 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) corresponding to the high reference value set in parameter **36-15 Term- X49/1 High Ref./Feedb. Value**.

36-14 Terminal X49/1 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in parameter **36-10 Terminal X49/1 Low Voltage** or parameter **36-11 Terminal X49/1 Low Current**.

36-15 Terminal X49/1 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in parameter **36-12 Terminal X49/1 High Voltage** or parameter **X49/1 High Current**.

36-16 Term. X49/1 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X49/1. A high time constant value improves dampening but also increases the time delay through the filter.

36-17 Term. X49/1 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter for either disabling or enabling the live zero monitoring function.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.32.3 36-2* Analog Input X49/3

36-20 Terminal X49/3 Low Voltage

Default value:	0.007 V	Parameter type:	Range, 0 - 10 V
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the voltage corresponding to the low reference value set in parameter **36-24 Term. X49/3 Low Ref./Feedb. Value**.

36-21 Terminal X49/3 Low Current

Default value:	4 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) corresponding to the low reference value set in parameter **36-24 Term. X49/3 Low Ref./Feedb. Value**.

36-22 Terminal X49/3 High Voltage

Default value:	10 V	Parameter type:	Range, 0 - 10 V
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the voltage corresponding to the high reference value set in parameter **36-25 Term. X49/3 High Ref./Feedb. Value**.

36-23 Terminal X49/3 High Current

Default value:	20 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) corresponding to the high reference value set in parameter **36-25 Term. X49/3 High Ref./Feedb. Value**.

36-24 Terminal X49/3 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in parameter **36-20 Terminal X49/1 Low Voltage** or parameter **36-21 Terminal X49/1 Low Current**.

36-25 Terminal X49/3 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in parameter **36-22 Terminal X49/3 High Voltage** or parameter **36-23 Terminal X49/3 High Current**.

36-26 Term. X49/3 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0

Data type:	Uint16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X49/3. A high time constant value improves dampening but also increases the time delay through the filter.

36-27 Term. X49/3 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter for either disabling or enabling the live zero monitoring function.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.32.4 36-3* Analog Input X49/5

36-30 Terminal X49/5 Low Voltage

Default value:	0.07 V	Parameter type:	Range, 0 - 10 V
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the voltage corresponding to the low reference value set in parameter **36-34 Term. X49/5 Low Ref./Feedb. Value**.

36-31 Terminal X49/3 Low Current

Default value:	4 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) corresponding to the low reference value set in parameter **36-34 Term. X49/5 Low Ref./Feedb. Value**.

36-32 Terminal X49/5 High Voltage

Default value:	10 V	Parameter type:	Range, 0 - 10 V
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Enter the voltage corresponding to the high reference value set in parameter **36-35 Term. X49/5 High Ref./Feedb. Value**.

36-33 Terminal X49/5 High Current

Default value:	20 mA	Parameter type:	Range, 0 - 20 mA
Setup:	All setups	Conversion index:	-3
Data type:	Int16	Change during operation:	True

Enter the current (mA) corresponding to the high reference value set in parameter **36-35 Term. X49/5 High Ref./Feedb. Value**.

36-34 Terminal X49/5 Low Ref./Feedb. Value

Default value:	0 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in parameter **36-30 Terminal X49/5 Low Voltage** or parameter **36-31 Terminal X49/4 Low Current**.

36-35 Terminal X49/5 High Ref./Feedb. Value

Default value:	100 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	True

Enter the reference or feedback value (in RPM, Hz, bar, and so on) corresponding to the voltage or current set in parameter **36-32 Terminal X49/5 High Voltage** or parameter **36-33 Terminal X49/5 High Current**.

36-36 Term. X49/5 Filter Time Constant

Default value:	0.005 s	Parameter type:	Range, 0.005 - 10 s
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Enter the filter time constant. This is a first-order digital low-pass filter time constant for suppressing electrical noise in terminal X49/3. A high time constant value improves dampening but also increases the time delay through the filter.

36-37 Term. X49/5 Live Zero

Default value:	[1] Enabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter for either disabling or enabling the live zero monitoring function.

Option	Name	Description
[0]	Disabled	
[1]*	Enabled	

5.32.5 36-4* Output X49/7

36-40 Terminal X49/7 Analogue Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the functionality of terminal X49/7.

Option	Name	Description
[0]*	No description	Indicates no signal on the analog output.
[52]	MCO	
[100]	Output freq. 0–100	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference Min–Max	Parameter 3-00 Reference Range [Min - Max] 0% = 0 mA; 100% = 20 mA Parameter 3-00 Reference Range [-Max - Max] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA.
[102]	Feedback ±200%	-200% to +200% of parameter 3-03 Maximum reference , (0–100 V)
[103]	Motor cur. 0–Imax	The value is taken from parameter 16-37 Inv. Max. Current . The inverter maximum current (160% current) is equal to 20 mA. Example: Inverter normal current (11 kW) is 24 A. 160 % = 38.4 A. Motor normal current is 22 A, the readout is 11.46 mA. $\frac{20 \text{ mA} \times 22 \text{ A}}{38.4 \text{ A}} = 11.46 \text{ mA}$ When the normal motor current is equal to 20 mA, the output setting of parameter 6-52 Terminal 42 Output Max Scale is: $\frac{I_{VLT, MAX} \times 100}{I_{Motor, Nom}} = \frac{38.4 \times 100}{22} = 175 \%$
[104]	Torque 0–Tlim	The torque setting is related to the setting in parameter 4-16 Torque Limit Motor Mode .
[105]	Torque 0–Tnom	The torque is related to the motor torque setting.
[106]	Power 0–Pnom	Taken from parameter 1-20 Motor Power [kW] .
[107]	Speed 0–HighLim	Taken from parameter 3-03 Maximum Reference . 20 mA equals the value in parameter 3-03 Maximum Reference .
[108]	Torque ±160%	Torque reference related to 160% torque.
[109]	Out frq 0–Fmax	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed loop 1	0–100%, (0–10 V)
[114]	Ext. closed loop 2	0–100%, (0–10 V)
[115]	Ext. closed loop 3	0–100%, (0–10 V)
[139]	Bus ctrl	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl t.o.	Parameter 4-54 Warning Reference Low defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

36-41 Terminal X49/7 Digital Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the function of terminal X49/7 as a digital output.

Option	Name	Description
[0]*	No operation	All digital and relay outputs are by default set to No Operation.
[1]	Control ready	The control card is ready.
[2]	Drive ready	The drive is ready to operate. Mains and control supplies are OK.
[3]	Drive rdy/rem ctrl	The drive is ready for operation and is in auto-on mode.
[4]	Standby/no warning	The drive is ready for operation. No start or stop command is given (start/disable). There are no warnings.
[5]	Running	The motor is running, and shaft torque is present.
[6]	Running/no warning	Output speed is higher than the speed set in parameter 1-81 Min Speed for Function at Stop [RPM] . The motor runs and there are no warnings.
[8]	Run on ref/no warn	The motor runs at reference speed. No warnings.
[9]	Alarm	An alarm activates the output. No warnings.
[10]	Alarm or warning	An alarm or a warning activates the output.
[11]	At torque limit	The torque limit set in parameter 4-16 Torque Limit Motor Mode or parameter 4-17 Torque Limit Generator Mode has been exceeded.
[12]	Out of current range	The motor current is outside the range set in parameter 4-18 Current Limit .
[13]	Below current, low	The motor current is lower than set in parameter 4-50 Warning Current Low .
[14]	Above current, high	The motor current is higher than set in parameter 4-51 Warning Current High .
[15]	Out of speed range	Output speed/frequency is outside the frequency range set in parameter 4-52 Warning Speed Low and parameter 4-53 Warning Speed High .
[16]	Below speed, low	Output speed is lower than the setting in parameter 4-52 Warning Speed Low .
[17]	Above speed, high	Output speed is higher than the setting in parameter 4-53 Warning Speed High .
[18]	Out of feedb. range	Feedback is outside the range set in parameter 4-56 Warning Feedback Low and parameter 4-57 Warning Feedback High .
[19]	Below feedback, low	Feedback is below the limit set in parameter 4-56 Warning Feedback Low .
[20]	Above feedback, high	Feedback is above the limit set in parameter 4-57 Warning Feedback High .
[21]	Thermal warning	Thermal warning turns on when the temperature exceeds the limit either in motor, drive, brake resistor, or connected thermistor.
[25]	Reverse	The motor runs (or is ready to run) clockwise when logic = 0 and counterclockwise when logic = 1. The output changes as soon as the reversing signal is applied.
[26]	Bus OK	Active communication (no timeout) via the serial communication port.

Option	Name	Description
[27]	Torque limit & stop	Use for performing a coasted stop in a torque limit condition. If the drive has received a stop signal and is in torque limit, the signal is logic 0.
[28]	Brake, no brake war	Brake is active and there are no warnings.
[29]	Brake ready, no fault	Brake is ready for operation and there are no faults.
[30]	Brake fault (IGBT)	Output is logic 1 when the brake IGBT is short-circuited. Use this function to protect the drive if there is a fault on the brake module. Use the digital output/relay to cut out the main voltage from the drive.
[33]	Safe stop active	Indicates that the Safe Torque Off on terminal 37 has been activated.
[35]	External interlock	The external interlock function has been activated via 1 of the digital inputs.
[40]	Out of ref range	Active when the actual speed is outside the settings in parameter 4-52 Warning Speed Low to parameter 4-55 Warning Reference High .
[41]	Below reference, low	Active when the actual speed is below speed reference setting.
[42]	Above ref, high	Active when actual speed is above speed reference setting.
[45]	Bus ctrl.	Controls digital output/relay via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . The output state is retained in the event of a bus timeout.
[46]	Bus ctrl, 1 if timeout	Controls output via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . If a bus timeout occurs, the output state is set high (on).
[47]	Bus ctrl, 0 if timeout	Controls output via bus. The state of the output is set in parameter 5-90 Digital & Relay Bus Control . If a bus timeout occurs, the output state is set low (off).
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	See parameter group 13-1* Comparators . If comparator 0 in SLC is true, the output goes high. Otherwise, it is low.
[61]	Comparator 1	See parameter group 13-1* Comparators . If comparator 1 in SLC is true, the output goes high. Otherwise, it is low.
[62]	Comparator 2	See parameter group 13-1* Comparators . If comparator 2 in SLC is true, the output goes high. Otherwise, it is low.
[63]	Comparator 3	See parameter group 13-1* Comparators . If comparator 3 in SLC is true, the output goes high. Otherwise, it is low.
[64]	Comparator 4	See parameter group 13-1* Comparators . If comparator 4 in SLC is true, the output goes high. Otherwise, it is low.
[65]	Comparator 5	See parameter group 13-1* Comparators . If comparator 5 in SLC is true, the output goes high. Otherwise, it is low.
[66]	Comparator 6	See parameter group 13-1* Comparators . If comparator 6 in SLC is true, the output goes high. Otherwise, it is low.

Option	Name	Description
[67]	Comparator 7	See parameter group 13-1* Comparators . If comparator 7 in SLC is true, the output goes high. Otherwise, it is low.
[68]	Comparator 8	See parameter group 13-1* Comparators . If comparator 8 in SLC is true, the output goes high. Otherwise, it is low.
[69]	Comparator 9	See parameter group 13-1* Comparators . If comparator 9 in SLC is true, the output goes high. Otherwise, it is low.
[70]	Logic rule 0	See parameter group 13-1* Comparators . If logic rule 0 in SLC is true, the output goes high. Otherwise, it is low.
[71]	Logic rule 1	See parameter group 13-4* Logic Rules . If logic rule 1 in SLC is true, the output goes high. Otherwise, it is low.
[72]	Logic rule 2	See parameter group 13-4* Logic Rules . If logic rule 2 in SLC is true, the output goes high. Otherwise, it is low.
[73]	Logic rule 3	See parameter group 13-4* Logic Rules . If logic rule 3 in SLC is true, the output goes high. Otherwise, it is low.
[74]	Logic rule 4	See parameter group 13-4* Logic Rules . If logic rule 4 in SLC is true, the output goes high. Otherwise, it is low.
[75]	Logic rule 5	See parameter group 13-4* Logic Rules . If logic rule 5 in SLC is true, the output goes high. Otherwise, it is low.
[76]	Logic rule 6	See parameter group 13-4* Logic Rules . If logic rule 6 in SLC is true, the output goes high. Otherwise, it is low.
[77]	Logic rule 7	See parameter group 13-4* Logic Rules . If logic rule 7 in SLC is true, the output goes high. Otherwise, it is low.
[78]	Logic rule 8	See parameter group 13-4* Logic Rules . If logic rule 8 in SLC is true, the output goes high. Otherwise, it is low.
[79]	Logic rule 9	See parameter group 13-4* Logic Rules . If logic rule 9 in SLC is true, the output goes high. Otherwise, it is low.
[80]	SL digital output A	See parameter 13-52 SL Controller Action . Output A is low on smart logic action [32] Set digital out A low . Output A is high on smart logic action [38].
[81]	SL digital output B	See parameter 13-52 SL Controller Action . Output B is low on smart logic action [33] Set digital out B low . Output B is high on smart logic action [39].
[82]	SL digital output C	See parameter 13-52 SL Controller Action . Output C is low on smart logic action [34] Set digital out C low . Output C is high on smart logic action [40].
[83]	SL digital output D	See parameter 13-52 SL Controller 1 Action . Output D is low on smart logic action [35] Set digital out D low . Output D is high on smart logic action [41].
[84]	SL digital output E	See parameter 13-52 SL Controller Action . Output E is low on smart logic action [36] Set digital out E low . Output E is high on smart logic action [42].
[85]	SL digital output F	See parameter 13-52 SL Controller Action . Output F is low on smart logic action [37] Set digital out F low . Output F is high on smart logic action [43].

Option	Name	Description
[90]	kWh counter pulse	
[120]	System on ref	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 164</i> , ATEX ETR <i>cur.lim.alarm</i> is active, the output is 1.
[152]	ATEX ETR freq. alarm	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 166</i> , ATEX ETR <i>freq.lim.alarm</i> is active, the output is 1.
[153]	ATEX ETR cur. warning	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>alarm 163</i> , ATEX ETR <i>cur.lim.warning</i> is active, the output is 1.
[154]	ATEX ETR freq. warning	Selectable if parameter 1-90 Motor Thermal Protection is set to [20] ATEX ETR or [21] Advanced ETR . If <i>warning 165</i> , ATEX ETR <i>freq.lim.warning</i> is active, the output is 1.
[155]	Verifying flow	
[160]	No alarm	The output is high when no alarm is present.
[161]	Running reverse	The output is high when the drive is running counterclockwise (the logical product of the status bits running AND reverse).
[164]	Local ref active, not OFF	
[165]	Local ref active	The output is high when parameter 3-13 Reference Site is set to [2] Local or when parameter 3-13 Reference Site is set to [0] Linked to hand/auto at the same time as the LCP is in hand-on mode.
[166]	Remote ref active	The output is high when parameter 3-13 Reference Site is set to [1] Remote or [0] Linked to hand/auto while the LCP is in auto-on mode.
[167]	Start command activ	The output is high when there is an active start command (via digital input, bus connection, <i>[Hand On]</i> , or <i>[Auto On]</i>), and no stop command is active.
[168]	Hand/Off	The output is high when the drive is in hand-on mode (as indicated by the LED light above <i>[Hand On]</i>).
[169]	Auto mode	The output is high when the drive is in auto-on mode (as indicated by the LED light above <i>[Auto On]</i>).
[173]	10Wh counter pulse	
[180]	Clock fault	The clock function has been reset to default (2000-01-01) because of a power failure.
[181]	Prev. maintenance	One or more of the preventive maintenance events programmed in parameter 23-10 Maintenance Item has passed the time for the specified action in parameter 23-22 Maintenance Action .
[182]	Deragging	
[183]	Pre/post lube	
[188]	AHF capacitor connect	

Option	Name	Description
[189]	External fan control	The internal logics for internal fan control is transferred to this output to make it possible to control an external fan (relevant for hp duct cooling).
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	The drive/system has entered sleep mode. See parameter group 22-4* Sleep Mode .
[194]	Broken belt	A broken-belt condition has been detected. Enable this function in parameter 22-60 Broken Belt Function .
[195]	Bypass valve control	
[196]	Emergency mode	The drive operates in emergency mode. See parameter group 24-0* Emergency Mode .
[197]	Emcy mode was act.	The drive has been operating in emergency mode. In software version 5.4X, this output is only active 1 minute after emergency mode is stopped. See parameter group 24-0* Emergency Mode .
[198]	Drive bypass	To be used as signal for activating an external electro-mechanical bypass, switching the motor direct on line. See parameter group 24-1* Drive Bypass .
NOTICE LOSS OF CERTIFICATION If enabling the drive bypass function, the drive is no longer certified for using the Safe Torque Off in versions where included.		
[199]	Pipe filling	
[200]	Full capacity	
[201]	Pump 1 running	
[202]	Pump 2 running	
[203]	Pump 3 running	
[204]	Pump 4 running	
[205]	Pump 5 running	
[206]	Pump 6 running	
[207]	Pump 7 running	
[208]	Pump 8 running	
[209]	Pump 9 running	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	See parameter group 13-1* Comparators .

Option	Name	Description
[241]	RS flipflop 1	See parameter group 13-1* Comparators .
[242]	RS flipflop 2	See parameter group 13-1* Comparators .
[243]	RS flipflop 3	See parameter group 13-1* Comparators .
[244]	RS flipflop 4	See parameter group 13-1* Comparators .
[245]	RS flipflop 5	See parameter group 13-1* Comparators .
[246]	RS flipflop 6	See parameter group 13-1* Comparators .
[247]	RS flipflop 7	See parameter group 13-1* Comparators .
[249]	Emcy m OPR unexpected	Emergency mode input or safe stop is not operating as expected, for example, live zero monitoring on an analog input is activated.
[250]	Emcy mode limits	During emergency mode operation, 1 of the critical alarms has been activated and suppressed by emergency mode. This may lead to reduced drive performance and expected operation lifetime before service is required.
[254]	Testing emcy mode	Emergency mode is activated in a special test mode where the drive stops on all alarms.

36-42 Terminal X49/7 Min Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Int16	Change during operation:	True

Match the minimum output of terminal X49/7 with a required value. The required value is defined as a percentage of the value selected in parameter **36-40 Terminal X49/7 Analogue Output**. To know more about how this parameter works, see parameter **6-52 Terminal 42 Output Max Scale**. The following example describes how the drive uses this parameter.

Example:

- Parameter **36-03 Terminal X49/7 Mode** = [0] Voltage 0–10 V.
- Parameter **36-40 Terminal X49/7 Analogue Output** = [100] Output frequency.
- Parameter **4-19 Max Output Frequency** = 200 Hz.

Application requirement: If the output frequency is lower than 20 Hz, the output of terminal X49/7 should be 0 V. To fulfil the example requirement, enter 10% in parameter **36-42 Terminal X49/7 Min. Scale**.

36-43 Terminal X49/7 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Scale the maximum output of terminal X49/7. For example, the scaling is done for the following reasons:

- To provide an output value lower than the maximum possible value.
- To provide the full signal range using output values lower than a certain limit.

To know more about how this parameter works, see parameter **6-52 Terminal 42 Output Max Scale**.

Example:

- Parameter **36-03 Terminal X49/7 Mode** = [0] Voltage 0–10 V
- Parameter **36-40 Terminal X49/7 Analogue Output** = [100] Output Frequency.
- Parameter **4-19 Max Output Frequency** = 200 Hz.

Example case 1: 5 V maximum output is required when the output frequency is 200 Hz. Parameter **36-43 Terminal X49/7 Max. Scale** x 100% = 200%.

Example case 2: 10 V maximum output is required when the output frequency is 150 Hz (75% of the maximum output frequency). Parameter **36-43 Terminal X49/7 Max. Scale** = 75%.

36-44 Terminal X49/7 Bus Ctrl

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	N2	Change during operation:	True

This parameter contains the output level of terminal X49/7 if the terminal is controlled by bus.

36-45 Terminal X49/7 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The drive sends the value of this parameter to the output terminal when the terminal is controlled by a fieldbus and a timeout is detected.

5.32.6 36-5* Output X49/9

36-50 Terminal X49/9 Analogue Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the functionality of terminal X49/9.

Option	Name	Description
[0]*	No operation	Indicates no signal on the analog output.
[52]	MCO	
[100]	Output frequency	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference	Parameter 3-00 Reference Range [Min - Max] 0% = 0 mA; 100% = 20 mA Parameter 3-00 Reference Range [-Max - Max] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA.
[102]	Feedback	

Option	Name	Description
[103]	Motor current	The value is taken from parameter 16-37 Inv. Max. Current. The inverter maximum current (160% current) is equal to 20 mA. Example: Inverter normal current (11 kW) is 24 A. 160 %=38.4 A. Motor normal current is 22 A, the readout is 11.46 mA. $\frac{20\text{mA} \times 22\text{A}}{38.4\text{A}} = 11.46\text{mA}$ When the normal motor current is equal to 20 mA, the output setting of parameter 6-52 Terminal 42 Output Max Scale is: $\frac{I_{\text{VLT, MAX}} \times 100}{I_{\text{Motor, Nom}}} = \frac{38.4 \times 100}{22} = 175\%$
[104]	Torque rel to limit	The torque setting is related to the setting in parameter 4-16 Torque Limit Motor Mode .
[105]	Torque relate to rated	The torque is related to the motor torque setting.
[106]	Power	Taken from parameter 1-20 Motor Power [kW] .
[107]	Speed	Taken from parameter 3-03 Maximum Reference . 20 mA equals the value in parameter 3-03 Maximum Reference .
[108]	Torque	Torque reference related to 160% torque.
[109]	Out frq 0-Fmax	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed loop 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[117]	Shaft power	
[139]	Bus ctrl	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl t.o.	Parameter 4-54 Warning Reference Low defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

36-51 Terminal X49/9 Digital Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True
Option	Name	Description	
[0]*	No operation		
[1]	Control ready		
[2]	Drive ready		
[3]	Drive rdy/rem ctrl		
[4]	Stand-by/no warning		
[5]	Running		

Option	Name	Description
[6]	Running/no warning	
[8]	Run on ref/no warn	
[9]	Alarm	
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[33]	Safe stop active	
[35]	External interlock	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	

Option	Name	Description
[66]	Comparator 6	
[67]	Comparator 7	
[68]	Comparator 8	
[69]	Comparator 9	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[76]	Logic rule 6	
[77]	Logic rule 7	
[78]	Logic rule 8	
[79]	Logic rule 9	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[84]	SL digital output E	
[85]	SL digital output F	
[90]	kWh counter pulse	
[120]	Local ref active	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	
[152]	ATEX ETR freq. alarm	
[153]	ATEX ETR cur. warning	
[154]	ATEX ETR freq. warning	
[155]	Verifying flow	
[160]	No alarm	
[161]	Running reverse	
[164]	Local ref active, not OFF	
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command activ	
[168]	Hand mode	
[169]	Auto mode	
[173]	10Wh counter pulse	

Option	Name	Description
[180]	Clock fault	
[181]	Prev. Maintenance	
[182]	Deragging	
[183]	Pre/post lube	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	
[194]	Broken belt	
[195]	Bypass valve control	
[196]	Emergency mode	
[197]	Emcy mode was act.	
[198]	Drive bypass	
[199]	Pipe filling	
[200]	Full capacity	
[201]	Pump 1 running	
[202]	Pump 2 running	
[203]	Pump 3 running	
[204]	Pump 4 running	
[205]	Pump 5 running	
[206]	Pump 6 running	
[207]	Pump 7 running	
[208]	Pump 8 running	
[209]	Pump 9 running	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	
[241]	RS flipflop 1	
[242]	RS flipflop 2	
[243]	RS flipflop 3	
[244]	RS flipflop 4	
[245]	RS flipflop 5	
[246]	RS flipflop 6	
[247]	RS flipflop 7	

Option	Name	Description
[249]	Emcy m OPR unexpected	
[250]	Emcy mode limits	
[254]	Testing emcy mode	

36-52 Terminal X49/9 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Match the minimum output of terminal X49/9 with a required value. The required value is defined as a percentage of the value selected in parameter **36-50 Terminal X49/9 Analogue Output**. To know more about how this parameter works, see parameter **6-52 Terminal 42 Output Max Scale**. The following example describes how the drive uses this parameter.

Example:

- Parameter **36-04 Terminal X49/9 Mode** = [0] Voltage 0–10 V.
- Parameter **36-50 Terminal X49/9 Analogue Output** = [100] Output frequency.
- Parameter **4-19 Max Output Frequency** = 200 Hz.

Application requirement: If the output frequency is lower than 20 Hz, the output of terminal X49/9 should be 0 V. To fulfill the example requirement, enter 10% in parameter **36-52 Terminal X49/9 Min. Scale**.

36-53 Terminal X49/9 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Scale the maximum output of terminal X49/9. For example, the scaling is done for the following reasons:

- To provide an output value lower than the maximum possible value.
- To provide the full signal range using output values lower than a certain limit.

To know more about how this parameter works, see parameter **6-52 Terminal 42 Output Max Scale**.

Example:

- Parameter **36-04 Terminal X49/9 Mode** = [0] Voltage 0–10 V
- Parameter **36-50 Terminal X49/9 Analogue Output** = [100] Output Frequency.
- Parameter **4-19 Max Output Frequency** = 200 Hz.

Example case 1: 5 V maximum output is required when the output frequency is 200 Hz. Parameter **36-53 Terminal X49/9 Max. Scale** x 100% = 200%.

Example case 2: 10 V maximum output is required when the output frequency is 150 Hz (75% of the maximum output frequency). Parameter **36-53 Terminal X49/9 Max. Scale** = 75%.

36-54 Terminal X49/9 Bus Ctrl

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0

Data type:	N2	Change during operation:	True

This parameter contains the output level of terminal X49/9 if the terminal is controlled by bus.

36-55 Terminal X49/9 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	0
Data type:	Uint16	Change during operation:	True

The drive sends the value of this parameter to the output terminal when the terminal is controlled by a fieldbus and a timeout is detected.

5.32.7 36-6* Output X49/11

36-60 Terminal X49/11 Analogue Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the functionality of terminal X49/11.

Option	Name	Description
[0]*	No operation	Indicates no signal on the analog output.
[52]	MCO	
[100]	Output freq. 0–100	0 Hz = 0 mA; 100 Hz = 20 mA.
[101]	Reference	Parameter 3-00 Reference Range [Min - Max] 0% = 0 mA; 100% = 20 mA Parameter 3-00 Reference Range [-Max - Max] -100% = 0 mA; 0% = 10 mA; +100% = 20 mA.
[102]	Feedback ±200%	
[103]	Motor cur. 0–Imax	The value is taken from parameter 16-37 Inv. Max. Current . The inverter maximum current (160% current) is equal to 20 mA. Example: Inverter normal current (11 kW) is 24 A. 160 % = 38.4 A. Motor normal current is 22 A, the readout is 11.46 mA. $\frac{20\text{mA} \times 22\text{A}}{38.4\text{A}} = 11.46\text{mA}$ When the normal motor current is equal to 20 mA, the output setting of parameter 6-52 Terminal 42 Output Max Scale is: $\frac{I_{VLT, MAX} \times 100}{I_{Motor, Nom}} = \frac{38.4 \times 100}{22} = 175\%$
[104]	Torque 0–Tlim	The torque setting is related to the setting in parameter 4-16 Torque Limit Motor Mode .
[105]	Torque 0–Tnom	The torque is related to the motor torque setting.
[106]	Power 0–Pnom	Taken from parameter 1-20 Motor Power [kW] .
[107]	Speed 0–HighLim	Taken from parameter 3-03 Maximum Reference . 20 mA equals the value in parameter 3-03 Maximum Reference .
[108]	Torque ±160%	Torque reference related to 160% torque.

Option	Name	Description
[109]	Out frq 0–Fmax	0 Hz = 0 mA, parameter 4-19 Max Output Frequency = 20 mA.
[113]	Ext. closed lopp 1	
[114]	Ext. closed loop 2	
[115]	Ext. closed loop 3	
[117]	Shaft power	
[139]	Bus ctrl	An output value set from fieldbus process data. The output works independently of internal functions in the drive.
[141]	Bus ctrl t.o.	Parameter 4-54 Warning Reference Low defines the behavior of the analog output in case of fieldbus timeout.
[147]	Main act val	
[156]	Flow rate	
[254]	DC link	

36-61 Terminal X49/11 Digital Output

Default value:	[0] No operation	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	No operation	
[1]	Control ready	
[2]	Drive ready	
[3]	Drive rdy/rem ctrl	
[4]	Stand-by/no warning	
[5]	Running	
[6]	Running/no warning	
[8]	Run on ref/no warn	
[9]	Alarm	
[10]	Alarm or warning	
[11]	At torque limit	
[12]	Out of current range	
[13]	Below current, low	
[14]	Above current, high	
[15]	Out of speed range	
[16]	Below speed, low	
[17]	Above speed, high	
[18]	Out of feedb. range	
[19]	Below feedback, low	

Option	Name	Description
[20]	Above feedback, high	
[21]	Thermal warning	
[25]	Reverse	
[26]	Bus OK	
[27]	Torque limit & stop	
[28]	Brake, no brake war	
[29]	Brake ready, no fault	
[30]	Brake fault (IGBT)	
[33]	Safe stop active	
[35]	External interlock	
[40]	Out of ref range	
[41]	Below reference, low	
[42]	Above ref, high	
[45]	Bus ctrl.	
[46]	Bus ctrl, 1 if timeout	
[47]	Bus ctrl, 0 if timeout	
[51]	MCO controlled	
[59]	Remote, enable, no TW	
[60]	Comparator 0	
[61]	Comparator 1	
[62]	Comparator 2	
[63]	Comparator 3	
[64]	Comparator 4	
[65]	Comparator 5	
[66]	Comparator 6	
[67]	Comparator 7	
[68]	Comparator 8	
[69]	Comparator 9	
[70]	Logic rule 0	
[71]	Logic rule 1	
[72]	Logic rule 2	
[73]	Logic rule 3	
[74]	Logic rule 4	
[75]	Logic rule 5	
[76]	Logic rule 6	
[77]	Logic rule 7	
[78]	Logic rule 8	

Option	Name	Description
[79]	Logic rule 9	
[80]	SL digital output A	
[81]	SL digital output B	
[82]	SL digital output C	
[83]	SL digital output D	
[84]	SL digital output E	
[85]	SL digital output F	
[90]	kWh counter pulse	
[120]	Local ref active	
[150]	CBM warning	
[151]	ATEX ETR cur. alarm	
[152]	ATEX ETR freq. alarm	
[153]	ATEX ETR cur. warning	
[154]	ATEX ETR freq. warning	
[155]	Verifying flow	
[160]	No alarm	
[161]	Running reverse	
[164]	Local ref active, not OFF	
[165]	Local ref active	
[166]	Remote ref active	
[167]	Start command activ	
[168]	Hand mode	
[169]	Auto mode	
[173]	10Wh counter pulse	
[180]	Clock fault	
[181]	Prev. Maintenance	
[182]	Deragging	
[183]	Pre/post lube	
[188]	AHF Capacitor Connect	
[189]	External Fan Control	
[190]	No-flow	
[191]	Dry pump	
[192]	End of curve	
[193]	Sleep mode	
[194]	Broken belt	
[195]	Bypass valve control	
[196]	Emergency mode	

Option	Name	Description
[197]	Emcy mode was act.	
[198]	Drive bypass	
[199]	Pipe filling	
[200]	Full capacity	
[201]	Pump 1 running	
[202]	Pump 2 running	
[203]	Pump 3 running	
[204]	Pump 4 running	
[205]	Pump 5 running	
[206]	Pump 6 running	
[207]	Pump 7 running	
[208]	Pump 8 running	
[209]	Pump 9 running	
[236]	Ext. CL 1 on ref	
[237]	Ext. CL 2 on ref	
[238]	Ext. CL 3 on ref	
[240]	RS flipflop 0	
[241]	RS flipflop 1	
[242]	RS flipflop 2	
[243]	RS flipflop 3	
[244]	RS flipflop 4	
[245]	RS flipflop 5	
[246]	RS flipflop 6	
[247]	RS flipflop 7	
[249]	Emcy m OPR unexpected	
[250]	Emcy mode limits	
[254]	Testing emcy mode	

36-62 Terminal X49/11 Min. Scale

Default value:	0%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Match the minimum output of terminal X49/11 with a required value. The required value is defined as a percentage of the value selected in parameter **36-60 Terminal X49/11 Analogue Output**. To know more about how this parameter works, see parameter **6-52 Terminal 42 Output Max Scale**. The following example describes how the drive uses this parameter.

Example:

- Parameter **36-05 Terminal X49/16 Mode** = [0] Voltage 0–10 V.

- Parameter **36-50 Terminal X49/11 Analogue Output** = [100] Output frequency.
- Parameter **4-19 Max Output Frequency** = 200 Hz.

Application requirement: If the output frequency is lower than 20 Hz, the output of terminal X49/9 should be 0 V. To fulfil the example requirement, enter 10% in parameter **36-62 Terminal X49/11 Min. Scale**.

36-63 Terminal X49/11 Max. Scale

Default value:	100%	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

Scale the maximum output of terminal X49/11. For example, the scaling is done for the following reasons:

- To provide an output value lower than the maximum possible value.
- To provide the full signal range using output values lower than a certain limit.

To know more about how this parameter works, see parameter **6-52 Terminal 42 Output Max Scale**.

Example:

- Parameter **36-05 Terminal X49/11 Mode** = [0] Voltage 0–10 V
- Parameter **36-60 Terminal X49/11 Analogue Output** = [100] Output Frequency.
- Parameter **4-19 Max Output Frequency** = 200 Hz.

Example case 1: 5 V maximum output is required when the output frequency is 200 Hz. Parameter **36-63 Terminal X49/11 Max. Scale** x 100% = 200%.

Example case 2: 10 V maximum output is required when the output frequency is 150 Hz (75% of the maximum output frequency). Parameter **36-63 Terminal X49/11 Max. Scale** = 75%.

36-64 Terminal X49/11 Bus Ctrl

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	All setups	Conversion index:	0
Data type:	N2	Change during operation:	True

This parameter contains the output level of terminal X49/11 if the terminal is controlled by bus.

36-65 Terminal X49/11 Timeout Preset

Default value:	0%	Parameter type:	Range, 0 - 100%
Setup:	1 setup	Conversion index:	0
Data type:	UInt16	Change during operation:	True

The drive sends the value of this parameter to the output terminal when the terminal is controlled by a fieldbus and a timeout is detected.

5.33 Parameter Group 40-** Special Settings

5.33.1 40-1* Aux. Functions Control

40-10 Kin. Back-up UdcRef

Default value:	Size related	Parameter type:	Range, 300 - 1080 V

Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Set DC-link voltage for kinetic backup mode. To set a higher DC-link voltage for riding through an unbalanced fault, set parameter **14-10 Mains Failure** to **[4] Kinetic back-up** and leave parameter **40-14 Mains Loss Duration** as set. If ride through is not required, set parameter **14-10 Mains Failure** to either **[1] Ctrl. ramp-down**, **[2] Ctrl. ramp-down, trip**, or **[5] Kinetic back-up, trip**.

40-11 Kin. Back-up Integral Time

Default value:	Size related	Parameter type:	Range, 0.001 - 1.000 s
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True

The kinetic back-up controller integral time value enables optimizing the DC-link voltage response. If there is external capacitance on the DC link, increase the value. To obtain a fast control response, decrease the value. However, if the value is too low, the process becomes unstable.

40-12 Kin.Back-up Lead Filter Time

Default value:	0.150 s	Parameter type:	Range, 0.001 - 1.000 s
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True



NOTE: This parameter is only valid in VVC+ control.

This parameter specifies the kinetic backup controller lead filter time. Increase this value to ensure stable DC-link voltage control for high-inertia applications.

40-13 Kin. Back-up Min Run Time

Default value:	Size related	Parameter type:	Range, 0.005 - 2 s
Setup:	All setups	Conversion index:	-3
Data type:	Uint16	Change during operation:	True

Minimum runtime of the kinetic back-up. Kinetic backup control must run during this time, even mains voltage can come back within this time span. The purpose of this function is to avoid the drive frequently changing in and out of kinetic back-up mode, if fluctuating mains voltage occurs.

40-14 Mains Loss Duration

Default value:	60.00 s	Parameter type:	Range, 0.05 - 60.00 s
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Enter the maximum value of mains loss duration. When parameter **14-10 Mains Failure** = **[4] Kinetic Back-up**, the DC-link voltage boosts to the value set in parameter **40-10 Kin. Back-up UdcRef**. The drive then returns to normal operation. The drive allows 2 successive mains faults. A 3rd mains fault triggers a trip. Setting this parameter to 60 s disables the function.

40-15 Kin.Back-up Start Off

Default value:	0.0 V	Parameter type:	Range, -200.0 - 200.0 V
Setup:	All setups	Conversion index:	-1
Data type:	Uint16	Change during operation:	True

Set the voltage offset to be added to the kinetic backup reference to boost the gain when kinetic back-up is activated. This function is used in low-inertia applications.

5.33.2 40-2* PM Motor Specific

40-26 Individual Currents

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select whether or not to use individual axis currents for induction calculations.

Option	Name	Description
[0]*	Off	
[1]	On	

5.33.3 40-3* Fieldbus Profile

40-37 Motor Current

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

View the current in percent of the motor current set in parameter **1-24 Motor Current**.

40-38 Motor Power

Default value:	0%	Parameter type:	Readout
Conversion index:	-2	Data type:	N2
Change during operation:	True		

View the power in percent of the motor power set in parameter **1-20 Motor Power [kW]**.

40-39 Motor Torque

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	N2	Change during operation:	True

View the torque in percent of the rated torque set in parameter **1-26 Motor Cont. Rated Torque**.

5.33.4 40-4* Extend. Alarm Log

40-40 Fault Log: Ext. Reference

Default value:	0%	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	False

View the present reference value applied on impulse or analog basis when the logged event occurred.

40-41 Alarm Log: Frequency

Default value:	0 Hz	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	False

View the actual motor frequency when the logged event occurred.

40-42 Fault Log: Current

Default value:	0 A	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	False

View the motor current measured when the logged event occurred.

40-43 Fault Log: Voltage

Default value:	0 V	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	False

View the motor voltage when the logged event occurred.

40-44 Fault Log: DC Link Voltage

Default value:	0 V	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	False

View the DC-link voltage when the logged event occurred.

40-45 Fault Log: Control Word

Default value:	0	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	False

View the control word sent from the drive when the logged event occurred.

40-46 Fault Log: Status Word

Default value:	0	Parameter type:	Readout, Array [10]

Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	False

View the status word sent from the drive when the logged event occurred.

40-47 Alarm Log: Torque

Default value:	0 Nm	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-1
Data type:	Int32	Change during operation:	False

View the actual motor torque when the logged event occurred.

40-48 Alarm Log: CBM Value

Default value:	0%	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	False

View the actual CBM value for this alarm.

40-49 Alarm Log: CBM Threshold

Default value:	0%	Parameter type:	Readout, Array [10]
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	False

View the CBM threshold for this alarm.

5.33.5 40-5* Advanced Control Settings

40-50 Flux Sensorless Model Shift

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use this parameter to enable or disable the shifting between flux model 1 and flux model 2 at low speed. See also parameter **1-66 Min. Current at Low Speed**.

Option	Name	Description
[0]	Off	Shifting between flux models 1 and 2 is disabled.
[1]	On	Shifting between flux models 1 and 2 is enabled.

40-51 Flux Sensorless Corr. Gain

Default value:	Size related	Parameter type:	Range, 0.1 - 200.0
Setup:	All setups	Conversion index:	-1
Data type:	UInt32	Change during operation:	True

Adjust the flux correction gain used at low speed.

40-52 Speed PID Anti Windup Gain

Default value:	Size related	Parameter type:	Range, 0 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

This Flux parameter is active in the drive when the following parameters are set to 1 of the values listed here:

- Parameter **1-00 Configuration Mode**
 - [0] *Speed open loop* or
 - [1] *Speed closed loop* or
 - [4] *Torque open loop*
- Parameter **1-01 Motor Control Principle**
 - [2] *Flux sensorless* or
 - [3] *Flux w/motor feedback*
- Parameter **1-10 Motor Construction**
 - [0] *Asynchron* or
 - [1] *PM, non-salient SPM* or
 - [2] *PM, salient IPM*

40-53 Current PID Anti Windup Gain

Default value:	Size related	Parameter type:	Range, 0 - 500%
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	True

This Flux parameter is active in the drive when the following parameters are set to 1 of the values listed here:

- Parameter **1-00 Configuration Mode**
- ◦ [0] *Speed open loop* or
- [1] *Speed closed loop* or
- [4] *Torque open loop*
- Parameter **1-01 Motor Control Principle**
 - [2] *Flux sensorless* or
 - [3] *Flux w/motor feedback*
- Parameter **1-10 Motor Construction**
 - [0] *Asynchron* or
 - [1] *PM, non-salient SPM* or
 - [2] *PM, salient IPM*

40-55 Modulation Index

Default value:	100%	Parameter type:	Range, 80 - 106%
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True



NOTE: This parameter is for IPM and SPM motors in VVC+ control principle only.

Activate this parameter by setting parameter **14-03 Overmodulation** to **[2] User Defined**. Use this parameter to set the maximum modulation index and thus trim the application, especially if running with high-power motors without sine-wave filters. Increasing the maximum modulation index increases the motor voltage and improves efficiency and stability. Setting the modulation index too high may lead to torque ripples on the motor shaft.

40-56 Rotor Position Estimation Gain

Default value:	100%	Parameter type:	Range, 10 - 100%
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

When running IPM with high speed, high load, and low mains voltage, there is an increased risk of nuisance alarms. To reduce the risk of alarms, decrease the value, which then increases control stability.

5.33.6 40-6* IPv6 Settings

40-60 IPv6 Address Assignment

Default value:	[3] Disable	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the method for assigning the IP address. If selecting **[0] Manual**, the IP address can be set in parameter **40-61 IPv6 Address**. To stop communication via IPv6, select **[3] Disable**.

Option	Name	Description
[0]	Manual	
[1]	Auto configuration	
[2]	DHCPv6	
[3]*	Disable	

40-61 IPv6 Address

Default value:	Size related	Parameter type:	Array [4]
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[39]	Change during operation:	True

Use this parameter for configuring the IP address of the option in IPv6 format.

40-62 Prefix Length

Default value:	0	Parameter type:	Array [4]
Setup:	1 setup	Conversion index:	0
Data type:	Uint8	Change during operation:	True



NOTE: If parameter **40-60 IPv6 Address** is set to **[1] Auto Configuration** or **[2] DHCPv6**, this parameter is read-only.

Use this parameter for configuring the submask of the option.

40-63 Default Gateway

Default value:	Size related	Parameter type:	Range, 3 - 39
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[39]	Change during operation:	True

Use this parameter for setting the default gateway for IPv6.

40-64 DHCPv6 Server

Default value:	Size related	Parameter type:	Range, 3 - 39
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[39]	Change during operation:	True

This parameter shows the IP address of the detected DHCPv6 server.

40-65 Lease Expires IPv6

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimD	Change during operation:	True

This parameter shows the remaining time for the currently assigned IP address by the DHCPv6 server in the format DD:HH:MM:SS.

40-66 Name Servers IPv6

Default value:	Size related	Parameter type:	Array [2]
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[39]	Change during operation:	True

This parameter shows the IP address found on the DHCPv6 server.

5.33.7 40-8* IoT Settings

40-80 IoT Profile

Default value:	[0] Disable	Parameter type:	Option
Setup:	1 setup	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select the profile to publish data on the selected IoT protocol.

Option	Name	Description
[0]*	Disable	
[1]	Profile 1	
[2]	Profile 2	
[3]	Profile 3	

40-81 IoT Connection Info

Default value:	0	Parameter type:	Array [8]
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[64]	Change during operation:	True

Shows the status and configuration information of the current IoT protocol.

5.33.8 40-9* Security

40-90 UUID

Default value:	Size related	Parameter type:	Range, 36 - 36
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[36]	Change during operation:	True

The Universal Unique Identifier (UUID) identifies this device within the network.

40-92 802.1X Port-Based Network Access Control

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use this parameter for setting the protocol used for network port access control using 802.1X.

Option	Name	Description
[0]*	Disable	
[1]	Enable EAP-TLS	

40-99 Protocol Status Word

Default value:	0	Parameter type:	Array [10]
Setup:	1 setup	Conversion index:	0
Data type:	Uint32	Change during operation:	True

This parameter shows the protocol status word for the drive in hex code.

5.34 Parameter Group 43-** Unit Readouts

5.34.1 43-0* Component Status

43-00 Component Temp.

Default value:	0 °C	Parameter type:	Readout, Array [18]
Setup:	All setups	Conversion index:	100
Data type:	Int8	Change during operation:	True

Shows the temperature of a system component. The elements of the array reference local PCB temperature sensor measurements. Parameter **16-31 System Temp** uses all elements in this array to calculate the system temperature.

43-01 Auxiliary Temp.

Default value:	0 °C	Parameter type:	Readout, Array [18]
Setup:	All setups	Conversion index:	100
Data type:	Int8	Change during operation:	True

Shows the temperature of an auxiliary component. The elements of the array reference the temperature measurements from the NTC temperature sensors connected to hardware components in the drive. Refer to the operating guide for specifications of temperature sensor placement.

43-02 Component SW ID

Default value:	0	Parameter type:	Readout, Array [18]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[18]	Change during operation:	True

Shows the software version of the installed option.

5.34.2 43-1* Power Card Status

43-10 HS Temp. ph.U

Default value:	0 °C	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	100
Data type:	Int8	Change during operation:	True

Shows the heat sink temperature at the location of the phase U IGBT power module. This measurement is not available in all enclosure sizes. Parameter **16-34 Heatsink Temp.** uses the value in this parameter.

43-11 HS Temp. ph.V

Default value:	0 °C	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	100
Data type:	Int8	Change during operation:	True

Shows the heat sink temperature at the location of the phase V IGBT power module. This measurement is not available in all enclosure sizes. Parameter **16-34 Heatsink Temp.** uses the value in this parameter.

43-12 HS Temp. ph.W

Default value:	0 °C	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	100
Data type:	Int8	Change during operation:	True

Shows the heat sink temperature at the location of the phase W IGBT power module. This measurement is not available in all enclosure sizes. Parameter **16-34 Heatsink Temp.** uses the value in this parameter.

43-13 PC Fan A Speed

Default value:	0 RPM	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	67
Data type:	UInt16	Change during operation:	True

Shows the measured speed of fan A on the power card. Each power card has up to 3 fan connections. Place the fan in the drive according to the operating guide. A typical placement for fan A is in the backchannel (the external fan). The value of this parameter is:

- The actual fan speed when there is a DC fan in the drive.
- Relative speed when there is an AC fan in the drive.

43-14 PC Fan B Speed

Default value:	0 RPM	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the measured speed of fan B on the power card. Each power card has up to 3 fan connections. Place the fan in the drive according to the operating guide. A typical placement for fan B is on the enclosure door (the internal fan). The value of this parameter is:

- The actual fan speed when there is a DC fan in the drive.
- Relative speed when there is an AC fan in the drive.

43-15 PC Fan C Speed

Default value:	0 RPM	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Changing during operation:	True

Shows the measured speed of fan C on the power card. Each power card has up to 3 fan connections. Place the fan in the drive according to the operating guide. A typical placement for fan C is inside the enclosure (the mixing fan). The value of this parameter is:

- The actual fan speed when there is a DC fan in the drive.
- Relative speed when there is an AC fan in the drive.

5.34.3 43-2* Fan Pow.Card Status

43-20 FPC Fan A Speed

Default value:	0 RPM	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the speed of the power card fan A.

43-21 FPC Fan B Speed

Default value:	0 RPM	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the speed of the power card fan B.

43-22 FPC Fan C Speed

Default value:	0 RPM	Parameter type:	Readout, Array [2]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the speed of the power card fan C.

43-23 FPC Fan D Speed

Default value:	0 RPM	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the speed of the power card fan D.

43-24 FPC Fan E Speed

Default value:	0 RPM	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the speed of the power card fan E.

43-25 FPC Fan F Speed

Default value:	0 RPM	Parameter type:	Readout, Array [4]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

Shows the speed of the power card fan F.

5.34.4 43-3* Warning Log

43-30 Warning Log: Warning Number

Default value:	0	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

View the warning number and look up its meaning in the chapter *Troubleshooting*.

43-31 Warning Log: Value

Default value:	0	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	Int16	Change during operation:	False

View an extra description of the warning.

43-32 Warning Log: Time

Default value:	0 s	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	Uint32	Change during operation:	False

View the time when the logged event occurred. Time is measured in seconds from drive start-up.

43-33 Warning Log: Date and Time

Default value:	Size related	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

View at which date and time the logged event occurred.

43-34 Warning Log: Setpoint

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

View an extra description of the error.

43-35 Warning Log: Feedback

Default value:	0 ProcessCtrlUnit	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	False

43-36 Warning Log: Current Demand

Default value:	0%	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	False

43-37 Warning Log: Process Ctrl Unit

Default value:	[0] None	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

Option	Name	Description
[0]*	None	
[1]	%	
[5]	PPM	
[10]	l/min	
[11]	RPM	
[12]	Pulse/s	
[20]	l/s	
[21]	l/min	
[22]	l/h	
[23]	m ³ /s	
[24]	m ³ /min	

Option	Name	Description
[25]	m ³ /h	
[30]	kg/s	
[31]	kg/min	
[32]	kg/h	
[33]	t/min	
[34]	t/h	
[40]	m/s	
[41]	m/min	
[45]	m	
[60]	°C	
[70]	mbar	
[71]	bar	
[72]	Pa	
[73]	kPa	
[74]	m WG	
[75]	mm Hg	
[80]	kW	
[120]	GPM	
[121]	gal/s	
[122]	gal/min	
[123]	gal/h	
[124]	CFM	
[125]	ft ³ /s	
[126]	ft ³ /s	
[127]	ft ³ /h	
[130]	lb/s	
[131]	lb/min	
[132]	lb/h	
[140]	ft/s	
[141]	ft/min	
[145]	ft	
[160]	°F	
[170]	psi	
[171]	lb/in ²	
[172]	in WG	
[173]	ft WG	

Option	Name	Description
[174]	in Hg	
[180]	HP	

43-38 Warning Log: Speed

Default value:	0 RPM	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	67
Data type:	Int32	Change during operation:	False

View the actual motor speed value when the logged event occurred.

43-39 Warning Log: Duration

Default value:	0 s	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	Int32	Change during operation:	False

View for how long the warning was active.

43-40 Warning Log: Ext. Reference

Default value:	0%	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	False

View the present reference value applied on impulse or analog basis when the logged event occurred.

43-41 Warning Log: Frequency

Default value:	0 Hz	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-1
Data type:	Int16	Change during operation:	False

View the actual motor frequency when the logged event occurred.

43-42 Warning Log: Current

Default value:	0 A	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-2
Data type:	Int32	Change during operation:	False

View the motor current measured when the logged event occurred.

43-43 Warning Log: Voltage

Default value:	0 V	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	False

View the motor voltage when the logged event occurred.

43-44 Warning: DC Link Voltage

Default value:	0 V	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

View the DC-link voltage when the logged event occurred.

43-45 Warning Log: Control Word

Default value:	0	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Data type:	V2	Change during operation:	False

View the control word sent from the drive when the logged event occurred.

43-46 Warning Log: Status Word

Default value:	0	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	0
Date type:	V2	Change during operation:	False

View the status word sent from the drive when the logged event occurred.

43-47 Warning Log: Torque

Default value:	0 Nm	Parameter type:	Readout, Array [30]
Setup:	All setups	Conversion index:	-1
Data type:	Int32	Change during operation:	False

View the actual motor torque when the logged event occurred.

5.34.5 43-6* Audit Log

43-60 Audit Log: Event

Default value:	[0] No event	Parameter type:	Readout, Array [100]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

View the event type of the logged alarm.

Index	Name
[0]*	No event
[1]	Factory reset event
[2]	Password changed
[3]	Boot mode activated
[4]	Sec. conf. uploaded
[5]	Sec. conf. applied
[6]	Successful login

Index	Name
[7]	Failed login (max no. of retries)
[8]	Audit log buffer overrun

43-61 Audit Log: Account

Default value:	0	Parameter type:	Readout, Array [100]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[21]	Change during operation:	False

View the account of the logged event.

43-62 Audit Log: Channel

Default value:	[0] Local control panel (LCP)	Parameter type:	Readout, Array [100]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

View which channel requested the logged event.

Index	Name
[0]*	Local control panel (LCP)
[1]	Serial RS-485 connection
[2]	USB
[3]	Fieldbus
[15]	Internal
[16]	Not applicable

43-63 Audit Log: Operating Seconds

Default value:	0 s	Parameter type:	Readout, Array [100]
Setup:	All setups	Conversion index:	0
Data type:	UInt32	Change during operation:	False

View the operating seconds when the logged event occurred.

The operating seconds are measured from start-up of the drive. The operating seconds are available if the drive does not have a clock option or a manually set clock.

43-64 Audit Log: Date and Time

Default value:	Size related	Parameter type:	Readout, Array [100]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

This parameter shows when the logged event occurred. Date and time are available if the drive has a clock option installed or the clock of the drive was set manually.

5.35 Parameter Group 45-** Condition Based Monitoring

5.35.1 45-0* Cockpit: Monitor

Use this parameter group to enable condition-based monitoring, define units, baseline computation, input sources, view baseline status, and progress.

45-00 Function

Default value:	–	Parameter type:	Option, Array [7]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

Set the notification level and enable monitoring of the drive.

Option	Name	Description
[0]	Off	Notification is disabled.
[1]	Warning	Warning notifications are triggered.
[2]	Alarm & warning	Both alarm and warning notifications are triggered.

Table 54: Parameter Index

Parameter ID	Description
45-00.0	Select the required option to enable stator winding monitoring.
45-00.1	Select the required option to enable load envelope.
45-00.2	Select the required option to enable sensor 1 vibration.
45-00.3	Select the required option to enable sensor 2 vibration.
45-00.4	Select the required option to enable sensor 3 vibration.
45-00.5	Select the required option to enable sensor 4 vibration.
45-00.6	Select the required option to enable cavitation monitoring.

45-01 Status

Default value:	[0] Off	Parameter type:	Readout, Array [7]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	False

The parameter shows the status of the monitor function, also when it is pending baseline completion.

Index	Name	Description
[0]*	Off	Status is disabled.
[1]	On	Shows current monitoring status.
[2]	Waiting for baseline	Baseline computation is in progress.
[3]	On - while baseline	Monitoring of cavitation is active during the online baseline, based on earlier thresholds.

Index	Name	Description
[4]	Hold - speed fluctuation	Due to fluctuation in pump speed, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuation disappears, the monitoring resumes. Resolution: Wait for the fluctuation to end, investigate the reason for the fluctuation. Alternatively, increase the value of parameter 45-83.1 Speed Fluctuation Limits to a proper level.
[5]	Hold - load fluctuation	Due to fluctuation in pump loading, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuation disappears, the monitoring resumes. Resolution: Wait for the fluctuation to end, investigate the reason for the fluctuation. Alternatively, increase the value of parameter 45-83.2 Load Fluctuation Limits to a proper level.
[6]	Hold - grid fluctuation	Due to fluctuation in magnitude of the power supply frequency, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuation disappears, the monitoring resumes. Resolution: Wait for the fluctuation to end, investigate the reason for fluctuation and address the issue. Alternatively, increase the value of parameter 45-83.3 Grid Fluctuation Limits to a proper level.
[7]	Hold - load+speed fluctuation	Due to concurrent fluctuations of both pump speed and loading conditions, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuations end, the monitoring resumes. Resolution: Wait for the fluctuations to end, investigate the reasons for the fluctuations and address the issue. Alternatively, increase the values of parameter 45-83.1 Speed Fluctuation Limits and/or parameter 45-83.2 Load Fluctuation Limits to proper levels.
[8]	Hold - grid+load fluctuation	Due to concurrent fluctuations of both pump loading condition and power supply, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuations end, the monitoring resumes. Resolution: Wait for the fluctuations to end, investigate the reasons for the fluctuations and address the issue. Alternatively, increase the values of parameter 45-83.2 Load Fluctuation Limits and/or parameter 45-83.3 Grid Fluctuation Limits to proper levels.

Index	Name	Description
[9]	Hold - grid+speed fluctuation	Due to concurrent fluctuations of both pump speed and power supply, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuations end, the monitoring resumes. Resolution: Wait for the fluctuations to disappear, investigate the reasons for the fluctuations and address the issue. Alternatively, increase the values of parameter 45-83.1 Speed Fluctuation Limits and/or parameter 45-83.3 Grid Fluctuation Limits to proper levels.
[10]	Hold - grid+load+speed fluct.	Due to concurrent fluctuations of both pump speed, loading condition, and power supply, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuations end, the monitoring resumes. Resolution: Wait for the fluctuations to end, investigate the reason for the fluctuations and address the issue. Alternatively, increase the value of parameter 45-83.1 Speed Fluctuation Limits, parameter 45-83.2 Load Fluctuation Limits, and/or parameter 45-83.3 Grid Fluctuation Limits to proper levels.
[11]	Hold - switching freq. transient	Due to fluctuation of the switching frequency of the drive, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuation disappears, the monitoring resumes. Wait for the fluctuation to end, investigate the reason for the fluctuation and address the issue.
[12]	Hold - DC bus transient	Due to fluctuation in the DC-link voltage of the drive, cavitation monitoring is put on hold to avoid false-positive warnings of cavitation. After the fluctuation disappears, the monitoring resumes. Resolution: Wait for the fluctuation to end, investigate the reason for the fluctuation. Alternatively, increase the values of parameter 45-83.1 Speed Fluctuation Limits, parameter 45-83.2 Load Fluctuation Limits, and/or parameter 45-83.3 Grid Fluctuation Limits to proper levels.
[13]	Hold - Sig. gain modified	Cavitation monitoring is disabled as parameter 45-81 Signature Gain is modified, and the value is now different from the one used during baseline. Another possibility is attempting to start cavitation monitoring without having a valid baseline. Resolution: Change the gain to the same value as used during baseline. Alternatively, run a new baseline with the new gain value.
[14]	Hold - Filter TC modified	Cavitation monitoring is disabled as parameter 45-82 Filter Time Constant is modified, and the value is now different from the one used during baseline. Resolution: Change the filter time constant to the same value as used during baseline. Alternatively, run a new baseline with the new filter time constant value.

Table 55: Parameter Index

Parameter ID	Description
45-01.0	Select the required option to view the status of the stator winding monitoring.
45-01.1	Select the required option to view the status of load envelope.
45-01.2	Select the required option to view the status of sensor 1 vibration.
45-01.3	Select the required option to view the status of sensor 2 vibration.
45-01.4	Select the required option to view the status of sensor 3 vibration.
45-01.5	Select the required option to view the status of sensor 4 vibration.
45-01.6	Select the required option to view the status of the cavitation function.

45-02 Start Time

Default value:	Size related	Parameter type:	Readout, Array [7]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows at which date and time the monitoring function was started.

Table 56: Parameter Index

Parameter ID	Description
45-02.0	View the timestamp for starting the stator winding monitoring.
45-02.1	View the timestamp for starting the load envelope monitoring.
45-02.2	View the timestamp for starting the sensor 1 vibration monitoring.
45-02.3	View the timestamp for starting the sensor 2 vibration monitoring.
45-02.4	View the timestamp for starting the sensor 3 vibration monitoring.
45-02.5	View the timestamp for starting the sensor 4 vibration monitoring.
45-02.6	View the timestamp for starting the cavitation monitoring.

45-03 Stop Time

Default value:	Size related	Parameter type:	Readout, Array [7]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows at which date and time the monitoring function was stopped.

Table 57: Parameter Index

Parameter ID	Description
45-03.0	View the timestamp for stopping the stator winding monitoring.
45-03.1	View the timestamp for stopping the load envelope monitoring.
45-03.2	View the timestamp for stopping the sensor 1 vibration monitoring.
45-03.3	View the timestamp for stopping the sensor 2 vibration monitoring.
45-03.4	View the timestamp for stopping the sensor 3 vibration monitoring.

Table 57: Parameter Index - (continued)

Parameter ID	Description
45-03.5	View the timestamp for stopping the sensor 4 vibration monitoring.
45-03.6	View the timestamp for stopping the cavitation monitoring.

45-09 Readout Setting

Default value:	[0] Actual	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Set the readout setting.

Option	Name	Description
[0]*	Actual	
[1]	Actual rel. To S1 High	
[2]	Actual rel. To S2 High	
[3]	Actual rel. To Alarm High	
[4]	Actual rel. To S1 Low (Only For Load)	
[5]	Actual rel. To S2 Low (Only For Load)	
[6]	Actual rel. To Alarm Low (Only For Load)	
[7]	Actual rel. to Act.B.Mean	
[8]	Actual rel. to Prev.B.Mean	

Table 58: Parameter Index

Parameter ID	Description
45-09.0	Select the readout setting for stator winding monitoring.
45-09.1	Select the readout setting for load envelope monitoring.
45-09.2	Select the readout setting for sensor 1 vibration monitoring.
45-09.3	Select the readout setting for sensor 2 vibration monitoring.
45-09.4	Select the readout setting for sensor 3 vibration monitoring.
45-09.5	Select the readout setting for sensor 4 vibration monitoring.
45-09.6	Select the readout setting for cavitation monitoring

5.35.2 45-1* Cockpit: Actl Status

Use the parameters in this group to compare the actual monitor values to all thresholds at the current motor output speed.

45-10 Alarm High Threshold

Default value:	0%	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the maximum threshold limit. The drive triggers a notification when threshold limit is exceeded.

Table 59: Parameter Index

Parameter ID	Description
45-10.0	Actual status of stator winding
45-10.1	Actual status of stator resonance active
45-10.2	Actual status of stator resonance load
45-10.3	Actual status of load envelope
45-10.4	Actual status of sensor 1 vibration
45-10.5	Actual status of sensor 2 vibration
45-10.6	Actual status of sensor 3 vibration
45-10.7	Actual status of sensor 4 vibration
45-10.8	Actual status of cavitation

45-11 Warning S2 High Threshold

Default value:	0%	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the maximum threshold limit for warning stage 2 for the index. The drive triggers a warning notification when threshold limit is exceeded.

Table 60: Parameter Index

Parameter ID	Description
45-11.0	Actual status of stator winding
45-11.1	Actual status of stator resonance active
45-11.2	Actual status of stator resonance load
45-11.3	Actual status of load envelope
45-11.4	Actual status of sensor 1 vibration
45-11.5	Actual status of sensor 2 vibration
45-11.6	Actual status of sensor 3 vibration
45-11.7	Actual status of sensor 4 vibration
45-11.8	Actual status of cavitation

45-12 Warning S1 High Threshold

Default value:	0%	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the maximum threshold limit for warning stage 1 in the parameter index. The drive triggers a warning notification when threshold limit is exceeded. Entering a value in the parameter indicates a user specified threshold limit.

Table 61: Parameter Index

Parameter ID	Description
45-12.0	Actual status of stator winding
45-12.1	Actual status of stator resonance active
45-12.2	Actual status of stator resonance load
45-12.3	Actual status of load envelope
45-12.4	Actual status of sensor 1 vibration
45-12.5	Actual status of sensor 2 vibration
45-12.6	Actual status of sensor 3 vibration
45-12.7	Actual status of sensor 4 vibration
45-12.8	Actual status of cavitation

45-13 Actual Monitor Value

Default value:	0%	Parameter type:	Readout, Array [9]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the current value of selected signal.

Table 62: Parameter Index

Parameter ID	Description
45-13.0	Actual status of stator winding
45-13.1	Actual status of stator resonance active
45-13.2	Actual status of stator resonance load
45-13.3	Actual status of load envelope
45-13.4	Actual status of sensor 1 vibration
45-13.5	Actual status of sensor 2 vibration
45-13.6	Actual status of sensor 3 vibration
45-13.7	Actual status of sensor 4 vibration
45-13.8	Actual status of cavitation

45-14 Warning S1 Low Threshold

Default value:	0%	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the minimum threshold limit for warning stage 1 notification in the parameter index. The drive triggers a notification when the actual monitoring value falls below the minimum threshold limit.

Table 63: Parameter Index

Parameter ID	Description
45-14.0	Actual status of stator winding
45-14.1	Actual status of stator resonance active
45-14.2	Actual status of stator resonance load
45-14.3	Actual status of load envelope
45-14.4	Actual status of sensor 1 vibration
45-14.5	Actual status of sensor 2 vibration
45-14.6	Actual status of sensor 3 vibration
45-14.7	Actual status of sensor 4 vibration

45-15 Warning S2 Low Threshold

Default value:	0%	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the minimum threshold limit for warning stage 2 notification in the parameter index. The drive triggers a warning stage 2 notification when the actual monitoring value falls below the threshold limit specified in the parameter.

Table 64: Parameter Index

Parameter ID	Description
45-15.0	Actual status of stator winding
45-15.1	Actual status of stator resonance active
45-15.2	Actual status of stator winding load
45-15.3	Actual status of load envelope
45-15.4	Actual status of sensor 1 vibration
45-15.5	Actual status of sensor 2 vibration
45-15.6	Actual status of sensor 3 vibration
45-15.7	Actual status of sensor 4 vibration

45-16 Alarm Low Threshold

Default value:	0%	Parameter type:	Readout, Array [8]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the minimum threshold limit in the parameter index. The drive triggers an alarm notification when the actual value falls below the minimum threshold limit.

Table 65: Parameter Index

Parameter ID	Description
45-16.0	Actual status of stator winding
45-16.1	Actual status of stator resonance active

Table 65: Parameter Index - (continued)

Parameter ID	Description
45-16.2	Actual status of stator resonance load
45-16.3	Actual status of load envelope
45-16.4	Actual status of sensor 1 vibration
45-16.5	Actual status of sensor 2 vibration
45-16.6	Actual status of sensor 3 vibration
45-16.7	Actual status of sensor 4 vibration

5.35.3 45-2* Baseline Settings

Use the parameters in this group to configure how to capture baseline data.

45-20 Type

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Use the parameter to select type of baseline computation.

Option	Name	Description
[0]*	Off	Baseline computation type is not set.
[1]	Baseline Run	Select the option when the application can operate from minimum to maximum speed in one sweep. On enabling this option, the condition-based monitoring function sets speed points. On completion of baseline computation, the motor is ramped down to 0. The option can only operate when Hand On mode is set via control panel.
[2]	Online Baseline	Select the option in applications where baseline run cannot be utilized. In this type of baseline computation, the drive is controlled by the application baseline and speed points are recorded and saved during the duration specified in parameter 45-24 Duration . The option can only operate when Auto-on mode is set via control panel.

45-21 Status

Default value:	[0] Not started	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

This parameter shows the current status of baseline capturing. The baseline must be completed before enabling any monitoring functions.

Index	Name
[0]*	Not started
[1]	Baseline run running

Index	Name
[2]	Online baseline running
[3]	Baseline completed
[4]	Baseline failed
[5]	Online inadequate data

45-22 Progress

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

Shows the progress of baseline computation. 0% indicates that the baseline computation is not started, and 100% indicates that baseline computation is completed.

45-23 Baseline Result Info

Default value:	[0] None	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

The parameter shows the status of the baseline result, that is, showing the reasons for failure or inadequate data at baseline run an online baseline.

Index	Name
[0]*	None
[1]	Baseline run OFF
[2]	Reverse direction
[3]	Speed limit exceeded
[4]	Speed diff low
[5]	Step ramp timeout
[6]	Stator supply imbalance
[7]	Online baseline OFF
[8]	Online baseline count limit
[9]	Not allowed - motor running

45-24 Duration

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select a suitable duration for baseline computation. If a value is not selected, by default, the system considers 2 minutes for baseline run and 1 hour for online baseline.

Option	Name	Description
[0]	1 min	
[1]	2 mins	
[3]	4 mins	
[6]	10 mins	
[9]	30 mins	
[13]	1 hour	
[16]	2 hours	
[19]	4 hours	
[23]	8 hours	
[27]	1 day	
[30]	2 days	
[33]	5 days	
[36]	1 week	
[40]	2 weeks	
[43]	1 month	
[46]	2 months	
[49]	4 months	
[52]	6 months	

45-25 Online Speed Band

Default value:	5%	Parameter type:	Range, 0 - 5%
Setup:	All setups	Conversion index:	0
Data type:	UInt8	Change during operation:	True

Use this parameter to define a window to capture the baseline data for different speed points when the speed of drive is within the specified band percentage. Setting the parameter increases a chance to capture all speed points in online baseline mode.

45-26 Min. Speed

Default value:	Size related	Parameter type:	Range, 0 - 35700 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	UInt16	Change during operation:	True

Use this parameter to set the minimum speed of the drive to begin condition-based monitoring functions. Ensure to set a value which exceeds the minimum speed limit of motor. The minimum limit of motor speed corresponds to the setting in parameter **4-11 Motor Speed Low Limit [RPM]**. For more information, refer to the drive-specific programming guide.

45-27 Max. Speed

Default value:	Size related	Parameter type:	Range, 100 - 35700 [RPM]
Setup:	All setups	Conversion index:	67
Data type:	UInt16	Change during operation:	True

Use this parameter to set the maximum speed of the drive for condition-based monitoring functions. Setting the minimum and maximum speed defines the speed range for condition-based monitoring functions to perform effectively. Ensure to set a value which does not exceed the maximum limit of motor speed. The maximum limit of motor speed corresponds to the setting in parameter **4-13 Motor Speed High Limit [RPM]**. For more information, refer to the drive-specific programming guide.

45-28 Speed Points

Default value:	Size related	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	67
Data type:	Uint32	Change during operation:	True

Shows the baseline speed points calculated within the range defined in parameter **45-26 Min. Speed** and parameter **45-27 Max. speed**.

5.35.4 45-3* Threshold Config.

45-30 Baseline Statistics

Default value:	[3] Mean $\pm$ 3 standard deviation	Parameter type:	Option, Array [7]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select the type of baseline statistical data for visualizing calculated threshold limits for each parameter index. The calculated threshold is used for monitoring purposes.

Option	Name	Description
[1]	Mean	Average of the baseline data is shown.
[2]	Maximum/minimum	Maximum and minimum of the baseline data is shown.
[3]*	Mean +/- 3 standard deviation	Mean and +/- 3 standard deviations of the baseline data is shown.

Table 66: Parameter Index

Parameter ID	Description
45-30.0	Threshold configuration of stator winding
45-30.1	Threshold configuration of load envelope
45-30.2	Threshold configuration of sensor 1 vibration
45-30.3	Threshold configuration of sensor 2 vibration
45-30.4	Threshold configuration of sensor 3 vibration
45-30.5	Threshold configuration of sensor 4 vibration
45-30.6	Threshold configuration of cavitation

45-31 Warning Mode

Default value:	[1] Offset	Parameter type:	Option, Array [7]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select a mode to define threshold limit for warnings.

Option	Name	Description
[0]	Absolute	Absolute value is considered as threshold limit.
[1]*	Offset	Calculates threshold as a sum of the computed baseline data and the offset values.
[2]	Factor	Calculates threshold as baseline data x factor.

The values can be specified in parameter **45-34 Warning S2 High**, parameter **45-35 Warning S1 High**, parameter **45-36 Warning S1 Low**, and parameter **45-37 Warning S2 Low**. For example, if selecting **[0] Absolute**, a warning S2 low value of 200, and a warning S1 high value of 300, the threshold limit for warning stage 2 ranges from 200–300.

Table 67: Parameter Index

Parameter ID	Description
45-31.0	Threshold configuration of stator winding
45-31.1	Threshold configuration of load envelope
45-31.2	Threshold configuration of sensor 1 vibration
45-31.3	Threshold configuration of sensor 2 vibration
45-31.4	Threshold configuration of sensor 3 vibration
45-31.5	Threshold configuration of sensor 4 vibration
45-31.6	Threshold configuration of cavitation

45-32 Alarm Mode

Default value:	–	Parameter type:	Option, Array [7]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select a mode to define the threshold limits for alarms.

Option	Name	Description
[0]	Absolute	Absolute value is considered as threshold.
[1]	Offset	Calculates threshold as a sum of the computed baseline data and the offset values.
[2]	Factor	Calculates threshold as baseline data * factor.

The values can be specified in parameter **45-33 Alarm High** and parameter **45-38 Alarm Low**. For example, if selecting **[0] Absolute**, setting an alarm low value of 200, and an alarm high value of 300, the threshold limit for alarms ranges from 200 to 300.

Table 68: Parameter Index

Parameter ID	Description
45-32.0	Threshold configuration of stator winding
45-32.1	Threshold configuration of load envelope
45-32.2	Threshold configuration sensor 1 vibration
45-32.3	Threshold configuration of sensor 2 vibration
45-32.4	Threshold configuration of sensor 3 vibration

Table 68: Parameter Index - (continued)

Parameter ID	Description
45-32.5	Threshold configuration of sensor 4 vibration
45-32.6	Threshold configuration of cavitation

45-33 Alarm High

Default value:	Size related	Parameter type:	Array [7]
Setup:	All setup	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Type the threshold value for high alarm notification. Based on the type of alarm mode selected by the user, a high alarm threshold is calculated.

Table 69: Parameter Index

Parameter ID	Description
45-33.0	Threshold configuration of stator winding
45-33.1	Threshold configuration of load envelope
45-33.2	Threshold configuration of sensor 1 vibration
45-33.3	Threshold configuration of sensor 2 vibration
45-33.4	Threshold configuration of sensor 3 vibration
45-33.5	Threshold configuration of sensor 4 vibration
45-33.6	Threshold configuration of cavitation

45-34 Warning S2 High

Default value:	Size related	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during option:	True

Type the threshold value for computing a warning S2 high notification. Based on the type of warning mode selected by the user, a warning S2 high threshold is calculated.

Table 70: Parameter Index

Parameter ID	Description
45-34.0	Threshold configuration of stator winding
45-34.1	Threshold configuration of load envelope
45-34.2	Threshold configuration of sensor 1 vibration
45-34.3	Threshold configuration of sensor 2 vibration
45-34.4	Threshold configuration of sensor 3 vibration
45-34.5	Threshold configuration of sensor 4 vibration
45-34.6	Threshold configuration of cavitation

45-35 Warning S1 High

Default value:	Size related	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Type the threshold value for computing a warning S1 high notification. Based on the type of warning mode selected by the user, a warning S1 high threshold is calculated.

Table 71: Parameter Index

Parameter ID	Description
45-35.0	Threshold configuration of stator winding
45-35.1	Threshold configuration of load envelope
45-35.2	Threshold configuration of sensor 1 vibration
45-35.3	Threshold configuration of sensor 2 vibration
45-35.4	Threshold configuration of sensor 3 vibration
45-35.5	Threshold configuration of sensor 4 vibration
45-35.6	Threshold configuration of cavitation

45-36 Warning S1 Low

Default value:	Size related	Parameter type:	Array [6]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Type the threshold value for computing a warning S1 low notification. Based on the type of warning mode selected by the user, a warning S1 low threshold is calculated.

Table 72: Parameter Index

Parameter ID	Description
45-36.0	Threshold configuration of stator winding
45-36.1	Threshold configuration of load envelope
45-36.2	Threshold configuration of sensor 1 vibration
45-36.3	Threshold configuration of sensor 2 vibration
45-36.4	Threshold configuration of sensor 3 vibration
45-36.5	Threshold configuration of sensor 4 vibration

45-37 Warning S2 Low

Default value:	Size related	Parameter type:	Array [6]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Type the threshold value for computing a warning S2 low notification. Based on the type of warning mode selected by the user, a warning S2 low threshold is calculated.

Table 73: Parameter Index

Parameter ID	Description
45-37.0	Threshold configuration of stator winding
45-37.1	Threshold configuration of load envelope
45-37.2	Threshold configuration of sensor 1 vibration
45-37.3	Threshold configuration of sensor 2 vibration
45-37.4	Threshold configuration of sensor 3 vibration
45-37.5	Threshold configuration of sensor 4 vibration

45-38 Alarm Low

Default value:	Size related	Parameter type:	Array [6]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Type the threshold value for computing a low alarm notification. Based on the type of alarm mode selected, a low alarm threshold is calculated.

Table 74: Parameter Index

Parameter ID	Description
45-38.0	Threshold configuration of stator winding
45-38.1	Threshold configuration of load envelope
45-38.2	Threshold configuration of sensor 1 vibration
45-38.3	Threshold configuration of sensor 2 vibration
45-38.4	Threshold configuration of sensor 3 vibration
45-38.5	Threshold configuration of sensor 4 vibration

45-39 Online Baseline Counter

Default value:	2	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

Type the minutes during which monitoring values are captured for a speed point during baseline generation. Speed points are captured for different types of condition-based monitoring during the minutes specified in this parameter.

Table 75: Parameter Index

Parameter ID	Description
45-39.0	Threshold configuration of stator winding
45-39.1	Threshold configuration of load envelope
45-39.2	Threshold configuration of sensor 1 vibration
45-39.3	Threshold configuration of sensor 2 vibration
45-39.4	Threshold configuration of sensor 3 vibration

Table 75: Parameter Index - (continued)

Parameter ID	Description
45-39.5	Threshold configuration of sensor 4 vibration
45-39.6	Threshold configuration of cavitation

45-40 Extend Factor

Default value:	1.00f	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

In this parameter, consider the extended factor required for setting the extended threshold generation via parameter **45-45 Threshold Generation**.

Table 76: Parameter Index

Parameter ID	Description
45-40.0	Threshold configuration of stator winding
45-40.1	Threshold configuration of load envelope
45-40.2	Threshold configuration of sensor 1 vibration
45-40.3	Threshold configuration of sensor 2 vibration
45-40.4	Threshold configuration of sensor 3 vibration
45-40.5	Threshold configuration of sensor 4 vibration
45-40.6	Threshold configuration of cavitation

5.35.5 45-4* Threshold Generation

The parameters in this parameter group support the generation of the CBM thresholds.

45-45 Threshold Generation

Default value:	[0] Off	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Off	Not applicable.
[1]	Generate now	Based on the selections, generate threshold for all functions from actual baseline data.
[2]	Auto generate	Not applicable.
[3]	Generate now - previous	Based on the selections, generate threshold for all functions from previous baseline data.
[4]	Gen. now - stator	Based on the selections, generate threshold for stator from actual baseline data.
[5]	Gen. now - load	Based on the selections, generate threshold for the load from actual baseline data.

Option	Name	Description
[6]	Gen. now - sensor 1	Based on the selections, generate threshold for sensor 1 from actual baseline data.
[7]	Gen. now - sensor 2	Based on the selections, generate threshold for sensor 2 from actual baseline data.
[8]	Gen. now - sensor 3	Based on the selections, generate threshold for sensor 3 from actual baseline data.
[9]	Gen. now - sensor 4	Based on the selections, generate threshold for sensor 4 from actual baseline data.
[10]	Extend auto gen.	After baseline has finished successfully, generate all function thresholds from the actual baseline data factored with the extend factor value.
[11]	Gen. now - cavitation	Based on the selections, generate cavitation thresholds from the actual baseline date.

45-46 Threshold Limits

Default value:	[0] Limits OK	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Clear the threshold limit warning when the threshold is at an acceptable level.

Option	Name	Description
[0]*	Limits OK	
[1]	Limits Exceeded	

5.35.6 45-5* Sensor Config.

Select the analog input for sensor and unit configuration.

45-50 Source

Default value:	[0] None	Parameter type:	Option, Array [4]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Select an analog input source for receiving sensor signals. Scaling of analog inputs is performed as defined in parameter group 6-**. **Analog In/Out.** For more information on parameter group 6-** **Analog In/Out**, refer to the drive-specific programming guide.

Option	Name	Description
[0]*	None	
[1]	Analog Input 53	
[2]	Analog Input 54	
[3]	Analog Input X30/11	
[4]	Analog Input X30/12	
[5]	Analog Input X42/1	

Option	Name	Description
[6]	Analog Input X42/3	
[7]	Analog Input X42/5	
[8]	Analog Input X48/2	
[9]	Analog Input X49/1	
[10]	Analog Input X49/3	
[11]	Analog Input X49/5	

Table 77: Parameter Index

Parameter ID	Description
45-50.0	Sensor 1 vibration configuration
45-50.1	Sensor 2 vibration configuration
45-50.2	Sensor 3 vibration configuration
45-50.3	Sensor 4 vibration configuration

45-51 Sensor 1 Unit

Default value:	[0] None	Parameter type:	Option, Array [4]
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use the parameter to set unit of monitoring signals from the sensor. The unit is specified on the vibration sensor.

Option	Name	Description
[0]*	None	
[1]	mm/s	
[2]	inch/s	
[3]	m/s2	
[4]	g	
[5]	bar	
[6]	psi	
[7]	Pa	
[8]	kPa	
[9]	MPa	
[10]	kg/cm2	
[11]	inHg	
[12]	m3/h	
[13]	US gpm	
[14]	l/h	
[15]	cfm	

Table 78: Parameter Index

Parameter ID	Description
45-50.0	Sensor 1 vibration configuration
45-50.1	Sensor 2 vibration configuration
45-50.2	Sensor 3 vibration configuration
45-50.3	Sensor 4 vibration configuration

5.35.7 45-6* Stator Res. Setting

45-60 Active Threshold

Default value:	2%	Parameter type:	0 - 100%
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Use this parameter to activate the resonance region supply imbalance control. Enter the threshold offset value from the baseline data.

45-61 Load Mode

Default value:	[0] Absolute	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]*	Absolute	Absolute value specified in parameter 45-33 Alarm High is considered as notification threshold.
[1]	Offset	Notification threshold is a sum of the computed baseline data and the offset values specified in parameter 45-33 Alarm High through parameter 45-38 Alarm Low .
[2]	Factor	Threshold limits is calculated as baseline data * factor value specified in parameter 45-33 Alarm High through parameter 45-38 Alarm Low .

45-62 Load Threshold

Default value:	Size related	Parameter type:	Range, 0 - 200%
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

45-63 Imbalance Limit

Default value:	0.50%	Parameter type:	Range, 0.05 - 10%
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

45-64 Imbalance Value

Default value:	0%	Parameter type:	Readout

Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual value of the supply imbalance.

45-65 DC-link Ripple Limit

Default value:	0.35%	Parameter type:	0.05 - 10%
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

When the motor output frequency matches the frequency of the DC-link voltage ripple, the threshold offset value activates.

45-66 DC-link Ripple Value

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

View the actual value of the DC-link voltage ripple.

5.35.8 45-8* Cavitation Config.

45-81 Signature Gain

Default value:	1.0	Parameter type:	Range, 0.1 - 10.0
Setup:	All setups	Conversion index:	0
Data type:	Uint8	Change during operation:	True

The cavitation signature varies depending on the pump type, size, and construction. Set a gain value for adjusting the magnitude of the cavitation signature. If the cavitation signature is higher than 10–20%, set a lower gain. Changing the gain requires repeating the baseline.

45-82 Filter Time Constant

Default value:	3.0 s	Parameter type:	0.1 - 25.0 s
Setup:	All setups	Conversion index:	-1
Data type:	Uint8	Change during operation:	True

The cavitation signature varies depending on pump type, size, and construction. Set a time constant for filtering the cavitation signature. If very dynamic cavitation signature occurs, select a high time constant value as it provides heavy filtering. Changing the time constant requires that the baseline is repeated.

45-83 Fluctuation Limits

Default value:	Size related	Parameter type:	Array [3]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Rapid changes in pump speed, load, or grid voltage magnitude can create false-positive events of cavitation. Set the limit for accepted fluctuation within speed, load, and grid. If the limit is exceeded, the cavitation detection function is put on hold until the fluctuation disappears.

Table 79: Parameter index

Parameter ID	Description
45-83.1	Speed fluctuation limits. Default value is 0.1.
45-83.2	Load fluctuation limits. Default value is 1.5.
45-83.3	Grid fluctuation limits. Default value is 3.0.

45-89 Cavitation [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Readout of cavitation signature, which indicates the level of turbulence in the pump. This value is used for baseline and monitoring.

5.35.9 45-9* Actual Readouts

The parameters in this group are readout parameters showing the actual monitoring values.

45-90 Stator [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual stator monitor value at motor output speed.

45-91 Load [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual load monitor value at motor output speed.

45-92 Sensor 1 [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual sensor 1 monitor value in % at motor output speed.

45-93 Sensor 1 [Unit]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter shows the actual sensor 1 monitor value in the selected unit at motor output speed.

45-94 Sensor 2 [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual sensor 2 monitor value in % at motor output speed.

45-95 Sensor 2 [Unit]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter shows the actual sensor 2 monitor value in the selected unit at motor output speed.

45-96 Sensor 3 [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual sensor 3 value in % at motor output speed.

45-97 Sensor 3 [Unit]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter shows the actual sensor 3 monitor value in the selected unit at motor output speed.

45-98 Sensor 4 [%]

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the actual sensor 4 monitor value in % at motor output speed.

45-99 Sensor 4 [Unit]

Default value:	0	Parameter type:	Readout
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

This parameter shows the actual sensor 4 monitor value in the selected unit at motor output speed.

5.36 Parameter Group 46-** CBM Adv. Thresholds

5.36.1 46-0* History

The parameters in this group hold threshold history, such as timestamps of the last modification.

46-00 Last Change Time

Default value:	Size related	Parameter type:	Readout, Array [7]
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows the time stamp of the latest modification to a notification threshold.

Table 80: Parameter Index

Index	Description
[0]	Threshold history of stator winding.
[1]	Threshold history of load envelope
[2]	Threshold history of sensor 1 vibration
[3]	Threshold history of sensor 2 vibration
[4]	Threshold history of sensor 3 vibration
[5]	Threshold history of sensor 4 vibration
[6]	Threshold history of cavitation

5.36.2 46-0* General

46-07 Monitoring Min Speed

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter monitors the minimum speed as defined in parameter *45-45 Threshold Generation*.

46-08 Monitoring Max Speed

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter monitors the maximum speed as defined in parameter *45-45 Threshold Generation*.

46-09 Monitoring Speeds

Default value:	0 RPM	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	67
Data type:	Int32	Change during operation:	True

This parameter shows the 20 speed points in RPM. By default, the baseline minimum speed is considered.

5.36.3 46-1* Timing

46-10 Alarm Time

Default value:	10 s	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the time in seconds to define the duration during which the alarm is not triggered. When the value which is monitored exceeds or falls below the alarm threshold for more than the time specified in the parameter, an alarm is triggered. Alarm time is the amount of time in seconds a monitoring state should be over the alarm threshold before triggering an alarm.

Table 81: Parameter Index

Parameter ID	Description
46-10.0	Timing of stator winding
46-10.1	Timing of load envelope
46-10.2	Timing of sensor 1 vibration
46-10.3	Timing of sensor 2 vibration
46-10.4	Timing of sensor 3 vibration
46-10.5	Timing of sensor 4 vibration
46-10.6	Timing of cavitation

46-11 Warning S2 Time

Default value:	10 s	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the time in seconds to define the duration during which the warning S2 is not triggered. When the value which is monitored exceeds or falls below the warning S2 threshold for more than the time specified in the parameter, a warning S2 is triggered.

Table 82: Parameter Index

Parameter ID	Description
46-11.0	Timing of stator winding
46-11.1	Timing of load envelope
46-11.2	Timing sensor 1 vibration
46-11.3	Timing sensor 2 vibration
46-11.4	Timing sensor 3 vibration
46-11.5	Timing sensor 4 vibration
46-11.6	Timing of cavitation

46-12 Warning S1 Time

Default value:	10 s	Parameter type:	Array [7]
Setup:	All setups	Conversion index:	-2
Data type:	Uint32	Change during operation:	True

Set the time in seconds to define the duration during which the warning S1 is not triggered. When the value, which is monitored, exceeds or falls below the warning S1 threshold for more than the time specified in the parameter, a warning S1 is triggered.

Table 83: Parameter Index

Parameter ID	Description
46-12.0	Timing of stator winding
46-12.1	Timing of load envelope
46-12.2	Timing of sensor 1 vibration
46-12.3	Timing of sensor 2 vibration
46-12.4	Timing of sensor 3 vibration
46-12.5	Timing of sensor 4 vibration
46-12.6	Timing of cavitation

46-13 Interpolation Type

Default value:	[0] Linear	Parameter type:	Option, Array [7]
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Set the type of interpolation parameter to construct accurate speed points.

Option	Name	Description
[0]*	Linear	Select this option for stator and load monitoring.
[1]	Staircase	Select this option for vibration monitoring.

Table 84: Parameter Index

Parameter ID	Description
46-13.0	Interpolation type of stator winding
46-13.1	Interpolation type of load envelope
46-13.2	Interpolation type of sensor 1 vibration
46-13.3	Interpolation type of sensor 2 vibration
46-13.4	Interpolation type of sensor 3 vibration
46-13.5	Interpolation type of sensor 4 vibration
46-13.6	Interpolation type of cavitation

5.36.4 46-2* Stator

46-20 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Set the threshold value which defines a high alarm for stator monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high alarm is triggered. The parameter contains 20 index values to manually configure Stator Winding Monitoring Alarm High Threshold for each individual speed point.

46-21 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a warning S2 alarm for stator monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S2 time, a high warning S2 is triggered. The parameter contains 20 index values to manually configure Stator Winding Monitoring Warning S2 High Threshold for each individual speed point.

46-22 Stator Warning S1

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a high warning S1 for stator monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S1 time, a high warning S1 is triggered. The parameter contains 20 index values which can be used to manually configure Stator Winding Monitoring Warning S1 High Threshold for each individual speed point.

46-23 Resonance Active

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

46-24 Resonance Load

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

5.36.5 46-3* Load

Use the parameters in this group to enter, adjust, and display threshold values for load envelope monitoring function.

46-30 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a high alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high alarm is triggered. The parameter contains 20 index values which can be used to manually configure Load Alarm High Threshold for each individual speed point.

46-31 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2

Data type:	UInt16	Change during operation:	True

Set the threshold value which defines a high warning S2 for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S2 time, a warning S2 high is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S2 High Threshold for each individual speed point.

46-32 Warning S1 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Set the threshold value which defines a high warning S1 for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S1 time, a high warning S1 is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S1 High Threshold for each individual speed point.

46-33 Warning S1 Low

Default value	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Set the threshold value which defines a low S1 warning for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S1 time, a low S1 warning is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S1 Low Threshold for each individual speed point.

46-34 Warning S2 Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Set the threshold value which defines a low S2 warning for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in warning S2 time, a low S2 warning is triggered. The parameter contains 20 index values which can be used to manually configure Load Warning S2 Low Threshold for each individual speed point.

46-35 Alarm Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Load Alarm Low Threshold for each individual speed point.

5.36.6 46-4* Sensor 1

Use the parameters in this group to enter, adjust, and display threshold values for Sensor 1 monitoring function.

46-40 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 1 Alarm High Threshold for each individual speed point.

46-41 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 1 Warning S2 High Threshold for each individual speed point.

46-42 Warning S1 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 1 Warning S2 High Threshold for each individual speed point.

46-43 Warning Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

46-44 Alarm Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

5.36.7 46-5* Sensor 2

Use the parameters in this group to enter, adjust, and display threshold values for Sensor 2 monitoring function.

46-50 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Alarm High Threshold for each individual speed point.

46-51 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Warning S2 High Threshold for each individual speed point.

46-52 Warning S1 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Alarm High Threshold for each individual speed point.

46-53 Warning Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

46-54 Alarm Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

5.36.8 46-6* Sensor 3

Use the parameters in this group to enter, adjust, and display threshold values for Sensor 3 monitoring function.

46-60 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a low alarm for load envelope monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a low alarm is triggered. The parameter contains 20 index values which can be used to manually configure Vibration 2 Alarm High Threshold for each individual speed point.

46-61 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a warning S2 notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a warning S2 high is triggered. The parameter contains 20 index values which can be used to manually configure warning S2 high threshold for each individual speed point.

46-62 Warning S1 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a warning stage 1 high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high warning is triggered. The parameter contains 20 index values which can be used to manually configure Warning S1 High Threshold for each individual speed point.

46-63 Warning Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

46-64 Alarm Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

5.36.9 46-7* Sensor 4

Use the parameters in this group to enter, adjust, and show threshold values for Sensor 4 monitoring function.

46-70 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a alarm high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high alarm is triggered. The parameter contains 20 index values which can be used to manually configure alarm high threshold for each individual speed point.

46-71 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a warning stage 2 high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high warning is triggered. The parameter contains 20 index values which can be used to manually configure Warning stage 2 high threshold for each individual speed point.

46-72 Warning S1 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Set the threshold value which defines a warning stage 1 high notification for monitoring. When the value of the monitored value exceeds the threshold specified in the parameter for the duration of time specified in alarm time, a high warning is triggered. The parameter contains 20 index values which can be used to manually configure warning stage 1 high threshold for each individual speed point.

46-73 Warning Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

46-74 Alarm Low

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

5.36.10 46-8* Cavitation

46-80 Alarm High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Upper threshold limit for cavitation monitoring at each monitoring speed points. An alarm high notification is issued if the threshold is exceeded.

46-81 Warning S2 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Upper threshold limit for cavitation monitoring at each monitoring speed points. A warning S2 high notification is issued if the threshold is exceeded.

46-82 Warning S1 High

Default value:	0%	Parameter type:	Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Upper threshold limit for cavitation monitoring at each monitoring speed points. A warning S1 high notification is issued if the threshold is exceeded.

5.37 Parameter Group 47-** CBM Baseline Data

5.37.1 47-0* History

The parameters in this group hold the baseline history of start and stop timestamps of the active and previous baseline.

47-00 Actual Start Time

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows a timestamp of when the actual baseline capturing was started.

47-01 Actual Time Stop

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows a timestamp of when the actual baseline capturing was stopped.

47-02 Previous Start Time

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows a timestamp of when the previous baseline capturing was started.

47-03 Previous Stop Time

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	True

This parameter shows a timestamp of when the previous baseline capturing was stopped.

5.37.2 47-0* Speeds

The parameters in this group show the baseline speed points of active and previous baseline data.

47-04 Actual Speed

Default value:	0 RPM	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	67
Change during operation:	True		

This parameter shows the baseline speed points of the actual baseline data captured.

47-05 Previous Speed

Default value:	0 RPM	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter shows the baseline speed points of the previous baseline data captured.

5.37.3 47-0* Stator

47-06 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the maximum stator winding readings for the active baseline.

47-07 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the mean and 3 standard deviations of stator winding readings for the active baseline.

47-08 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the average of stator winding readings for the active baseline.

47-09 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the minimum value of motor stator windings for active baseline.

47-10 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the active minutes to capture monitoring values for speed points.

47-11 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the maximum stator winding readings for the previous baseline.

47-12 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the mean and 3 standard deviations of stator winding readings for the previous baseline.

47-13 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

This parameter shows the average of stator winding readings for the previous baseline.

47-14 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]

Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

The parameter shows the minimum value of motor stator windings for previous baseline.

47-15 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the previous minutes to capture monitoring values for speed points.

5.37.4 47-1* Stator Res. Active

47-16 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the active stator resistance.

47-17 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of stator resistance readings for the active baseline.

47-18 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

Shows the mean of stator resistance recordings for active load in the active baseline.

47-19 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

Shows the minimum of all stator resistance recordings for active load in the active baseline.

47-20 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum stator resistance readings for the previous baseline.

47-21 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of stator resistance readings for the previous baseline.

47-22 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of stator resistance readings for the previous baseline.

47-23 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of motor stator resistance for previous baseline.

5.37.5 47-2* Stator Res. Load

47-24 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum load dependent stator resonance. An indexed parameter with 20 pointers showing stator resonance load recordings from minimum to maximum.

47-25 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average and standard deviation of the stator resonance load recordings for the active baseline.

47-26 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of the stator resonance load recordings for the active baseline.

47-27 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the minimum value of the stator resonance load recordings for the active baseline.

47-28 Previous Max

Default value:	0%	Parameter Type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum stator resonance readings for the previous baseline.

47-29 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of stator resonance readings for the previous baseline.

47-30 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of stator resonance readings for the previous baseline.

47-31 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of motor stator resonance for the previous baseline.

5.37.6 47-3* Load

47-32 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum positive load envelope recordings for the active baseline. An indexed parameter with 20 pointers of positive load envelope recordings with minimum to maximum.

47-33 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the active mean and 3 standard deviation of load envelope recordings for active baseline.

47-34 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the active mean of load envelope recordings for the active baseline.

47-35 Actual Mean - 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the active mean minus 3 standard deviation of load envelope recordings for the active baseline.

47-36 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the minimum value of load envelope recordings for the active baseline.

47-37 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the active minutes to capture monitoring values for load envelope.

47-38 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum value for load envelope readings for the previous baseline.

47-39 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2

Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of load envelope readings for the previous baseline.

47-40 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of load envelope readings for the previous baseline.

47-41 Previous Mean - 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean minus 3 standard deviations of load envelope readings for the previous baseline.

47-42 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of load envelope for the previous baseline.

47-43 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the previous minutes to capture monitoring values for load envelope.

5.37.7 47-4* Sensor 1

47-44 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-45 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-46 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average value of recordings from vibration sensors for the active baseline.

47-47 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the minimum value of recordings from vibration sensors for the active baseline.

47-48 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the active minutes to capture monitoring values for Sensor 1.

47-49 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum value for Sensor 1 readings for the previous baseline.

47-50 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of Sensor 1 readings for the previous baseline.

47-51 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of Sensor 1 readings for the previous baseline.

47-52 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]

Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of Sensor 1 for the previous baseline.

47-53 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the previous minutes to capture monitoring values for Sensor 1.

5.37.8 47-5* Sensor 2

47-54 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-55 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-56 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

Shows the average value of recordings from vibration sensors for active baseline.

47-57 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the minimum value of recordings from vibration sensors for active baseline.

47-58 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the active minutes to capture monitoring values for Sensor 2.

47-59 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum value for Sensor 2 readings for the previous baseline.

47-60 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of Sensor 2 readings for the previous baseline.

47-61 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of Sensor 2 readings for the previous baseline.

47-62 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of Sensor 2 for the previous baseline.

47-63 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the previous minutes to capture monitoring values for Sensor 2.

5.37.9 47-6* Sensor 3

47-64 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-65 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-66 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

Shows the average value of recordings from vibration sensors for active baseline.

47-67 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the minimum value of recordings from vibration sensors for active baseline.

47-68 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the active minutes to capture monitoring values for Sensor 3.

47-69 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum value for Sensor 3 readings for the previous baseline.

47-70 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of Sensor 3 readings for the previous baseline.

47-71 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2

Data type:	Uint16	Change during operation:	False

This parameter shows the average of Sensor 3 readings for the previous baseline.

47-72 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of Sensor 3 for the previous baseline.

47-73 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the previous minutes to capture monitoring values for Sensor 3.

5.37.10 47-7* Sensor 4

47-74 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum recordings from vibration sensors for the active baseline.

47-75 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average and 3 standard deviations for upper threshold of recordings from vibration sensors for active baseline.

47-76 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

Shows the average value of recordings from vibration sensors for active baseline.

47-77 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the minimum value of recordings from vibration sensors for active baseline.

47-78 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the active minutes to capture monitoring values for Sensor 4.

47-79 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the maximum value for Sensor 4 readings for the previous baseline.

47-80 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the mean and 3 standard deviations of Sensor 4 readings for the previous baseline.

47-81 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average of Sensor 4 readings for the previous baseline.

47-82 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of Sensor 4 for the previous baseline.

47-83 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the previous minutes to capture monitoring values for Sensor 4.

5.37.11 47-8* Cavitation

47-84 Actual Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the maximum value of the actual baseline statistical data captured for cavitation values.

47-85 Actual Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the mean + 3 times standard deviation value of the actual baseline statistical data captured for cavitation values.

47-86 Actual Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the mean value of the actual baseline statistical data captured for cavitation values.

47-87 Actual Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the minimum value of the actual baseline statistical data captured for cavitation values.

47-88 Actual Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the online baseline count for the actual baseline data for cavitation values.

47-89 Previous Max

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the maximum value of the previous baseline statistical data captured for cavitation values.

47-90 Previous Mean + 3 Std. Dev.

Default value:	0%	Parameter type:	Readout, Array [20]

Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the mean + 3 standard deviation value of the previous baseline statistical data captured for cavitation values.

47-91 Previous Mean

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter shows the mean value of the previous baseline statistical data captured for cavitation values.

47-92 Previous Min

Default value:	0%	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

The parameter displays the minimum value of the previous baseline statistical data captured for cavitation values.

47-93 Previous Counter

Default value:	0	Parameter type:	Readout, Array [20]
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	False

The parameter shows the online baseline for the previous baseline data for cavitation values.

5.37.12 47-9* Min Max Speed

47-95 Actual Min Speed

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter shows the minimum speed of the actual baseline data.

47-96 Actual Max Speed

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter shows the maximum speed of the actual baseline data.

47-97 Previous Min Speed

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter shows the minimum speed of the previous baseline data.

47-98 Previous Max Speed

Default value:	0 RPM	Parameter type:	Readout
Setup:	All setups	Conversion index:	67
Data type:	Uint16	Change during operation:	True

This parameter shows the maximum speed of the previous baseline data.

5.38 Parameter Group 48-** CBM Applications

5.38.1 48-0* Cavitation Control

48-00 Function

Default value:	[0] Disabled	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Use cavitation control to lower the pump speed if a cavitation warning appears. For standalone operation, set the parameter manually. For remote operation, set the parameter via fieldbus.

Option	Name	Description
[0]*	Disabled	This selection disables cavitation control.
[1]	Enabled	This selection enables cavitation control.

48-01 Status

Default value:	[0] Disabled - local	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

This parameter shows the status of the cavitation controller.

Table 85: Parameter Index

ID	Status value	Description
[0]	Disabled - local	The cavitation control is disabled by a local command via the LCP or MCT 10.
[1]	Disabled - remote	The cavitation control is disabled by a remote command via fieldbus.
[2]	Enabled - local ref.	The cavitation control is enabled. The drive in hand-on mode and follows the local speed reference as there is no cavitation detected yet.
[3]	Enabled - remote ref.	The cavitation control is enabled. The drive is in auto-on mode and follows the remote speed reference as there is no cavitation detected yet.
[5]	Standby - drive coasted	The cavitation control is on standby as the drive is coasted. The algorithm re-enables itself automatically when the drive is back in normal operation.

Table 85: Parameter Index - (continued)

ID	Status value	Description
[6]	Standby - drive standby	The cavitation control is on standby as the drive is in standby state. The algorithm re-enables itself automatically when the drive is back in normal operation.
[7]	Standby - drive off	The cavitation control is on standby as the drive is in off state. The algorithm re-enables itself automatically when the drive is back in normal operation.
[8]	Standby - drive alarm	The cavitation control is on standby due to various alarms. The algorithm re-enables itself automatically when the drive is back in normal operation.
[9]	Standby - BL running	The cavitation control is disabled for the entire duration of the baseline. Allow baseline to finish correctly and perform a proper threshold generation for cavitation. The cavitation control re-enables itself automatically when the drive is back in normal operation.
[10]	Standby - not in cavit ctrl range	The actual speed is outside the range allowed for cavitation control, which puts the cavitation control in standby. Resolution: The algorithm re-enables itself automatically when the actual speed returns to its baseline range. Alternatively, check if the limits in the following parameters are set correctly: - Parameter 48-05 Minimum Speed [RPM]/parameter 48-06 Minimum Speed [Hz]. - Parameter 4-11 Motor Speed Low Limit [RPM]/parameter 4-12 Motor Speed Low Limit [Hz]. - Parameter 3-02 Minimum Reference. - Parameter 45-26 CBM Baseline Min Speed.
[11]	Standby - not in BL speed range	The actual speed is outside of the baseline speed range, which puts cavitation control on standby due to lack of cavitation data. Resolution: The algorithm re-enables itself automatically when the actual speed returns into its baseline range. Alternatively, check if the limits in the following parameters are set correctly: - Parameter 48-05 Minimum Speed [RPM]/parameter 48-06 Minimum Speed [Hz]. - Parameter 4-11 Motor Speed Low Limit [RPM]/parameter 4-12 Motor Speed Low Limit [Hz]. - Parameter 3-02 Minimum Reference. - Parameter 45-26 CBM Baseline Min Speed.
[12]	Standby - other priority task	The application is under an operating condition which requires another function of a higher priority to take control of the pump, for example, jogging, deragging, and dry run. This forces the cavitation control into standby mode. The algorithm re-enables itself automatically when the drive returns to normal operation.

Table 85: Parameter Index - (continued)

ID	Status value	Description
[13]	Ramp down - cavit. detected	Cavitation control lowers the speed because of detecting cavitation. The speed decreases according to parameter 48-02 Step Change in Speed . The LCP indicates that the speed reference is controlled by cavitation control. Resolution: Verify the reasons for cavitation warnings.
[14]	Ramp up - no cavit.	Cavitation control sets the speed towards the actual speed reference since cavitation is no longer present. The actual speed reference can be local or remote. The speed increases according to parameter 48-02 Step Change in Speed . The LCP indicates that the speed reference is still controlled by cavitation control. Resolution: Allow sufficient time for cavitation control to reach its actual speed reference.
[15]	At min speed - cavit. detected	Cavitation control reached its minimum allowed speed while cavitation is still present. The cavitation remains at this value for the time that cavitation persists. The LCP indicates that the speed reference is controlled by cavitation control. Resolution: Verify the reasons for cavitation warnings. Alternatively, check if the speed limit is set correctly.
[16]	At no return speed	Cavitation control avoided cavitation by lowering the speed and stays at the actual speed because parameter 48-04 Return to Reference is set to [0] No . The LCP indicates that the speed reference is controlled by cavitation control. Resolution: Verify the reasons for cavitation warnings. Alternatively, check if the parameter is set correctly.

48-02 Step Change in Speed

Default value:	3%	Parameter type:	Range, 0.1 - 20%
Setup:	All setups	Conversion index:	-1
Data type:	UInt8	Change during operation:	True

Set the value of the speed change which the cavitation control performs at each step time. The value is defined in percent of the motor nominal speed set in parameter **1-25 Motor Nominal Speed**.

48-03 Step Time

Default value:	15 s	Parameter type:	Range, 1 - 600 s
Setup:	All setups	Conversion index:	0
Data type:	UInt16	Change during operation:	True

Set the discrete periodical control time of the cavitation control. The value must be equal to or greater than any of the timers defined in parameter **46-12.6 Warning S1 Time** or parameter **46-11.6 Warning S2 Time**.

48-04 Return to Reference

Default value:	[1] Yes	Parameter type:	Option
Setup:	All setups	Conversion index:	–

Data type:	UInt8	Change during operation:	True

Select if the cavitation control should remain at the last speed reference that avoided the cavitation, or if it should gradually return to the actual speed reference while continuously checking that the cavitation has disappeared.

Option	Name	Description
[0]	No	With this selection, cavitation control does not return to the actual speed reference, but remains at the last speed reference that avoided the cavitation.
[1]*	Yes	This selection, the cavitation control gradually returns to the actual speed reference.

48-05 Minimum Speed [RPM]

Default value:	Size related	Parameter type:	Range, par. 4-11 - par. 4-13 RPM
Setup:	All setups	Conversion index:	67
Data type:	UInt16	Change during operation:	True

Specify the minimum RPM limit for cavitation control to regulate the speed reference. This value must not be lower than any of the following:

- Parameter *4-11 Motor Speed Low Limit [RPM]*
- Parameter *3-02 Minimum Reference*
- Parameter *45-26 CBM Baseline Min Speed*

48-06 Minimum Speed [Hz]

Default value:	Size related	Parameter type:	Range, Par. 4-12 - par. 4-14
Setup:	All setups	Conversion index:	-1
Data type:	UInt16	Change during operation:	True

Specify the minimum Hz limit for cavitation control to regulate the speed reference. This value must not be lower than any of the following:

- Parameter *4-12 Motor Speed Low Limit [Hz]*
- Parameter *3-02 Minimum Reference*
- Parameter *45-26 CBM Baseline Min Speed*

5.39 Parameter Group 49-** CBM Sine Wave Filter

5.39.1 49-0* Cockpit: Monitoring

Use the parameters in this group for configuring and providing overall status of the sine-wave filter monitoring functions.

49-00 Autonomous Function

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Autonomous monitoring function for CBM-SWF. Select **[1] Warning** or **[2] Alarm & warning** notification to start the monitoring of the sine-wave filter.

For manual testing and immediate, on-demand measurements (bypassing the default 2-day waiting period), toggle this parameter from **[1] Warning** or **[2] Alarm and warning** to **[0] Off** and then back to the original option.

Option	Name	Description
[0]	Off	
[1]	Warning	
[2]	Alarm & warning	

49-01 Autonomous Status

Default value:	[0] Disabled	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False

This parameter shows the status of the monitoring function.

Index	Name	Description
[0]*	Disabled	The autonomous monitoring function is disabled. There is no check of the SWF capacitors.
[1]	Ready - latest available	Measurement is done successfully, and the latest results are available for readout.
[2]	Measurement in progress	Measurement is in progress. Notification and data will be available shortly.
[3]	Waiting for new measurement	The result of the latest measurement requires further verification. A new measurement will start at the time set in parameter 49-03 Next Measurement .
[4]	Standby - baseline in progress	Baseline is in progress and monitoring cannot be enabled. Allow the baseline to finish before enabling monitoring.
[5]	Standby - voltage limit	The voltage limit is reached, which temporarily stops the capacitor measurement. The algorithm re-enables itself when getting inside the normal voltage range allowed for measurement.
[6]	Standby - speed out of range	The speed limit is reached, which temporarily stops the measurement. The allowed speed range is 1.5 Hz to 1.1 times the nominal frequency. The algorithm re-enables itself automatically when getting inside the normal speed range allowed for measurement.
[7]	Standby - after alarm reset	Any alarm or reset of the drive stops the autonomous monitoring immediately and stays on hold until the alarm clears. The algorithm re-enables itself automatically. Wait until the alarm clears, then check the drive and sine-wave filter for faults.
[8]	Standby - manual interrupt local	The current measurement is manually stopped while the drive is configured to use local reference from LCP. Re-enable the autonomous function.

Index	Name	Description
[9]	High Dynamic Loading	Monitoring is temporarily on hold due to too high dynamical changes of the speed or loading. The algorithm re-enables itself automatically when normal conditions are established.
[10]	Communication failed	Monitoring is temporarily on hold due to internal communication errors. Re-enable the autonomous function. If it is not successful, contact support.
[11]	Capacitor disconnect on all phases	The monitoring detected a connection problem with all 3 SWF capacitors and it temporarily on hold. The algorithm runs again to check the capacitance at the time set in parameter 49-03 Next Measurement . Check if the sine-wave filter components are disconnected or damaged.
[12]	Baseline data not available	Baseline data is missing, thus monitoring is not allowed to start. Perform a new baseline.
[13]	Capacitor disconnected on phase U	The monitoring detected a connection problem, either with the capacitor or inductor of a given phase and is temporarily on hold. The algorithm runs again to check the capacitance at the time set in parameter 49-03 Next Measurement . Check if the sine-wave filter components are disconnected or damaged.
[14]	Capacitor disconnected on phase V	Same description as [13] Capacitor disconnected on phase U .
[15]	Capacitor disconnected on phase W	Same description as [13] Capacitor disconnected on phase U .
[16]	Upper measurement limit exceeded on phase U	The monitoring detected that the measurement of a given phase falls outside of the higher limit of the measurement range. The algorithm runs again to check the capacitance measurement at the time set in parameter 49-03 Next Measurement . Check if capacitors are disconnected or damaged. Alternatively, set the operation point of the drive at a lower loading current. Another alternative is to increase parameter 49-15 Frequency Sweep Max to a higher value, for example, 1800 Hz. Then start a new baseline.
[17]	Upper measurement limit exceeded on phase V	Same description as [16] Upper measurement limit exceeded on phase U .
[18]	Upper measurement limit exceeded on phase W	Same description as [16] Upper measurement limit exceeded on phase U .
[19]	Lower measurement limit exceeded on phase U	The monitoring detected that the measurement of a given phase falls outside of the lower limit of the measurement range. The algorithm runs again to check the capacitance measurement at the time set in parameter 49-03 Next Measurement . Check if the capacitors are disconnected or damaged. Alternatively, set the operation point of the drive at a higher loading current. Another alternative is to decrease parameter 49-14 Frequency Sweep Min at a lower value, for example, 150 Hz. Then start a new baseline.
[20]	Lower measurement limit exceeded on phase V	Same description as [19] Lower measurement limit exceeded on phase U .
[21]	Lower measurement limit exceeded on phase W.	Same description as [19] Lower measurement limit exceeded on phase U .
[22]	Upper measurement limit exceeded on all phases	Same description as [16] Upper measurement limit exceeded on phase U .

Index	Name	Description
[23]	Lower measurement limit exceeded on all phases.	Same description as [19] Lower measurement limit exceeded on phase U .
[24]	Motor is not connected	The motor is not connected, and monitoring is temporarily set on hold. The drive is kept in operation without any other action. It can also happen for low drive current, for example, during AEO. Check and reconnect the motor cable and restart the application. Alternatively, allow the drive current to increase.
[25]	Standby - AMA	Measurement is on hold while AMA is running. Measurement resumes once AMA is completed.
[26]	Standby - kinetic backup	Measurement is on hold during kinetic backup. Measurement resumes once kinetic backup is completed.
[27]	Standby - mains failure	Measurement is on hold during mains failure. Measurement resumes once the mains failure is resolved.
[28]	Standby - stall limit	Measurement is on hold during stall limit. Resumes measurement once the stall limit is resolved.
[29]	Standby - active power derate	Measurement is on hold during active power derate. Measurement resumes after power derate.
[30]	Communication timeout	Measurement is halted due to an error that occurred internally. The algorithm restarts measurement at the time set in parameter 49-03 Next Measurement .
[31]	Standby - drive OFF state	Measurement is on hold as the drive is in OFF state. Start the drive with the specified speed range.
[32]	Standby - drive in standby state	Measurement is on hold as the drive is in standby state. Enable [Start] digital output pin and run the drive the specified speed range.
[33]	Standby - manual interrupt remote	Current measurement is manually stopped via fieldbus by a remote reference. Re-enable the autonomous function in parameter 49-00 Autonomous Function .
[34]	Standby - drive in coast state	Measurement is on hold due as the drive is in coast state. Start the drive with the specified speed range.

49-02 Autonomous Capacitance Value

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	False

This parameter shows the latest lowest value of U, V, W phase capacitance in percentage of parameter **49-13 Baseline Capacitance Value**.

49-03 Next Measurement

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

This parameter shows the next measurement time in the time-of-day format. The parameter is only valid if the date and time is set.

5.39.2 49-1* Baseline Settings

Use the parameters in this group for configuring how to capture baseline data. Progress and status are provided in readout parameters.

49-10 Baseline Generate

Default value:	–	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

Option	Name	Description
[0]	Baseline off	No baselining is taking place.
[1]	Baseline start	Select this option to start the initial baseline measurement of the sine-wave filter.

49-11 Baseline Status

Default value:	[0] Not started	Parameter type:	Readout
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	True

This parameter shows the status of the baseline monitoring function.

Index	Name	Description
[0]*	Not started	Baseline is not yet performed, and there is no data available to start any monitoring.
[1]	Baseline running	Baseline has started to run at the selected speed and current. After all steps are successfully completed, data is saved into EEPROM. If the baseline fails, details are available in the status code via the LCP or VLT® Motion Control Tool MCT 10.
[2]	Baseline completed	Baseline is successfully completed, and data is available for use. Monitoring can be enabled.
[3]	BL fail - no connection all phases	The capacitor of a given phase is disconnected from the sine-wave filter. Check the filter capacitors or their connection and replace if needed.
[4]	BL fail - no connection U phase	Same description as [3] BL fail - no connection all phases .
[5]	BL fail - no connection V phase	Same description as [3] BL fail - no connection all phases .
[6]	BL fail - no connection W phase	Same description as [3] BL fail - no connection all phases .
[7]	BL fail - manual interrupt remote	The baseline process is remotely stopped. Restart the baseline to get capacitance data.
[8]	BL fail - alarm	An alarm occurred during baseline. Check for correct installation of the drive and its settings and restart the baseline.
[9]	BL fail - time out	The baseline step is not able to get data in due time. Check for correct drive settings and restart the baseline.
[10]	BL fail - low capacitance in U phase	The capacitor of the given phase is lower than 50% of the nameplate value and is considered abnormal to continue the baseline. Check for correct installation of the sine-wave filter. Measure and replace capacitors if needed and restart the baseline.

Index	Name	Description
[11]	BL fail - low capacitance in V phase	Same description as [10] BL fail - low capacitance in U phase .
[12]	BL fail - low capacitance in W phase	Same description as [10] BL fail - low capacitance in U phase .
[13]	BL fail - state B comm fail	This is an internal drive error regarding communication between processors. Check for correct settings of the drive and restart the baseline.
[14]	BL fail - others	This is an internal drive error. Check for correct settings of the drive and restart the baseline.
[15]	BL fail - upper measurement limit exceeded on phase U	Measurement of a given phase is outside the higher limit of the measurement range. Check for correct installation of the sine-wave filter, measure and replace capacitors if needed. Alternatively, set the operation point of the drive at a lower loading current. Another alternative is to increase parameter 49-15 Frequency Sweep Max to a higher value, for example, 1800 Hz. Then restart the baseline.
[16]	BL fail - upper measurement limit exceeded on phase V	Same description as [15] BL fail - upper measurement limit exceeded on phase U .
[17]	BL fail - upper measurement limit exceeded on phase W	Same description as [15] BL fail - upper measurement limit exceeded on phase U .
[18]	BL fail - upper measurement limit exceeded on all phases	Same description as [15] BL fail - upper measurement limit exceeded on phase U .
[19]	BL fail - lower measurement limit exceeded on phase U	Measurement of a given phase is outside of the lower limit of the measurement range. Check for correct installation of the sine-wave filter, measure and replace capacitors if needed. Alternatively, set the operation point of the drive at a higher loading current. Another alternative is to decrease parameter 49-14 Frequency Sweep Minto to a lower value, for example, 150 Hz. Then restart the baseline.
[20]	BL fail - lower measurement limit exceeded on phase V	Same description as [19] BL fail - lower measurement limit exceeded on phase U .
[21]	BL fail - lower measurement limit exceeded on phase W	Same description as [19] BL fail - lower measurement limit exceeded on phase U .
[22]	BL fail - lower measurement limit exceeded on all phases	Same description as [19] BL fail - lower measurement limit exceeded on phase U .
[23]	BL fail - motor is not connected	The motor is not detected. The baseline stops without saving the data. It can also happen at low drive current, for example, during AEO. Check and reconnect the motor cable and restart the application. Alternatively, allow the drive current to increase by using higher loading. Restart the baseline.
[24]	BL fail - speed not in range	The speed is outside the specified range of 1.5 Hz to 110% nominal speed. Set the speed in the specified range and restart the baseline.
[25]	BL fail - RMS current variation	The drive current changed by more than 15% during baseline. The baseline repeats the measurement 3 times and stops if conditions still are not met. Set the load profile to fit the given interval and repeat the baseline.

Index	Name	Description
[26]	BL fail - Drive OFF state	The drive is in OFF state which does not allow the baseline to proceed. Start the drive in hand-on or auto-on mode within the specified speed range and restart the baseline.
[27]	BL fail - voltage limit	The drive output voltage reached the maximum voltage during the measurements. The baseline repeats the measurement 3 times and stops if conditions are still not met. Set the load profile to fit the given interval and repeat the baseline.
[28]	BL fail - high dynamic	The drive current changed rapidly during measurement. Set the load profile to fit the given interval and repeat the baseline.
[29]	BL fail - AMA running	The drive is running AMA. Disconnect SWF and run the drive to finish the AMA. When the AMA is complete, restart the baseline by connecting the SWF.
[30]	BL fail - k.backup	The drive is in kinetic backup mode. Allow the drive to finish the kinetic backup and restart the baseline.
[31]	BL fail - mains failure	Mains supply does not meet the conditions for drive operation. Restore the power supply to fulfill the normal operating conditions of the drive and restart the baseline.
[32]	BL fail - coast mode	The drive is in coast mode. Allow the drive to get out of coast mode and restart the baseline.
[33]	BL fail - stall protection	The drive is in stall mode. Allow the drive to finish stall mode and restart the baseline.
[34]	BL fail - active power derate	The drive is in active power derate mode. Allow the drive to finish the active power mode and restart the baseline.
[35]	BL fail - manual interrupt local	The baseline was interrupted manually via LCP or MCT 10. Restart the baseline to get capacitance data.
[36]	BL fail - state 1 comm fail	This is an internal drive error regarding communication between processors. Check for correct settings of the drive and try to start a new baseline.
[37]	BL fail - SWF not selected	The sine-wave filter option is not selected. If the drive starts with parameter 14-22 Operation Mode set to [2] Initialization after baseline completion, the baseline capacitance value shows incorrect data. Set parameter 14-55 Output Filter to either [1] Sine-wave filter or [2] Sine-wave filter fixed . Then set parameters 14-56 Capacitance Output Filter and 14-57 Inductance Output Filter to appropriate values before restarting the drive.
[38]	BL fail - motor type incorrect	The selected motor type is not supported. Set parameter 1-10 Motor Construction to [0] Asynchron .
[39]	BL fail - ctrl. principle incorrect	The selected motor control principle is not supported. Set parameter 1-01 Motor Control Principle to [1] VVC+ .

49-12 Baseline History

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

Time stamp of the baseline capture completion in the time-of-day format. The parameter is only valid if the date and time are set.

49-13 Baseline Capacitance Value

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	False

This parameter shows the average value of the U, V, and W phase capacitance captured during baseline measurement. The average value is shown as a percentage of parameter **14-56 Capacitance Output Filter**.

49-14 Frequency Sweep Min

Default value:	300 Hz	Parameter type:	Range, 100 - 1200 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

If the measurement fails with a **Lower measurement limit exceeded**, try to lower the minimum limit.

49-15 Frequency Sweep Max

Default value:	1600 Hz	Parameter type:	Range, Par. 49-14 - 2500 Hz
Setup:	All setups	Conversion index:	0
Data type:	Uint16	Change during operation:	True

If the measurement fails with an **Upper measurement limit exceeded**, try to increase the maximum limit.

49-18 SineWave Filter Type

Default value:	[0] Danfoss	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	Uint8	Change during operation:	False



NOTE: This parameter cannot be adjusted while the drive is running.

Select the filter connection type.

Option	Name	Description
[0]*	Danfoss	Use this option for Danfoss sine-wave filters.
[1]	Delta NonDanfoss	Use this option for sine-wave filters with delta-connected capacitors.
[2]	Star NonDanfoss	Use this option for sine-wave filters with star-connected capacitors.

5.39.3 49-2* Threshold Config.

Use the parameters in this group for configuring thresholds for warnings and alarms.

49-20 Warning S1 Threshold

Default value:	90%	Parameter type:	Range, 50 - 130%

Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the 1st warning threshold level, *Warning 541, SineWaveFilter*. The level for this warning must be higher than the level set in parameter **49-21 Warning S2 Threshold**.

49-21 Warning S2 Threshold

Default value:	85%	Parameter type:	Range, 50% - Par. 49-20 [%]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the 2nd warning threshold level, *Warning 531, SineWaveFilter S2*. The level for this warning must be higher than the level set in parameter **49-22 Alarm Threshold**.

49-22 Alarm Threshold

Default value:	75%	Parameter type:	Range, 50% - Par. 49-21 [%]
Setup:	All setups	Conversion index:	-2
Data type:	Uint16	Change during operation:	True

Enter the alarm threshold level where the drive should stop the application (*Alarm 541, SineWaveFilter*).

49-23 Warning S1 Time

Default value:	10 min	Parameter type:	Range, 0 - 180 min
Setup:	All setups	Conversion index:	70
Data type:	Uint32	Change during operation:	True

Set the monitoring delay trigger time for warning S1.

49-24 Warning S2 Time

Default value:	10 min	Parameter type:	Range, 0 - 180 min
Setup:	All setups	Conversion index:	70
Data type:	Uint32	Change during operation:	True

Set the monitoring delay trigger time for warning S2.

49-25 Alarm Time

Default value:	10 min	Parameter type:	Range, 0 - 180 min
Setup:	All setups	Conversion index:	70
Data type:	Uint32	Change during operation:	True

Set the monitoring delay trigger time for alarm.

49-26 Last Modified Time

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0

Data type:	TimeOfDay	Change during operation:	False

This parameter shows the last modified time of the thresholds in the time-of-day format. The parameter is only valid if the date and time are set.

5.39.4 49-3* Adv Monitoring Readouts 1

Use the parameters in this group to show monitoring capacitance data.

49-30 Readout Setting

Default value:	[0] Actual	Parameter type:	Option
Setup:	All setups	Conversion index:	–
Data type:	UInt8	Change during operation:	True

Select which readout configuration to use for updating the relative readouts in parameter group **49-3* Adv Monitoring Readouts 1**.

Option	Name	Description
[0]*	Actual	This setting represents the relative actual capacitance in respect to the baseline value.

49-31 Capacitance of Phase U

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	False

This parameter shows the capacitance of the U phase measured during monitoring.

49-32 Capacitance of Phase V

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	False

This parameter shows the capacitance of the V phase measured during monitoring.

49-33 Capacitance of Phase W

Default value:	0%	Parameter type:	Readout
Setup:	All setups	Conversion index:	-2
Data type:	UInt16	Change during operation:	False

This parameter shows the capacitance of the W phase measured during monitoring.

49-34 Measurement History

Default value:	Size related	Parameter type:	Readout
Setup:	All setups	Conversion index:	0
Data type:	TimeOfDay	Change during operation:	False

This parameter shows the last time stamp of capacitance measured in the time-of-day format. The parameter is only valid if the date and time are set.

5.40 Parameter Group 50-** License

50-00 License Installed

Default value:	0	Parameter type:	Readout, Array [3]
Setup:	All setups	Conversion index:	0
Data type:	VisStr[40]	Change during operation:	False

Shows all licenses activated in the drive.

50-01 License Code

Default value:	Size related	Parameter type:	Range, 0 - 19
Setup:	1 setup	Conversion index:	0
Data type:	VisStr[19]	Change during operation:	True

Enter the license code provided by the sales representative to activate licensed features in the drive. The license code comprises 16 alphanumeric characters in the format (XXXX-XXXX-XXXX-XXXX). When the license is accepted by the drive, the parameter is shown as 0000-0000-0000-0000.



NOTE: Restart the drive after entering the new license code. Parameters relevant for configuring the new feature(s) are now shown in the drive. The new type code is reflected in parameter **15-45 Actual Typecode String**. The original type code of the drive can be viewed in parameter **15-44 Ordered Typecode String**. The activated license is shown in parameter **50-00 License Installed**.

The license code can also be set from the factory.

5.41 Parameter Group 600-** PROFIsafe

600-00 Velocity Reference Value

Default value:	1500.000 ReferenceFeedbackUnit	Parameter type:	Range, -999999.999 - 999999.999 ReferenceFeedbackUnit
Setup:	All setups	Conversion index:	-3
Data type:	Int32	Change during operation:	True

The velocity reference sets the speed value for 100% for N2/N4 normalized speed signals.

6 Troubleshooting

6.1 Status Messages

6.1.1 Warnings and Alarms

A warning or an alarm is signaled by the relevant indicator light on the front of the drive and indicated by a code on the display.

A warning remains active until its cause is no longer present. Under certain circumstances, operation of the motor may still be continued. Warning messages may be critical, but are not necessarily so.

In the event of an alarm, the drive trips. Reset the alarm to resume operation once the cause has been rectified.

3 ways to reset:

- Press *[Reset]*.
- Via a digital input with the reset function.
- Via serial communication/optional fieldbus.



NOTE: After a manual reset pressing *[Reset]*, press *[Auto On]* to restart the motor.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip locked.

Alarms that are trip locked offer extra protection, meaning that the mains supply must be switched off before the alarm can be reset. After being switched back on, the drive is no longer blocked and can be reset once the cause has been rectified.

Alarms that are not trip locked can also be reset using the automatic reset function in parameter **14-20 Reset Mode** (Warning: Automatic wake up is possible.)

If a warning or alarm is marked against a code in the alarm/warning code list, this means that either a warning occurs before an alarm, or it is possible to specify whether a warning or an alarm should be shown for a given fault.

This is possible, for instance, in parameter **1-90 Motor Thermal Protection**. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash. Once the problem has been rectified, only the alarm continues flashing until the drive is reset.



NOTE: No missing motor phase detection (numbers 30-32) and no stall detection are active when parameter **1-10 Motor Construction** is set to *[1] PM non-salient SPM*.

6.1.2 Alarm/Warning Code List



NOTE: If more selections are marked as default, it indicates that the warning changes to an alarm after a certain time.

- X = Default
- (X) = Possible selection
- – = Not relevant

Table 86: Alarm/Warning Code List

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling</i> . Critical alarms cause a trip			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
1	10 volts low	X	–	–	Parameter 14-90.0 Fault Level	Ignored	Ignored	Warning	–
2	Live zero error	(X)	(X)	–	Parameter 6-01 Live Zero Timeout Function , Parameter 6-02 Fire Mode Live Zero Timeout Function	Ignored	Ignored	(Warning/ Trip)	–
3	No motor	(X)	–	–	Parameter 1-80 Function at Stop	Ignored	Ignored	(Warning/ Trip)	–
4	Mains ph. loss	(X)	(X)	(X)	Parameter 14-12 Response to Mains Imbalance	Ignored	Ignored	(Warning/ Trip)	X
5	DC voltage high	X	–	–	–	Ignored	Ignored	Warning	–
6	DC voltage low	X	–	–	–	Ignored	Ignored	Warning	–
7	DC overvolt	X	X	–	–	Trip+Reset	Trip	Warning/ Trip	–
8	DC undervolt	X	X	–	–	Trip+Reset	Trip	Warning/ Trip	–
9	Inverter overld.	X	X	–	Alternatively, parameter 14-61 Function at Inverter Overload can be set to [0] De- rate	Ignored	Ignored	Warning/ Trip	X
		X	–	–	Alternatively, parameter 14-90 Fault Settings can be set to [0] Off				

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in <i>parameter 24-09 Emergency Mode Alarm Handling</i> . Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
10	Motor ETR over	(X)	(X)	–	Parameter 1-90 Motor Thermal Protection	Ignored	Ignored	(Warning/Trip)	–
11	Motor th over	(X)	(X)	–	Parameter 1-90 Motor Thermal Protection	Ignored	Ignored	(Warning/Trip)	–
12	Torque limit	X	X	–	Parameter 14-90.6 Fault level and parameter 14-25 Trip Delay at Torque Limit	Ignored	Ignored	Warning/Trip	–
13	Overcurrent	X	X	X	Parameter 14-90 Fault Settings	Trip+Reset	Trip	Trip lock	–
14	Ground fault	X	X	X	Parameter 14-90.4 Fault Level	Trip+Reset	Trip	Trip	–
15	Incomp. HW	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
16	Short circuit	–	X	X	Parameter 14-90.8 Fault Level default is Trip Lock	Trip+Reset	Trip	Trip lock	–
17	Ctrl. word TO	(X)	(X)	–	Parameter 8-04 Control Word Timeout Function , default [0] Off	Ignored	Ignored	(Warning/Trip)	–
18	Start failed	–	X	–	–	Ignored	Ignored	Trip	–
20	Temp. input error	–	–	–	–	–	–	–	–
21	Param error	–	–	–	–	–	–	–	–
23	Internal fans	X	–	–	Parameter 14-53 Fan Monitor	Ignored	Ignored	(Warning/Trip)	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling</i> . Critical alarms cause a trip			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
24	External fans	X	–	–	Parameter 14-53 Fan Monitor	Ignored	Ignored	(Warning/ Trip)	–
25	Brake resistor	X	–	–	–	Ignored	Ignored		–
26	Brake over- load	(X)	(X)	–	Parameter 2-13 Brake Power Monitoring , default [0] Off	Ignored	Ignored	(Warning/ Trip)	–
27	Brake IGBT	X	X	–	–	Ignored	Ignored	Warning/ Trip	–
28	Brake check	(X)	(X)	–	Parameter 2-15 Brake Check	Ignored	Ignored	(Warning/ Trip lock)	–
29	Power mod- ule temp	–	–	X	Parameter 14-90.9 Fault Level	Ignored	Ignored	Trip lock	X
30	U phase loss	(X)	(X)	(X)	Alternatively, parameter 4-58 Missing Motor Phase Function can be set to [0] Disable .	Ignored	Ignored	Trip lock	–
		–	–	X	Parameter 14-90.16 Fault Level				
31	V phase loss	(X)	(X)	(X)	Alternatively, parameter 4-58 Missing Motor Phase Function can be set to [0] Disable .	Ignored	Ignored	Trip lock	–
		–	–	X	Parameter 14-90.16 Fault Level				

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in <i>parameter 24-09 Emergency Mode Alarm Handling</i> . Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
32	W phase loss	(X)	(X)	(X)	Alternatively, parameter 4-58 Missing Motor Phase Function can be set to [0] Disable .	Ignored	Ignored	Trip lock	–
		–	–	X	Parameter 14-90.16 Fault Level				
33	Inrush fault	–	X	X	–	Ignored	Ignored	Trip lock	X
34	Fieldbus fault	X	X	–	Parameter 14-90.27 Fault Level	Ignored	Ignored	Warning/ Trip	–
35	Option fault	–	–	–	–	Ignored	Ignored	Warning	–
36	Mains failure	X	X	–	Parameter 14-10 Mains Failure , default [0] Off	Ignored	Ignored	(Warning/ Trip)	–
37	Phase imbalance	–	X	–					
38	Internal fault	–	X	X	–	Ignored	Ignored	Trip/Trip lock	X
39	Heat sink sensor	–	X	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	X
40	Overload T27	(X)	–	–	Parameter 5-00 Digital I/O Mode , parameter 5-01 Terminal 27 Mode	Ignored	Ignored	(Warning)	–
41	Overload T29	(X)	–	–	Parameter 5-00 Digital I/O Mode , parameter 5-02 Terminal 29 Mode	Ignored	Ignored	(Warning)	–
42	Ovrlld X30/6-7	(X)	–	–	–	–	–	–	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling. Critical alarms cause a trip</i>			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
43	Ext. supply (option)	X	–	–	–	–	–	–	–
45	Ground fault 2	X	X ⁽¹⁾	X	Parameter 14-90.5 Fault Level	Ignored	Ignored	Trip	–
46	Pwr. card sup- ply	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
47	24 V supply low	X	X	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	–
48	1.2 V supply low	–	X	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	–
49	Speed limit	–	X	–	Parameter 1-86 Trip Low Speed [RPM]	Ignored	Ignored	Warning/(Trip)	–
50	AMA calibra- tion	–	X	–	–	Ignored	Ignored	Trip	–
51	AMA U _{nom} , I _{nom}	–	X	–	–	Ignored	Ignored	Trip	–
52	AMA low I _{nom}	–	X	–	–	Ignored	Ignored	Trip	–
53	AMA big mo- tor	–	X	–	–	Ignored	Ignored	Trip	–
54	AMA small mot	–	X	–	–	Ignored	Ignored	Trip	–
55	AMA par. range	–	X	–	–	Ignored	Ignored	Trip	–
56	AMA interrupt	–	X	–	–	Ignored	Ignored	Trip	–
57	AMA timeout	–	X	–	–	Ignored	Ignored	Trip	–
58	AMA internal	X	X	–	–	Ignored	Ignored	Trip	–
59	Current limit	X	–	–	Parameter 14-90 Fault Settings	Ignored	Ignored	Warning	–
60	External inter- lock	–	X	–	–	Ignored	Ignored	Warning	–
61	Tracking error	(X)	(X)	–	–	–	–	–	---

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in <i>parameter 24-09 Emergency Mode Alarm Handling</i> . Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
62	Output freq. lim.	X	–	–	–	Ignored	Ignored	Warning	–
63	Mech. brake low	–	(X)	–	–	–	–	–	–
64	Voltage limit	X	–	–	Parameter 14-90 Fault Settings	Ignored	Ignored	Warning	–
65	Ctrl. card temp	X	X	X	Parameter 14-90.11 Fault Level	Ignored	Ignored	Trip lock	X
66	Low temp.	X	–	–	–	Ignored	Ignored	Warning	–
67	Option change	–	X	–	–	Ignored	Ignored	Trip	–
68	Safe stop	(X)	(X) ⁽¹⁾	–	Parameter 5-19 Terminal 37 Safe Stop	Trip	Trip	Trip	–
69	Pwr. card temp	–	X	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	X
70	Illegal FC config	–	–	X	–	Ignored	Ignored	Trip lock	–
71	PTC 1 safe stop	X	X ⁽¹⁾	–	–	Ignored	Ignored	Warning/ Trip	–
72	Dangerous failure	–	–	X ⁽¹⁾	–	Ignored	Ignored	Trip lock	–
73	Safe stop auto restart	(X)	(X)	–	Parameter 5-19 Terminal 37 Safe Stop	Ignored	Ignored	(Warning/ Trip)	–
76	Power unit setup	X	–	–	–	Ignored	Ignored	Warning	–
77	Reduced power mode	X	–	–	Parameter 14-59 Actual Number of Inverter Units	–	–	–	–
79	Illegal PS config	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
80	Drive initialized	–	X	–	–	Ignored	Ignored	Trip	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling. Critical alarms cause a trip</i>			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
81	CSIV corrupt	–	X	–	–	–	–	–	–
82	CSIV parame- ter error	–	X	–	–	–	–	–	–
90	Feedback mon.	(X)	(X)	–	–	–	–	–	–
91	AI54 set wrong	–	–	X	–	Ignored	Ignored	Trip lock	–
92	No-flow	(X)	(X)	–	Parameter 22-23 No-flow Function	Ignored	Ignored	(Warning/ Trip)	–
93	Dry pump	(X)	(X)	(X)	Parameter 22-26 Dry Pump Function	Ignored	Ignored	(Warning/ Trip)	–
94	End of curve	(X)	(X)	(X)	Parameter 22-50 End of Curve Function	Ignored	Ignored	(Warning/ Trip)	–
95	Broken belt	(X)	(X)	(X)	Parameter 22-60 Broken Belt Function	Ignored	Ignored	(Warning/ Trip)	–
96	Start delayed	X	–	–	–	Ignored	Ignored	Warning	–
97	Stop delayed	X	–	–	–	Ignored	Ignored	Warning	–
98	Clock fault	(X)	(X)	(X)	–	Ignored	Ignored	Warning	–
99	Locked rotor	–	(X)	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip/Trip lock	–
100	Derag limit fault	–	–	–	–	Ignored	Ignored	–	–
104	Mixing fans	X	X	–	Parameter 14-53 Fan Monitor	Ignored	Ignored	(Warning/ Trip)	–
124	User alert	(X)	(X)	(X)	Parameter group 13-9* User Defined Alerts	Ignored	Ignored	(Warning/ Trip)	–
129	I2C comm. failure	X	–	–	–	–	–	–	–
144	Inrush supply	–	–	–	–	–	–	–	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling</i> . Critical alarms cause a trip			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
145	Ext. SCR dis- able	–	X	–	–	–	–	–	–
146	Mains voltage	X	X	–	–	–	–	–	–
147	Mains fre- quency	X	X	–	–	–	–	–	–
148	System temp	X	X	–	–	–	–	–	–
161	Feedback not ready	X	–	–	–	–	–	–	–
162	Memory error	–	–	–	–	–	–	–	–
163	ATEX ETR cur.lim.warnin g	X	–	–	–	–	–	–	–
164	ATEX ETR cur.lim.alarm	–	X	–	–	–	–	–	–
165	ATEX ETR freq.lim.warni ng	X	–	–	–	–	–	–	–
166	ATEX ETR freq.lim.alarm	–	X	–	–	–	–	–	–
200	Emergency mode	–	–	–	–	Ignored	Ignored	Warning	–
201	Emerg. m was active	–	–	–	–	Ignored	Ignored	Warning	–
202	Emerg. m lim- its exceeded	X	–	X	–	Ignored	Ignored	Warning	–
217	Protection mode	X	–	–	Parameter 14-90 Fault Settings	Ignored	Ignored	Warning	–
219	Pump inter- lock	X	–	–	–	Ignored	Ignored	Warning	–
220	Overload trip	–	X	–	–	–	–	–	–
221	Bypass inter- lock	–	X	–	–	–	–	–	–
222	M2 open failed	–	–	X	–	–	–	–	–
223	M2 close failed	–	–	X	–	–	–	–	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling. Critical alarms cause a trip</i>			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
224	M3 open failed	–	–	X	–	–	–	–	–
225	Overload X59/3-6	X	–	–	–	–	–	–	–
226	M3 close failed	–	–	X	–	–	–	–	–
227	Bypass com error				–	–	–	–	–
228	APU low volt- age	X	–	–	–	–	–	–	–
229	Motor dis- conn.	X	–	–	–	–	–	–	–
230	Read failed	–	X	–	–	–	–	–	–
231	Read com- plete	–	X	–	–	–	–	–	–
232	Read in progress	–	X	–	–	–	–	–	–
239	SAS file in- valid	–	X	–	–	–	–	–	–
240	Write failed	–	X	–	–	–	–	–	–
241	Write com- plete	–	X	–	–	–	–	–	–
242	Write in progress	–	X	–	–	–	–	–	–
243	Brake IGBT	(X)	(X)	(X)	Parameter 2-13 Brake Power Monitoring , default [0] Off	Ignored	Ignored	Warning/ Trip	–
244	Heat sink temp	–	–	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	X
245	Heat sink sen- sor	–	–	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	X
246	Pwr. card sup- ply	–	–	X	–	Ignored	Ignored	Trip/Trip lock	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter reference	Emergency mode alarm handling selected in <i>parameter 24-09 Emergency Mode Alarm Handling</i> . Critical alarms cause a trip			Warranty-affecting alarms in emergency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
247	Pwr. card temp	–	–	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	X
248	Illegal PS config	–	–	X	–	Ignored	Ignored	Trip/Trip lock	–
249	Rect. low temp.	X	–	–	–	–	–	–	---
250	New spare part	–	–	X	–	Ignored	Ignored	Trip lock	–
251	New type code	–	X	X	–	Ignored	Ignored	Trip/Trip lock	–
252	X49/7 overload	–	–	–	–	–	–	–	–
253	X49/9 overload	–	–	–	–	–	–	–	–
254	X49/11 overload	–	–	–	–	–	–	–	–
258	Missing motor	–	–	–	–	–	–	–	–
259	Pump failed	–	–	–	–	–	–	–	–
260	AMA complete	–	X	–	Parameter 1-29 AMA configured via fieldbus and started via fieldbus control word.	Ignored	Ignored	–	–
273	BTM error	–	–	–	–	–	–	–	–
274	Flow not confirmed	–	–	–	–	–	–	–	–
275	Flow switch failure	–	–	–	–	–	–	–	–
276	Totalized vol. overflow	–	–	–	–	–	–	–	–
277	Actual vol. overflow	–	–	–	–	–	–	–	–
280	Emcy m service warning	X	–	–	–	–	–	–	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling</i> . Critical alarms cause a trip			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
281	Emcy OPR un- expected	X	–	–	–	–	–	–	–
290	Connection to one master is lost	X	–	–	–	–	–	–	–
300	Mains cont. fault	–	–	X	Parameter 14-90 Fault Settings	Ignored	Ignored	Trip lock	–
301	SC cont. fault	–	–	–	–	–	–	–	–
421	FPC temp	–	X	–	–	–	–	–	–
423	FPC updating	–	X	–	–	–	–	–	–
424	FPC update success	–	X	–	–	–	–	–	–
425	FPC update failure	–	–	X	–	–	–	–	–
426	FPC config	–	–	X	–	–	–	–	–
427	FPC supply	–	X	–	–	–	–	–	–
432	Inrush mode error	–	X	–	–	–	–	–	–
500 ^{(2), (3)}	Stator S2	(X)	(X)	–	Parame- ter 45-00.0 Function	Ignored	Ignored	Ignored	–
501	Load S2	(X)	(X)	–	Parame- ter 45-00.1 Function	Ignored	Ignored	Ignored	–
502	Sensor 1 S2	(X)	(X)	–	Parame- ter 45-00.2 Function	Ignored	Ignored	Ignored	–
503	Sensor 2 S2	(X)	(X)	–	Parame- ter 45-00.3 Function	Ignored	Ignored	Ignored	–
504	Sensor 3 S2	(X)	(X)	–	Parame- ter 45-00.4 Function	Ignored	Ignored	Ignored	–
505	Sensor 4 S2	(X)	(X)	–	Parame- ter 45-00.5 Function	Ignored	Ignored	Ignored	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling</i> . Critical alarms cause a trip			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
506	Load low S2	(X)	(X)	–	Parame- ter 45-00.1 <i>Function</i>	Ignored	Ignored	Ignored	–
507	Cavitation S2	(X)	–	–	Parame- ter 45-00.6 <i>Function</i>	Ignored	Ignored	Ignored	–
510	Stator	(X)	(X)	–	Parame- ter 45-00.0 <i>Function</i>	Ignored	Ignored	Ignored	–
511	Load	(X)	(X)	–	Parame- ter 45-00.1 <i>Function</i>	Ignored	Ignored	Ignored	–
512	Sensor 1	(X)	(X)	–	Parame- ter 45-00.2 <i>Function</i>	Ignored	Ignored	Ignored	–
513	Sensor 2	(X)	(X)	–	Parame- ter 45-00.3 <i>Function</i>	Ignored	Ignored	Ignored	–
514	Sensor 3	(X)	(X)	–	Parame- ter 45-00.4 <i>Function</i>	Ignored	Ignored	Ignored	–
515	Sensor 4	(X)	(X)	–	Parame- ter 45-00.5 <i>Function</i>	Ignored	Ignored	Ignored	–
516	Load low	(X)	(X)	–	Parame- ter 45-00.1 <i>Function</i>	Ignored	Ignored	Ignored	–
517	Cavitation	–	X	–	Parame- ter 45-00.6 <i>Function</i>	Ignored	Ignored	Ignored	–
517	Cavitation S1	(X)	–	–	Parame- ter 45-00.6 <i>Function</i>	Ignored	Ignored	Ignored	–
520	Stator thld at max/min	(X)	–	–	–	–	–	–	–
521	Load thld at max/min	(X)	–	–	–	–	–	–	–
522	Sensor 1 thld at max/min	(X)	–	–	–	–	–	–	–

Table 86: Alarm/Warning Code List - (continued)

#	Description	Warning	Alarm/ trip	Alarm/ trip lock	Parameter ref- erence	Emergency mode alarm handling selected in <i>parameter 24-09 Emer- gency Mode Alarm Handling. Critical alarms cause a trip</i>			War- ranty-affect- ing alarms in emer- gency mode
						[0] Trip + Reset	[1] Trip	[2] Test	
523	Sensor 2 thld at max/min	(X)	–	–	–	–	–	–	–
524	Sensor 3 thld at max/min	(X)	–	–	–	–	–	–	–
525	Sensor 4 thld at max/min	(X)	–	–	–	–	–	–	–
527	Cavitation thld at max/ min	(X)	–	–	Parame- ter 45-00.6 <i>Function</i>	–	–	–	–
531	SineWave- Filter S2	(X)	–	–	Parame- ter 49-00 <i>Autonomous</i> <i>Function</i>	Ignored	Ignored	Ignored	–
541	SineWave- Filter	–	(X)	–	Parame- ter 49-00 <i>Autonomous</i> <i>Function</i>	Ignored	Ignored	Ignored	–
541	Sine-wave fil- ter warning 1	(X)	–	–	Parame- ter 49-00 <i>Autonomous</i> <i>Function</i>	Ignored	Ignored	Ignored	–
549	SWF Out- OfRange mea- surement	(X)	–	–	Parame- ter 49-00 <i>Autonomous</i> <i>Function</i>	–	–	–	–
550	Sensor 1 low	(X)	(X)	–	Parame- ter 45-00.2 <i>Function</i>	Ignored	Ignored	Ignored	–
551	Sensor 2 low	(X)	(X)	–	Parame- ter 45-00.3 <i>Function</i>	Ignored	Ignored	Ignored	–
552	Sensor 3 low	(X)	(X)	–	Parame- ter 45-00.4 <i>Function</i>	Ignored	Ignored	Ignored	–
553	Sensor 4 low	(X)	(X)	–	Parame- ter 45-00.5 <i>Function</i>	Ignored	Ignored	Ignored	–
600	Thread timing	–	–	–	–	–	–	–	–

1) Cannot be auto reset via **parameter 14-20 Reset Mode**.

2) All warnings and alarms from 500–525 require a CBM license.

3) All CBM warnings and alarms have warning and alarm/trip, where warning is default if the CBM license is installed and monitoring is enabled.

A trip is the action following an alarm. The trip coasts the motor and is reset by pressing [Reset] or by a digital input (parameter group **5-1*Digital Inputs**). The original event that caused an alarm cannot damage the drive or cause dangerous conditions.

A trip lock is an action when an alarm occurs, which could damage the drive or connected parts. A trip lock situation can only be reset by cycling power.

6.1.3 Indicator Light

Table 87: Indicator Light

Warning	Yellow
Alarm	Flashing red
Trip locked	Yellow and red

6.1.4 Alarm Word, Warning Word, and Extended Status Word

Table 88: Description of Alarm Word

Bit	Hex	Dec	Alarm word Parameter 16-90 Alarm Word	Alarm word 2 Parameter 16-91 Alarm Word 2	Alarm word 3 Parameter 16-97 Alarm Word 3
0	00000001	1	Brake check (A28)	Servicetrip, read/write	Temp. input error
1	00000002	2	Pwr.card temp (A69)	Servicetrip, (reserved)	Memory module fault
2	00000004	4	Ground fault (A14)	Servicetrip, typecode/spare part	Internal fan error
3	00000008	8	Ctrl.card temp (A65)	Servicetrip, (reserved)	Sync. fault
4	00000010	16	Ctrl. word TO (A17)	Servicetrip, (reserved)	OPM fault
5	00000020	32	Overcurrent (A13)	Reserved	–
6	00000040	64	Torque limit (A12)	Reserved	Profibus converter invalid
7	00000080	128	Motor th over (A11)	Reserved	–
8	00000100	256	Motor ETR over (A10)	Reserved	–
9	00000200	512	Inverter overld. (A9)	Reserved	–
10	00000400	1024	DC undervolt (A8)	Reserved	–
11	00000800	2048	DC overvolt (A7)	Reserved	–
12	00001000	4096	Short circuit (A16)	Reserved	–
13	00002000	8192	Inrush fault (A33)	Reserved	–
14	00004000	16384	Mains ph. loss (A4)	Reserved	–
15	00008000	32768	AMA not OK	Reserved	–
16	00010000	65536	Live zero error (A2)	Reserved	–

Table 88: Description of Alarm Word - (continued)

Bit	Hex	Dec	Alarm word Parameter 16-90 Alarm Word	Alarm word 2 Parameter 16-91 Alarm Word 2	Alarm word 3 Parameter 16-97 Alarm Word 3
17	00020000	131072	Internal fault (A38)	KTY error	–
18	00040000	262144	Brake overload (A26)	Fans error	–
19	00080000	524288	U phase loss (A30)	ECB error	–
20	00100000	1048576	V phase loss (A31)	Reserved	–
21	00200000	2097152	W phase loss (A32)	Reserved	–
22	00400000	4194304	Fieldbus fault (A34)	Reserved	–
23	00800000	8388608	24 V supply low (A47)	Reserved	–
24	01000000	16777216	Mains failure (A36)	Reserved	–
25	02000000	33554432	1.8 V supply low (A48)	Reserved	Emergency mode
26	04000000	67108864	Brake resistor (A25)	Reserved	Sensor 4
27	08000000	134217728	Brake IGBT (A27)	Reserved	Sensor 3
28	10000000	268435456	Option change (A67)	Reserved	Sensor 2
29	20000000	536870912	Drive initialized (A80)	Feedback fault (A61, A90)	Sensor 1
30	40000000	1073741824	Safe stop (A68)	PTC 1 Safe Stop (A71)	Load
31	80000000	2147483648	Mech. brake low (A63)	Dangerous failure (A72)	Stator

Table 89: Description of Warning Word

Bit	Hex	Dec	Warning word Parameter 16-92 Warning Word	Warning word 2 Parameter 16-93 Warning Word 2	Warning word 3 Parameter 16-98 Warning Word 3
0	00000001	1	Brake check (W28)	Start delayed	Temp. input error
1	00000002	2	Pwr.card temp (A69)	Stop delayed	–
2	00000004	4	Earth fault (W14)	Reserved	Internal fan warning
3	00000008	8	Ctrl.card temp (W65)	Reserved	–
4	00000010	16	Ctrl. word TO (W17)	–	–
5	00000020	32	Overcurrent (W13)	Reserved	Test MOC function
6	00000040	64	Torque limit (W12)	Reserved	Profibus converter time warning
7	00000080	128	Motor th over (W11)	Reserved	EmcymodeActive
8	00000100	256	Motor ETR over (W10)	Reserved	EmcymodeHasBeen-Active
9	00000200	512	Inverter Overld (W9)	Discharge high	EmcymodeLimits active

Table 89: Description of Warning Word - (continued)

Bit	Hex	Dec	Warning word Parameter 16-92 Warning Word	Warning word 2 Parameter 16-93 Warning Word 2	Warning word 3 Parameter 16-98 Warning Word 3
10	00000400	1024	DC under volt (W8)	Multi-motor under-load	EmcymodeServiceRequest due to limits
11	00000800	2048	DC over volt (W7)	Multi-motor over-load	EmcymodeNotReady-ToOperate
12	00001000	4096	DC voltage low (W6)	Compressor inter-lock	CBM Reserved
13	00002000	8192	DC voltage high (W5)	Mechanical brake sliding	CBM Reserved
14	00004000	16384	Mains ph. loss (W4)	Safe option warning	CBM Reserved
15	00008000	32768	No motor (W3)	Auto DC braking	CBM Reserved
16	00010000	65536	Live zero error (W2)		CBM Reserved
17	00020000	131072	10 V low (W1)	KTY warn	CBM Reserved
18	00040000	262144	Brake overload (W26)	Fans warn	Load low S2
19	00080000	524288	Brake resistor (W25)	ECB warn	Load low
20	00100000	1048576	Brake IGBT (W27)	Hoist mechanical brake (W22)	Sensor 4 S2
21	00200000	2097152	Speed limit (W49)	Reserved	Sensor 4
22	00400000	4194304	Fieldbus fault (W34)	Reserved	Sensor 3 S2
23	00800000	8388608	24 V supply low (W47)	Reserved	Sensor 3
24	01000000	16777216	Mains failure (W36)	Reserved	Sensor 2 S2
25	02000000	33554432	Current limit (W59)	Power Limit Motor	Sensor 2
26	04000000	67108864	Low temp (W66)	Power Limit Generator	Sensor 1 S2
27	08000000	134217728	Voltage limit (W64)	Reserved	Sensor 1
28	10000000	268435456	Encoder loss (W90)	Reserved	Load S2
29	20000000	536870912	Output freq. lim. (W62)	BackEMF too high	Load
30	40000000	1073741824	Safe stop (W68)	PTC thermistor (W74)	Stator S2
31	80000000	2147483648	Extended status word	–	Stator

Table 90: Description of Extended Status Word

Bit	Hex	Dec	Ext. status word Parameter 16-94 Ext. Status Word	Ext. status word 2 Parameter 16-95 Ext. Status Word 2	Ext. status word 3 Parameter 16-99 Ext. Status Word 3
Extended Status Word					
0	00000001	1	Ramping	Off	High pressure stop
1	00000002	2	AMA running	Hand/auto	Low pressure stop
2	00000004	4	Start CW/CCW start_possible is active, when the DI selections [12] OR [13] are active and the requested direction matches the reference sign	–	Defrost
3	00000008	8	Slow down slow down command active, for example via CTW bit 11 or DI	–	Pre/post lube
4	00000010	16	Catch up catch up command active, for example via CTW bit 12 or DI	–	User-defined alerts
5	00000020	32	Feedback high feedback >parameter 4-57 Warning Feedback High	Relay 123 active	–
6	00000040	64	Feedback low feedback <parameter 4-56 Warning Feedback Low	Start prevented	–
7	00000080	128	Output current high current >parameter 4-51 Warning Current High	Control ready	–
8	00000100	256	Output current low current <parameter 4-50 Warning Current Low	Drive ready	–
9	00000200	512	Output freq high speed >parameter 4-53 Warning Speed High	Quick stop	–

Table 90: Description of Extended Status Word - (continued)

Bit	Hex	Dec	Ext. status word Parameter 16-94 Ext. Status Word	Ext. status word 2 Parameter 16-95 Ext. Status Word 2	Ext. status word 3 Parameter 16-99 Ext. Status Word 3
10	00000400	1024	Output freq low speed <parameter 4-52 Warning Speed Low	DC brake	–
11	00000800	2048	Brake check OK Brake test NOT OK	Stop	–
12	00001000	4096	Braking max. BrakePower > pa- rameter 2-12 Brake Power Limit [kW]	Standby	–
13	00002000	8192	Braking	Freeze output re- quest	–
14	00004000	16384	Out of speed range	Freeze output	–
15	00008000	32768	OVC active	Jog request	–
16	00010000	65536	AC brake	Jog	–
17	00020000	131072	Password timelock number of allowed password trials ex- ceeded - timelock active	Start request	–
18	00040000	262144	Password protection 0-61 = ALL_NO_ACCESS OR BUS_NO_ACCESS OR BUS_READONLY	Start	–
19	00080000	524288	Reference high reference >parame- ter 4-55 Warning Reference High	Start applied	–
20	00100000	1048576	Reference low Reference <para- meter 4-54 Warning Reference Low	Start delay	–
21	00200000	2097152	Local reference Reference site = RE- MOTE -> auto on pressed & active	Sleep	–
22	00400000	4194304	Protection mode	Sleep boost	–
23	00800000	8388608	Unused	Running/pipe filling	–
24	01000000	16777216	Unused	Drive bypass	–

Table 90: Description of Extended Status Word - (continued)

Bit	Hex	Dec	Ext. status word Parameter 16-94 Ext. Status Word	Ext. status word 2 Parameter 16-95 Ext. Status Word 2	Ext. status word 3 Parameter 16-99 Ext. Status Word 3
25	02000000	33554432	Unused	Emergency mode	–
26	04000000	67108864	Unused	Reserved	–
27	08000000	134217728	Unused	Reserved	–
28	10000000	268435456	Unused	Reserved	–
29	20000000	536870912	Unused	Reserved	–
30	40000000	1073741824	Unused	Reserved	–
31	80000000	2147483648	Unused	Reserved	–

The alarm words, warning words and extended status words can be read out via a serial bus or optional fieldbus for diagnostics. See also parameter **16-94 Ext. Status Word**.

6.1.5 Alarm and Warning Words - CBM SWF

The bit for each alarm and warning number is configured in parameter **18-55 Active Alarm Number**, parameter **18-56 Active Warning Number**, parameter **18-67 Alarm Word 4**, and parameter **18-68 Warning Word 4**. The alarm and warning numbers are shown in the LCP.

Table 91: Bits for Configuring Alarm and Warning Numbers

Alarm or warning overview	Alarm number	Warning number	Alarm word 4 Parameter 18-67	Warning word 4 Parameter 18-68	Description
Alarm	541	–	0x1	0xC0	Sine-wave Filter Alarm
Warning S2	–	531	–	0xC0	Sine-wave Filter Warning S2
Warning S1	–	541	–	0x40	Sine-wave Filer Warning S1
Warning	–	549	–	–	SWF Out of Range Measurement

[Table 92](#) shows the alarm and warning conversion. The conversion for bit, hexadecimal, and decimal are listed for parameter **18-67 Alarm Word 4** and parameter **18-68 Warning Word 4**.

Table 92: Alarm and Warning Conversion Table

Bit	Hexadecimal	Decimal	Alarm word 4 Parameter 18-67	Warning word 4 Parameter 18-68
1	1	1	0x1	0xC0
7	40	64	–	0x40
8	80	128	–	0x80

6.1.6 Alarm and Warning Words - CBM Cavitation

The bit for each alarm and warning number is configured in parameter **18-55 Active Alarm Number**, parameter **18-56 Active Warning Number**, parameter **18-67 Alarm Word 4**, and parameter **18-68 Warning Word 4**. The alarm and warning numbers are shown in the LCP and saved in the drive logs.

Table 93: Alarm and Warnings Register

Alarm or warning overview	Alarm number Parameter 18-55	Warning number Parameter 18-56	Alarm word 4 Parameter 18-67	Warning word 4 Parameter 18-68	Description
Alarm	517	–	0x2	–	Cavitation Alarm
Warning S2	–	507	–	0x200	Cavitation Warning S2
Warning S1	–	517	–	0x100	Cavitation Warning S1
Cavitation Thld at Max/Min	–	527	–	–	Cavitation thresholds at maximum/minimum

[Table 94](#) shows the alarm and warning conversion. The conversion for bit, hexadecimal, and decimal are listed for parameter **18-67 Alarm Word 4** and parameter **18-68 Warning Word 4**.

Table 94: Alarm and Warning Conversion Table

Bit	Hexadecimal	Decimal	Alarm word 4 Parameter 18-67	Warning word 4 Parameter 18-68
2	0x2	2	0x2	–
9	0x100	256	–	0x100
10	0x2020	512	–	0x200
9,10	0x300	768	–	0x300

6.2 Descriptions of Warnings and Alarms

Warning 1, 10 Volts Low

Cause

The control card voltage is less than 10 V from terminal 50. Remove some of the load from terminal 50, as the 10 V supply is overloaded. Maximum 15 mA or minimum 590 Ω.

A short circuit in a connected potentiometer or incorrect wiring of the potentiometer can cause this condition.

Troubleshooting

- Remove the wiring from terminal 50.
- If the warning clears, the problem is with the wiring. If the warning does not clear, replace the control card.

WARNING/ALARM 2, Live Zero Error

Cause

This warning or alarm only appears if programmed in parameter **6-01 Live Zero Timeout Function**. The signal on 1 of the analog inputs is less than 50% of the minimum value programmed for that input. Broken wiring or faulty device sending the signal can cause this condition.

Troubleshooting

- Check connections on all the analog input terminals. Control card terminals 53 and 54 for signals, terminal 55 common.
- Check that the drive programming and switch settings match the analog signal type.
- Perform the input terminal signal test.

WARNING 3, No Motor

Cause

No motor is connected to the output of the drive.

Troubleshooting

- Check the cable connection between the drive and the motor.

WARNING/ALARM 4, Mains Phase Loss

Cause

A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears for a fault in the input rectifier. Options are programmed in parameter *14-12 Response to Mains Imbalance*.

Troubleshooting

- Check the supply voltage and supply currents to the drive.

Warning 5, DC Link Voltage High

Cause

The DC-link voltage (DC) is higher than the high-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

Warning 6, DC Link Voltage Low

Cause

The DC-link voltage (DC) is lower than the low-voltage warning limit. The limit depends on the drive voltage rating. The unit is still active.

WARNING/ALARM 7, DC Overvoltage

Cause

If the DC-link voltage exceeds the limit, the drive trips after a time.

Troubleshooting

- Extend the ramp time.
- Change the ramp type.

WARNING/ALARM 8, DC Under Voltage

Cause

If the DC-link voltage (DC-link) drops below the undervoltage limit, the drive trips after a fixed time delay. The time delay varies with unit size.

Troubleshooting

- Check that the supply voltage matches the drive voltage.
- Perform the input voltage test.
- Perform the soft charge circuit test.

WARNING/ALARM 9, Inverter Overload

Cause

The drive is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection issues a warning at 90% and trips at 100%, while giving an alarm. The drive cannot be reset until the counter is below 90%.

The fault occurs when the drive has run with more than 100% overload for too long.

Troubleshooting

- Compare the output current shown on the LCP with the drive rated current.
- Compare the output current shown on the LCP with the measured motor current.
- Show the thermal drive load on the LCP and monitor the value. When running above the drive continuous current rating, the counter increases. When running below the drive continuous current rating, the counter decreases.

WARNING/ALARM 10, Motor ETR Overtemperature

Cause

According to the electronic thermal protection (ETR), the motor is too hot. Select whether the drive issues a warning or an alarm when the counter reaches 100% in parameter **1-90 Motor Thermal Protection**. The fault occurs when the motor runs with more than 100% overload for too long.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- Check that the motor current set in parameter **1-24 Motor Current** is correct.
- Ensure that the motor data in parameter **1-20** to parameter **1-25** is set correctly.
- Running AMA in parameter **1-29 Automatic Motor Adaptation (AMA)** tunes the drive to the motor more accurately and reduces thermal loading.

WARNING/ALARM 11, Motor Thermistor Overtemperature

Cause

Check whether the thermistor is disconnected. Select whether the drive issues a warning or an alarm in parameter **1-90 Motor Thermal Protection**.

Troubleshooting

- Check for motor overheating.
- Check if the motor is mechanically overloaded.
- When using terminal 53 or 54, check that the thermistor is connected correctly between either terminal 53 or 54 (analog voltage input) and terminal 50 (+10 V supply). Also check that the terminal switch for 53 or 54 is set for voltage. Check that parameter **1-93 Thermistor Resource** selects terminal 53 or 54.
- When using terminal 18, 19, 31, 32, or 33 (digital inputs), check that the thermistor is connected correctly between the digital input terminal used (digital input PNP only) and terminal 50. Select the terminal to use in parameter **1-93 Thermistor Resource**.

WARNING/ALARM 12, Torque Limit

Cause

The torque has exceeded the value in parameter **4-16 Torque Limit Motor Mode** or the value in parameter **4-17 Torque Limit Generator Mode**. Parameter **14-25 Trip Delay at Torque Limit** can change this warning from a warning-only condition to a warning followed by an alarm.

Troubleshooting

- If the motor torque limit is exceeded during ramp-up, extend the ramp-up time.
- If the generator torque limit is exceeded during ramp-down, extend the ramp-down time.
- If torque limit occurs while running, increase the torque limit. Make sure that the system can operate safely at a higher torque.
- Check the application for excessive current draw on the motor.

WARNING/ALARM 13, Overcurrent

Cause

The inverter peak current limit (approximately 200% of the rated current) is exceeded. The warning lasts about 5 s, then the drive trips and issues an alarm. Shock loading or fast acceleration with high-inertia loads can cause this fault.

Troubleshooting

- Remove power and check if the motor shaft can be turned.
- Check that the motor size matches the drive.
- Check *parameters 1-20 to 1-25* for correct motor data.

ALARM 14, Ground Fault

Cause

There is current from the output phases to ground, either in the cable between the drive and the motor or in the motor itself.

Troubleshooting

- Remove power to the drive and repair the ground fault.
- Check for ground faults in the motor by measuring the resistance to ground of the motor cables and the motor with a megohmmeter.

Alarm 15, Hardware Mismatch

Cause

A fitted option is not operational with the present control card hardware or software.

Troubleshooting

- Record the values of the following parameters and contact Danfoss.
 - a. Parameter **15-40 FC Type**
 - b. Parameter **15-41 Power Section**
 - c. Parameter **15-42 Voltage**
 - d. Parameter **15-43 Software Version**
 - e. Parameter **15-45 Actual Typecode String**
 - f. Parameter **15-49 SW ID Control Card**
 - g. Parameter **15-50 SW ID Power Card**

- h. Parameter *15-60 Option Mounted*
- i. Parameter *15-61 Option SW Version* (for each option slot).

ALARM 16, Short Circuit

Cause

There is short-circuiting in the motor or motor wiring.

Troubleshooting

- Remove power to the drive and repair the short circuit.

WARNING/ALARM 17, Control Word Timeout

Cause

There is no communication to the drive. The warning is only active when parameter *8-04 Control Word Timeout Function* is NOT set to *[0] Off*. If parameter *8-04 Control Word Timeout Function* is set to *[5] Stop and Trip*, a warning appears. The drive then ramps down until it trips, while giving an alarm. Parameter *8-03 Control Timeout Time* could possibly be increased.

Troubleshooting

- Check connections on the serial communication cable.
- Increase parameter *8-03 Control Word Timeout Time*.
- Check the operation of the communication equipment.
- Verify a proper installation based on EMC requirements.

ALARM 18, Start Failed

Cause

The speed cannot exceed the value set in parameter *1-78 Compressor Start Max Speed [Hz]* during start within the allowed time, which is set in parameter *1-79 Compressor Start Max Time to Trip*. The alarm may be caused by a blocked motor.

Troubleshooting

- Check if the motor is blocked.
- Check if the start maximum speed is set higher than the working speed after ramp up.
- Check if the start maximum time to trip is set shorter than the normal ramp up time.

WARNING/ALARM 20, Temp. Input Error

Cause

The temperature detected by VLT® Sensor Input Option MCB 114 exceeds the limit.

This warning/alarm is only active when *[5] Stop and trip* is selected in parameter *35-06 Temperature Sensor Alarm Function*.

Troubleshooting

- Check the settings of the following parameters:
 - a. Parameter group *35-1* Temp. Input X48/4*
 - b. Parameter group *35-2* Temp. Input X48/7*
 - c. Parameter group *35-3* Temp. Input X48/10*
- Check the feedback temperature from the following parameters:
 - a. Parameter *18-37 Temp. Input X48/4*

- b. Parameter *18-38 Temp. Input X48/7*
- c. Parameter *18-39 Temp. Input X48/10*

Warning/Alarm 21, Parameter Error

Cause

The parameter is out of range. The parameter number is shown in the display.

Troubleshooting

- Set the affected parameter to a valid value.

Warning 23, Internal Fan Fault

Cause

The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in parameter *14-53 Fan Monitor* by selecting *[0] Disabled*.

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this warning appears. For drives with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Cycle for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the control card.

Warning 24, External Fan Fault

Cause

The fan warning function is a protective function that checks if the fan is running/mounted. The fan warning can be disabled in parameter *14-53 Fan Monitor* by selecting *[0] Disabled*.

For drives with DC fans, a feedback sensor is mounted in the fan. If the fan is commanded to run and there is no feedback from the sensor, this warning appears. For drives with AC fans, the voltage to the fan is monitored.

Troubleshooting

- Check for proper fan operation.
- Cycle power to the drive and check that the fan operates briefly at start-up.
- Check the sensors on the heat sink.

WARNING 25, Brake Resistor Short-circuited

Cause

The brake resistor is monitored during start-up. If a short circuit occurs, the brake function is disabled and the alarm appears. The drive is tripped.

Troubleshooting

- Remove the power to the drive and check the connection of the brake resistor.

WARNING/ALARM 26, Brake Resistor Power Limit

Cause

The power transmitted to the brake resistor is calculated as an average value over the last 120 s of run time. The calculation is based on the DC-link voltage and the brake resistor value set in parameter **2-11 Brake Resistor (ohm)**. The warning is active when the dissipated braking power is higher than the value set in parameter **2-12 Brake Power Limit (kW)**. The drive trips if the warning persists for 1200 s.

Troubleshooting

- Decrease brake energy via lower speed or longer ramp time.

ALARM 27, Brake IGBT/Brake Chopper Short-circuited

Cause

The brake transistor is monitored during start-up. If a short circuit occurs, the brake function is disabled, and an alarm is issued. The drive is tripped.

Troubleshooting

- Remove the power to the drive and remove the brake resistor.

ALARM 28, Brake Check

Cause

The brake resistor is not connected or not working.

Troubleshooting

- Check if brake resistor is connected or it is too large for the drive.

ALARM 29, Power Module Temp

Cause

The maximum temperature of the heat sink is exceeded. The temperature fault is not reset until the temperature drops below a defined heat sink temperature. The trip and reset points are different, based on the drive power size.

Troubleshooting

Check for the following conditions:

- The ambient temperature is too high.
- The motor cables are too long.
- Incorrect airflow clearance above and below the drive.
- Blocked airflow around the drive.
- Damaged heat sink fan.
- Dirty heat sink.

ALARM 30, Motor Phase U Missing

Cause

WARNING



HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

Motor phase U between the drive and the motor is missing.

Troubleshooting

- Disconnect power from the drive and check motor phase U.

ALARM 31, Motor Phase V Missing

Cause

WARNING



HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

Motor phase V between the drive and the motor is missing.

Troubleshooting

- Disconnect power from the drive and check motor phase V.

ALARM 32, Motor Phase W Missing

Cause

WARNING



HAZARDOUS VOLTAGE

AC drives contain hazardous voltage when connected to the AC mains or connected on the DC terminals. Failure to perform installation, start-up, and maintenance by qualified personnel can result in death or serious injury.

- Only qualified personnel must perform installation, start-up, and maintenance.

Motor phase W between the drive and the motor is missing.

Troubleshooting

- Disconnect power from the drive and check motor phase W.

ALARM 33, Inrush Fault

Cause

Too many power-ups have occurred within a short time period.

Troubleshooting

- Let the unit cool to operating temperature.
- Check potential DC-link fault to ground.

WARNING/ALARM 34, Fieldbus Fault

Cause

The fieldbus on the communication option card is not working.

Troubleshooting

- Check the fieldbus communication option card.

ALARM 35, Option Fault

Cause

Fieldbus or option B detects internal faults.

Troubleshooting

- Contact the local supplier.

WARNING/ALARM 36, Mains Failure

Cause

This warning/alarm is only active if the supply voltage to the drive is lost and parameter **14-10 Mains Failure** is not set to **[0] No function**.

Troubleshooting

- Check the fuses to the drive and mains supply to the unit.

ALARM 37, Phase Imbalance

Cause

There is a current imbalance between the power units.

ALARM 38, Internal Fault

Cause

When an internal fault occurs, a code number is shown.

Table 95: Internal Fault List

Fault number	Cause	Solution
140–142	Power board EEPROM data error	Upgrade the software in the drive to the latest version.
176	The firmware in the drive does not match the drive.	Upgrade the software in the drive to the latest version.
256	Flash ROM check-sum error.	Upgrade the software in the drive to the latest version.
2304	Firmware mismatch between the control card and the power card.	Upgrade the software in the drive to the latest version.

Table 95: Internal Fault List - (continued)

Fault number	Cause	Solution
2560	Communication error between the control card and the power card.	Upgrade the software in the drive to the latest version. If the alarm occurs again, check the connection between the control card and the power card.
3840	Serial flash version error.	Upgrade the software in the drive to the latest version.
4608	Drive power size error.	Upgrade the software in the drive to the latest version. If the alarm occurs again, contact a Danfoss supplier.
5632	Option hardware version error.	The hardware version of the option or the fieldbus variant is not compatible with the drive software.
5888	Option software version error.	The software version of the option or the fieldbus variant is not compatible with the drive software. Change either the fieldbus software or the drive software.
6144	The option is not supported.	Check if the product supports this option.
6400	Option combination error.	Remove the option.
Other	Other internal faults.	Power cycle the drive. If the alarm occurs again, contact a Danfoss supplier.

Troubleshooting

- See the above table for the causes and solutions for different internal faults. If the fault persists, contact the Danfoss supplier or service department for assistance.

ALARM 39, Heat Sink Sensor

Cause

There is no feedback from the heat sink temperature sensor. The signal from the IGBT thermal sensor is not available on the power card.

Troubleshooting

- Check the ribbon cable between the power card and the gate drive card.
- Check for a defective power card.
- Check for a defective gate drive card.

WARNING 40, Overload T27

Troubleshooting

- Check the load connected to terminal 27 or remove the short-circuit connection.
- Check parameter *5-00 Digital I/O Mode* and parameter *5-01 Terminal 27 Mode*.

WARNING 41, Overload T29

Troubleshooting

- Check the load connected to terminal 29 or remove the short-circuit connection.
- Check parameter *5-00 Digital I/O Mode* and parameter *5-02 Terminal 29 Mode*.

WARNING 42, Ovrlid X30/6-7

Troubleshooting, X30/6

- Check the load connected to the terminal or remove the short-circuit connection.

- Check parameter *5-32 Term X30/6 Digi Out (MCB 101)* (VLT® General Purpose I/O MCB 101).

Troubleshooting, X30/7

- Check the load connected to the terminal or remove the short-circuit connection.
- Check parameter *5-33 Term X30/7 Digi Out (MCB 101)* (VLT® General Purpose I/O MCB 101).

WARNING 43, Ext. Supply

Cause

VLT® Extended Relay Option MCB 113 is mounted without 24 V DC. Select 1 of the options in the troubleshooting list.

Troubleshooting

- Connect a 24 V DC external supply.
- Specify that no external supply is used via parameter *14-80 Option Supplied by External 24VDC* set to *[0] No*. A change in parameter *14-80 Option Supplied by External 24VDC* requires a power cycle.

ALARM 45, Earth (Ground) Fault 2

Cause

A ground fault has occurred.

Troubleshooting

- Check for proper grounding and loose connections.
- Check for proper wire size.
- Check the motor cables for short circuits or leakage currents.

ALARM 46, Power Card Supply

Cause

The supply on the power card is out of range. Another reason can be a defective heat sink fan. There are 3 supplies generated by the switch mode supply (SMPS) on the power card:

- 24 V.
- 5 V.
- ± 18 V.

When powered with VLT® 24 V DC Supply MCB 107, only 24 V and 5 V supplies are monitored. When powered with 3-phase mains voltage, all 3 supplies are monitored.

Troubleshooting

- Check for a defective power card.
- Check for a defective control card.
- Check for a defective option card.
- If 24 V DC is used, verify proper supply power.
- Check for a defective heat sink fan.

WARNING/ALARM 47, 24 V Supply Low

Cause

The 24 V DC is measured on the control card.

Troubleshooting

- Check for a defective control card.

ALARM 48, 1.8 V Supply Low**Cause**

The 1.8 V DC supply used on the control card is outside of the allowed limits. The supply is measured on the control card.

Troubleshooting

- Check for a defective control card.
- If an option is installed, check for overvoltage.

WARNING 49, Speed Limit**Cause**

The warning is shown when the speed is outside of the specified range in parameter *4-12 Motor Speed Low Limit [Hz]* and parameter *4-14 Motor Speed High Limit [Hz]*.

Troubleshooting

- Check if the system ran outside of the speed range.
- Check if parameter *4-12 Motor Speed Low Limit [Hz]* and parameter *4-14 Motor Speed High Limit [Hz]* are set correctly.

ALARM 50, AMA Calibration**Cause**

A calibration error has occurred.

Troubleshooting

- Contact a Danfoss supplier or the Danfoss service department.

ALARM 51, AMA check U_{nom} and I_{nom} **Cause**

The settings for motor voltage, motor current, and motor power are wrong.

Troubleshooting

- Check the settings in parameter *1-20* to parameter *1-25*.

ALARM 52, AMA Low I_{nom} **Cause**

The motor current is too low.

Troubleshooting

- Check the setting in parameter *1-24 Motor Current*.

ALARM 53, AMA Big Motor**Cause**

The power size of the motor is too large for the AMA to operate.

Troubleshooting

- Check the settings in parameter group *1-2* Motor Data*.

ALARM 54, AMA Small Motor**Cause**

The power size of the motor is too small for the AMA to operate.

Troubleshooting

- Check the settings in parameter group *1-2* Motor Data*.

ALARM 55, AMA Parameter Range**Cause**

The parameter values of the motor are outside of the acceptable range. The AMA does not run.

Troubleshooting

- Check the settings in parameter group *1-2* Motor Data*.

ALARM 56, AMA Interrupted**Cause**

The AMA is manually interrupted.

Troubleshooting

- Re-run the AMA calibration.

ALARM 57, AMA Timeout**Cause**

AMA timeout.

Troubleshooting

- Try to restart the AMA. Repeated restarts can overheat the motor.

ALARM 58, AMA Internal Fault**Cause**

An AMA internal fault occurs.

Troubleshooting

- Contact a local Danfoss supplier.

WARNING/ALARM 59, Current Limit**Cause**

The current is higher than the value in parameter *4-18 Current Limit*.

Troubleshooting

- Ensure that the motor data in parameter *1-20* to parameter *1-25* is set correctly.
- Possibly increase the current limit.
- Be sure that the system can operate safely at a higher limit.

ALARM 60, External Interlock

Cause

A digital input signal indicates a fault condition external to the drive. An external interlock has commanded the drive to trip.

Troubleshooting

- Clear the external fault condition.
- To resume normal operation, apply 24 V DC to the terminal programmed for external interlock.
- Reset the drive.

WARNING/ALARM 61, Feedback Error

Cause

An error between calculated speed and speed measurement from feedback device.

Troubleshooting

- Check the settings for warning/alarm/disabling in parameter *4-30 Motor Feedback Loss Function*.
- Set the tolerable error in parameter *4-31 Motor Feedback Speed Error*.
- Set the tolerable feedback loss time in parameter *4-32 Motor Feedback Loss Timeout*.

WARNING/ALARM 62, Output Frequency Limit

Cause for Flux Mode

If the output frequency reaches the value set in parameter *4-19 Max Output Frequency*, the drive issues a warning. The warning ceases when the output drops below the maximum limit. If the drive is unable to limit the frequency, it trips and issues an alarm. The latter may happen in the Flux mode if the drive loses control of the motor.

Troubleshooting for Flux Mode

- Check the application for possible causes. The load torque could be too significant to drag the motor run to a high speed.
- Increase the output frequency limit. Ensure that the system can operate safely at a higher output frequency.

Cause for VVC TCL Mode

The output speed limit is reached, and the torque reference is derated. If the system is designed to reduce the speed by speed limit function, the warning only means that the speed limit is active.

Troubleshooting for VVC TCL Mode

- The system speed exceeds the speed limit, in this case, adjust the system speed or adjust the speed limit.
- If the speed limit function is used to control system speed, the warning can be ignored.

ALARM 63, Mechanical Brake Low

Cause

The actual motor current has not exceeded the release brake current within the start delay time window.

WARNING 64, Voltage Limit

Cause

The load and speed combination demands a motor voltage higher than the actual DC-link voltage.

Troubleshooting

- Check if the mains input is not high enough.
- Check if the output frequency is too high above motor nominal frequency.

WARNING/ALARM 65, Control Card Over Temperature**Cause**

The cutout temperature of the control card has exceeded the upper limit.

Troubleshooting

- Check that the ambient operating temperature is within the limits.
- Check the fan operation.
- Check the control card.

WARNING 66, Heat Sink Temperature Low**Cause**

The drive is too cold to operate. This warning is based on the temperature sensor in the IGBT module.

Troubleshooting

- Increase the ambient temperature of the unit.
- Supply a trickle amount of current to the drive whenever the motor is stopped by setting parameter *2-00 DC Hold/Preheat Current* to 5% and parameter *1-80 Function at Stop*.

ALARM 67, Option Module Configuration Has Changed**Cause**

One or more options have either been added or removed since the last power-down.

Troubleshooting

- Check that the configuration change is intentional and reset the unit.

ALARM 68, Safe Stop Activated**Cause**

The Safe Torque Off (STO) has been activated.

Troubleshooting

- To resume normal operation, apply 24 V DC to terminal 37, then send a reset signal via bus, digital I/O, or by pressing *[Reset]*.

WARNING/ALARM 69, Power Card Temperature**Cause**

The cutout temperature of the power card has exceeded the upper limit.

Troubleshooting

- Check that the ambient operating temperature is within limits.
- Check fan operation.
- Check the power card.

ALARM 70, Illegal FC Configuration

Cause

The control card and power card are incompatible.

Troubleshooting

- To check compatibility, contact the Danfoss supplier with the type code from the unit nameplate and the part numbers on the cards.

ALARM 71, PTC 1 Safe Stop

Cause

Because the motor is too warm, the VLT® PTC Thermistor Card MCB 112 activated Safe Torque Off (STO).

Troubleshooting

- Once the motor temperature reaches an acceptable level, and the digital input from MCB 112 is deactivated, perform 1 of the following:
 - Send a reset signal via bus or digital I/O.
 - Press [Reset].

ALARM 72, Dangerous Failure

Cause

Safe Torque Off (STO) with trip lock. An unexpected combination of STO commands has occurred.

Troubleshooting

- VLT® PTC Thermistor Card MCB 112 enables X44/10, but STO is not enabled.
- MCB 112 is the only device using STO (specified via *[4] PTC 1 alarm* or *[5] PTC 12 warning* in parameter *5-19 Terminal 37 Safe Stop*). STO is activated, but X44/10 is not.

WARNING 73, Safe Stop Auto Restart

Cause

STO is activated.

Troubleshooting

- With automatic restart enabled, the motor can start when the fault is cleared.

WARNING 76, Power Unit Setup

Cause

The required number of power units does not match the detected number of active power units.

Troubleshooting

- When replacing a drive module, this warning can occur if the power-specific data in the module power card does not match the rest of the drive. Confirm that the spare part and its power card are the correct code number.

WARNING 77, Reduced Power Mode

Cause

The drive is operating in reduced power mode (less than allowed number of inverter sections). The warning is generated on power cycle when the drive is set to run with fewer inverters and remains on.

ALARM 79, Illegal Power Section Configuration

Cause

The scaling card has an incorrect code number or is not installed. The MK102 connector on the power card could not be installed.

ALARM 80, Drive Initialized to Default Value

Cause

Parameter settings are initialized to default settings after a manual reset.

Troubleshooting

- To clear the alarm, reset the unit.

ALARM 81, CSIV Corrupt

Cause

The CSIV file has syntax errors.

ALARM 82, CSIV Parameter Error

Cause

CSIV failed to initialize a parameter.

ALARM 90, Feedback Monitor

Troubleshooting

- Check the connection to the encoder/resolver option and, if necessary, replace the VLT® Encoder Input MCB 102 or VLT® Resolver Input MCB 103.

ALARM 91, Analog Input 54 Wrong Settings

Troubleshooting

- Set switch S202 in position OFF (voltage input) when a KTY sensor is connected to analog input terminal 54.

WARNING/ALARM 92, No Flow

Cause

A no-flow condition has been detected in the system. Parameter **22-23 No-Flow Function** is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the drive after the fault has been cleared.

WARNING/ALARM 93, Dry Pump

Cause

A no-flow condition in the system with the drive operating at high speed may indicate a dry pump. Parameter **22-26 Dry Pump Function** is set for warning or alarm.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING/ALARM 94, End of Curve

Cause

Feedback is lower than the setpoint. This may indicate a leakage in the system. Parameter *22-50 End of Curve Function* is set for warning or alarm.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING/ALARM 95, Broken Belt

Cause

Torque is below the torque level set for no load, indicating a broken belt. Parameter *22-60 Broken Belt Function* is set for alarm.

Troubleshooting

- Troubleshoot the system and reset the drive after clearing the fault.

WARNING 96, Start Delayed

Cause

Motor start has been delayed due to short-cycle protection. Parameter *22-76 Interval between Starts* is enabled.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING 97, Stop Delayed

Cause

Stopping the motor has been delayed due to short-cycle protection. Parameter *22-76 Interval between Starts* is enabled.

Troubleshooting

- Troubleshoot the system.
- Reset the drive when the fault is cleared.

WARNING 98, Clock Fault

Cause

Time is not set or the RTC clock has failed.

Troubleshooting

- Reset the clock in parameter *0-70 Date and Time*.

ALARM 99, Locked Rotor

Cause

The rotor is blocked. It is only enabled for PM motor control.

Troubleshooting

- Check if the motor shaft is locked.

- Check if the start current triggers the current limit set in parameter **4-18 Current Limit**.
- Check if it increases the value in parameter **30-23 Locked Rotor Detection Time [s]**.

WARNING/ALARM 104, Mixing Fan Fault

Cause

The fan is not operating. The fan monitor checks that the fan is spinning at power-up or whenever the mixing fan is turned on. The mixing fan fault can be configured as a warning or an alarm in parameter **14-53 Fan Monitor**.

Troubleshooting

- Cycle power to the drive to determine if the warning/alarm returns.

ALARM 144, Inrush Supply

Cause

A supply voltage on the inrush card is out of range.

Troubleshooting

- See the bit field result report value for more details.
 - Bit 2: Vcc high
 - Bit 3: Vcc low
 - Bit 4: Vdd high
 - Bit 5: Vdd low

ALARM 145, External SCR Disable

Cause

The alarm indicates a series DC-link capacitor voltage imbalance.

WARNING/ALARM 146, Mains Voltage

Cause

Mains voltage is outside valid operating range.

Troubleshooting

- See the following report values for details.
 - Voltage too low: 0=R-S, 1=S-T, 2=T-R
 - Voltage too high: 3=R-S, 4=S-T, 5=T-R

WARNING/ALARM 147, Mains Frequency

Cause

Mains frequency is outside valid operating range.

Troubleshooting

- The following report values provide more information:
 - 0: frequency too low
 - 1: frequency too high

WARNING/ALARM 148, System Temp

Cause

One or more of the system temperature measurements is too high.

WARNING 163, ATEX ETR Cur.Lim.Warning

Cause

The drive has run above the characteristic curve for more than 50 s. The warning is activated at 83% and deactivated at 65% of the allowed thermal overload.

Alarm 164, ATEX ETR Cur.Lim.Alarm

Cause

Running above the characteristic curve for more than 60 s within a period of 600 s activated the alarm, and the drive trips.

WARNING 165, ATEX ETR Freq.Lim.Warning

Cause

The drive has run for more than 50 s below the allowed minimum frequency as set in parameter *1-98 ATEX ETR Interpol. Points.Freq.*.

ALARM 166, ATEX ETR Freq.Lim.Alarm

Cause

The drive has run for more than 60 s in a period of 600 s below the allowed minimum frequency as set in parameter *1-98 ATEX ETR Interpol. Points. Freq.*.

Warning 200, Emergency Mode

Cause

Emergency mode is active.

Troubleshooting

- The warning clears when emergency mode is removed.
- See the emergency mode data in the alarm log.

Warning 201, Emerg. M Was Active

Cause

Emergency mode is no longer active.

Troubleshooting

- Cycle power to the unit to remove the warning. See the emergency mode data in the alarm log.

Warning 202, Emerg. M Limits Exceeded

Cause

While operating in emergency mode, 1 or more alarm conditions have been ignored, which would normally trip the unit. Operating in this condition voids the warranty of the unit.

Troubleshooting

- Cycle power to the unit to remove this warning. See the emergency mode data in the alarm log. See parameter **18-10 Emergency Mode Log** for further details.

Warning 217, Protection Mode

Either motor current or DC voltage has reached the hardware limit.

Troubleshooting

- Check that the drive matches the motor requirements.
- Check that the motor is not overloaded.
- Check the input power supply and motor configurations.

Warning 218, Stall Limit

During torque limit, current limit, or field weakening, the drive runs in stall protection and is not able to follow the reference.

Troubleshooting

- Check that the motor is not overloaded.
- Tune the stall protection adjustment factor.

WARNING 220, Configuration File Version not Supported

Cause

The drive does not support the current configuration file version. Customization is aborted.

ALARM 243, Brake IGBT

Cause

This alarm is only for multi-drive systems. It is equivalent to *Alarm 27, Brake chopper fault*. The report value in this alarm log indicates which drive module generated the alarm. This IGBT fault can be caused by any of the following:

- The DC fuse is blown.
- The brake jumper is not in position.
- The Klaxon switch opened due to an overtemperature condition in the brake resistor.

Indication of the drive module generating the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

ALARM 244, Heat Sink Temperature

Cause

The maximum temperature of the heat sink has been exceeded. The temperature fault cannot reset until the temperature drops below the defined heat sink temperature. The trip and reset points are different, based on the power size. This alarm is equivalent to *Alarm 29, Power module temp*.

Troubleshooting

- Check for the following:
 - a. Ambient temperature too high.

- b. Motor cables too long.
- c. Incorrect airflow clearance above or below the AC drive.
- d. Blocked airflow around the unit.
- e. Damaged heat sink fan.
- f. Dirty heat sink.

ALARM 245, Heat Sink Sensor

Cause

There is no feedback from the heat sink temperature sensor. This signal from the IGBT thermal sensor is not available on the power card. This alarm is equivalent to *Alarm 39, Heat sink sensor*.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from the left.
- 3 = Third drive module from the left (in 4-module systems).
- 4 = Fourth drive module from the left (in 4-module systems).

Troubleshooting

- Check the power card.
- Check the gate drive card.
- Check the ribbon cable between the power card and the gate drive card.

ALARM 246, Power Card Supply

Cause

The supply on the power card is out of range. This alarm is only for multi-drive systems. It is equivalent to *Alarm 46, Power card supply*.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

ALARM 247, Power Card Temperature

Cause

This alarm is only for multi-drive systems. It is equivalent to *Alarm 69, Power card temperature*.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

ALARM 248, Illegal Power Section Configuration

Cause

This alarm is only for multi-drive systems. It is equivalent to *Alarm 79, Illegal power section configuration*.

The report value in the alarm log indicates which drive module generated the alarm:

- 1 = Left drive module.
- 2 = Second drive module from left.
- 3 = Third drive module from left (in 4-module systems).
- 4 = Fourth drive module from left (in 4-module systems).

Troubleshooting

- Check the current scaling cards on the MDCIC.

WARNING 249, Rect. Low Temperature

Cause

The temperature of the rectifier heat sink is too low, which indicates that the temperature sensor may be detect.

WARNING 250, New Spare Part

Cause

A component in the drive system has been replaced.

Troubleshooting

- Enter the serial number and type code for canceling the trip lock status after a power cycle.

WARNING 251, New Typecode

Cause

The power card or other components have been replaced, and the type code has changed.

Troubleshooting

- Reset the drive for normal operation.

Alarm 260, AMA Complete

An alarm has coasted the drive after AMA was executed via fieldbus.

Troubleshooting

- Ensure that AMA data is completed properly.
- Check the AMA status in parameter **18-65 AMA Status**.

Warning 280, Emcy M Service Warning

Cause

Emergency mode requires service.

Troubleshooting

- Contact a Danfoss supplier or the Danfoss service department.

Warning 281, Emcy OPR unexpected

Cause

Emergency mode critical alarm has occurred and impacts the drive performance in Emergency mode.

Troubleshooting

- Reset the drive.
- If resetting the drive does not solve the problem, contact Danfoss service department.

ALARM 421, FPC Temp

Cause

A fault caused by the on-board temperature sensor is detected on the fan power card. The report values identify which fan power card detected the fault.

Troubleshooting

- Check the wiring.
- Check the on-board temperature sensor.
- Replace the fan power card.

ALARM 423, FPC Updating

Cause

The alarm is generated when the fan power card reports that it has an invalid PUD. The control card attempts to update the PUD. A subsequent alarm can result depending on the update. See *Alarm 424, FPC Update Successful* and *Alarm 425, FPC Update Failure*.

ALARM 424, FPC Update Successful

Cause

This alarm is generated when the control card has updated the fan power card PUD successfully.

Troubleshooting

- Press *[Reset]* to stop the alarm.

ALARM 425, FPC Update Failure

Cause

This alarm is generated after the control card failed to update the fan power card PUD.

Troubleshooting

- Check the fan power card wiring.
- Replace the fan power card.
- Contact supplier.

ALARM 426, FPC Config

Cause

The number of found fan power cards does not match the number of configured fan power cards. See parameter group *15-6* Option Ident* for the number of configured fan power cards.

Troubleshooting

- Check fan power card wiring.
- Replace the fan power card.

ALARM 427, FPC Supply**Cause**

Supply voltage faults (5 V, 24 V, or 48 V) on the fan power card is detected.

Troubleshooting

- Check fan power card wiring.
- Replace the fan power card.

ALARM 432, Inrush Mode Error**Cause**

An active inrush card reported the wrong mode. The report value indicates which inrush card reported the alarm.

Troubleshooting

- Check inrush card wiring.
- Replace the inrush card.

Warning 500, Motor Stator Winding Warning 2**Cause**

The stator winding reached condition orange. A severe fault might occur soon in the motor.

Troubleshooting

- Check the stator windings.

Warning 501, Load Envelope Warning 2**Cause**

Application load has reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased motor load.

Warning 502, Vibration Monitoring Warning 2**Cause**

A significant increase in motor vibration is detected. The vibration levels have reached condition orange.

Troubleshooting

- Investigate the root cause for severe vibration.

Warning 506, Load Envelope Low Warning 2

The application load has reached condition orange low limit.

Troubleshooting

- Investigate the root cause for the decrease in motor load and then check the load specified for the application

Warning 507, Cavitation Warning 2

Cause

There is a further increase of turbulence in the pump, indicating the possibility of cavitation. The cavitation has reached condition orange.

Troubleshooting

- Investigate the root cause of the increased turbulence.
- Check if the pump operates as specified in datasheets at the correct pressure-flow operation point.
- Check the hydraulic system for pressure drop at the pump inlet.
- Check for clogged pipes or filters.

ALARM 510, Motor Stator Winding Alarm

Cause

Stator winding has reached condition red. A severe fault is detected in the motor.

Troubleshooting

- Check motor stator winding.

WARNING 510, Motor Stator Winding Warning 1

Cause

Stator winding reached condition yellow. An early fault is detected in the motor.

Troubleshooting

- Check the motor stator winding.

ALARM 511, Load Envelope Alarm

Cause

Application load has reached condition red.

Troubleshooting

- Check root cause for excessive overload or underload.

WARNING 511, Load Envelope Warning 1

Cause

Application load has reached condition yellow.

Troubleshooting

- Check root cause for high motor load.

Alarm 512, Sensor 1 Monitoring Alarm

Cause

There is an excessive amount of motor vibration on sensor 1. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 512, Sensor 1 Monitoring Warning 1

Cause

An increase in the Sensor 1 value is detected. The value levels in Sensor 1 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 513, Sensor 2 Monitoring Warning 1

Cause

There is an excessive amount of motor vibration on sensor 2. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 513, Sensor 2 Monitoring Warning 1

Cause

An increase in the Sensor 2 value is detected. The value levels in Sensor 2 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 514, Sensor 3 Monitoring Alarm

Cause

There is an excessive amount of motor vibration on sensor 3. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 514, Sensor 3 Monitoring Warning 1

Cause

An increase in the Sensor 3 value is detected. The value levels in Sensor 3 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 515, Sensor 4 Monitoring Alarm

Cause

There is an excessive amount of motor vibration on sensor 4. The vibration levels have reached condition red.

Troubleshooting

- Investigate the root cause for the excessive vibration. Before commissioning of condition-based monitoring, ensure to comply with the ISO10816 standard for machinery.

Warning 515, Sensor 4 Monitoring Warning 1

Cause

An increase in the Sensor 4 value is detected. The value levels in Sensor 4 have reached condition yellow.

Troubleshooting

- Investigate the root cause for the increased values.

Alarm 516, Load Envelope Low Alarm

The application load has reached low-level condition red.

Troubleshooting

- Investigate the root cause for the decrease in motor load and then check the load specified for the application.

Warning 516, Load Envelope Low Warning 1

The application load has reached low-level condition yellow.

Troubleshooting

- Investigate the root cause for the decrease in motor load and then check the load specified for the application.

Alarm 517, Cavitation Alarm

Cause

There is an excessive turbulence at the pump, indicating the possibility of cavitation. Cavitation has reached condition red.

Troubleshooting

- Investigate the root cause of the increased turbulence.
- Check if the pump operates as specified in datasheets at the correct pressure-flow operation point.
- Check the hydraulic system for pressure drop at the pump inlet.
- Check for clogged pipes or filters.

Warning 517, Cavitation Warning 1

Cause

There is an increased turbulence at the pump, indicating the possibility of cavitation. Cavitation has reached condition yellow.

Troubleshooting

- Investigate the root cause of the increased turbulence.
- Check if the pump operates as specified in datasheets, at the correct pressure-flow operation point.
- Check the hydraulic system for pressure drop at the pump inlet.
- Check for clogged pipes or filters.

Warning 520, Stator Thld At Max/Min

Cause

The stator in the condition-based monitoring is either at its minimum or maximum limit.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-2* Stator** and adjust the values if needed.

- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 521, Load Thld At Max/Min

Cause

The load threshold in the condition-based monitoring is either at its minimum or maximum.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-3* Load** and adjust the values if needed.
- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 522, Sensor 1 Thld At Max/Min

Cause

The sensor 1 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 1 function.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-4* Sensor 1** and adjust the values if needed.
- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 523, Sensor 2 Thld At Max/Min

Cause

The sensor 2 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 2 function.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-5* Sensor 2** and adjust the values if needed.
- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 524, Sensor 3 Thld At Max/Min

Cause

The sensor 3 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 3 function.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-6* Sensor 3** and adjust the values if needed.
- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 525, Sensor 4 Thld At Max/Min

Cause

The sensor 4 threshold in the condition-based monitoring is at its minimum or maximum value of the Sensor 4 function.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-7* Sensor 4** and adjust the values if needed.
- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 527, Cavitation Thld At Max/Min

Cause

The cavitation threshold in the condition-based monitoring is at its minimum or maximum value of the cavitation function.

Troubleshooting

- Check the threshold values at maximum or minimum in parameter group **46-** CBM Adv Thresholds** to parameter group **46-8* Cavitation** and adjust the values if needed.
- Acknowledge the generation by setting parameter **45-46 Threshold Limit** to **[0] Limit OK**.

Warning 531, Sine-wave Filter Warning 2

Cause

The sine-wave filter has reached condition orange. An increased degradation is detected on the capacitors in the output sine-wave filter. A severe fault may occur soon in the sine-wave filter.

Troubleshooting

- Investigate the root cause for the capacitor degradation, such as high ambient temperature or humidity.
- Check that the loading conditions and the drive switching frequency are within the specifications.
- Check for aging.

Alarm 541, Sine-wave Filter Alarm

Cause

The sine-wave filter has reached condition red. A severe degradation is detected on the capacitors in the output sine-wave filter. A severe fault is detected in the sine-wave filter.

Troubleshooting

- Investigate the root cause for the capacitor degradation, such as high ambient temperature or humidity.
- Check that the loading conditions and drive switching frequency are within the specifications.
- Check for aging.

Warning 541, Sine-wave Filter Warning 1

Cause

The sine-wave filter has reached condition yellow. An early degradation is detected on the capacitors in the sine-wave filter.

Troubleshooting

- Investigate the root cause for the capacitor degradation, such as high ambient temperature or humidity.
- Check that the loading conditions and drive switching frequency are within the specifications.
- Check for aging.

Warning 549, Sine-wave Filter Out of Range Measurement

Cause

The measurement range of the capacitors in the sine-wave filter reached its limits.

Troubleshooting

- Extend the measurement range by increasing parameter **49-15 Frequency Sweep Max**, or by decreasing parameter **49-14 Frequency Sweep Min**. Alternatively, repeat the measurement at another operating point of the motor.

- Check for correct installation of the sine-wave filter.
- Measure and replace capacitors if needed.

Alarm 550, Sensor 1 Low Monitoring Alarm

The value measured on Sensor 1 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 550, Sensor 1 Low Monitoring Warning 1

The value measured on Sensor 1 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Alarm 551, Sensor 2 Low Monitoring Alarm

The value measured on Sensor 2 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 551, Sensor 2 Low Monitoring Warning 1

The value measured on Sensor 2 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Alarm 552, Sensor 3 Low Monitoring Alarm

The value measured on Sensor 3 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 552, Sensor 3 Low Monitoring Warning 1

The value measured on Sensor 3 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Alarm 553, Sensor 4 Low Monitoring Alarm

The value measured on Sensor 4 is very low and has reached condition red low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.

Warning 553, Sensor 4 Low Monitoring Warning 1

The value measured on Sensor 4 is very low and has reached condition yellow low.

Troubleshooting

- Investigate the root cause for the value reaching the red low level. For example, lost connection to analog inputs or no proper data communication on fieldbus sensors.



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