INOVANCE

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MD310 Series General-Purpose AC Drive User Guide

Industrial automation | Intelligent Elevator | New Energy Vehicle | Industrial Robot | Rail Transit

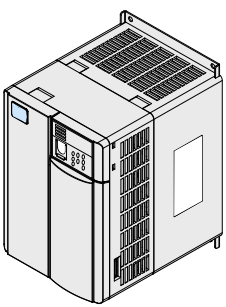
Data code 19012579A00

Preface

Thank you for purchasing the MD310 series AC drive developed by Inovance.

The MD310 series AC drive is a compact general-purpose multi-function AC drive. It adopts open-loop vector control and V/f control to drive asynchronous motors. The power range of MD310 series AC drive covers 0.4 kW to 18.5 kW. It can achieve close-loop process control that allows up to 16 speeds in multi-reference operation mode through the built-in RS485 communication interface and PID. With the wobble frequency and fixed length control functions, it can be applied in industries including textile, paper-making, wire drawing, machine tool, packaging, food, wind turbine, and water pump.

This user guide describes the functions and usage of the MD310, including model selection, parameter setting, commissioning, and maintenance. Read through the user guide carefully before use. Keep this user guide properly for future reference. The equipment integrator must deliver this user guide together with the equipment to end users.



Precaution
◆ Drawings in the user guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions. ◆ The drawings in the manual are shown for description only and may not match the product you purchased. ◆ The instructions are subject to change, without notice, due to product upgrade, specification modification as well as efforts to increase the accuracy and convenience of the manual. ◆ Operators must take mechanical precautions to protect personal safety and wear protective equipment, such as safety shoes, safety clothing, safety glasses, protective gloves, and protective sleeves.

- Unpacking

Check the following items upon unpacking.

Check that the nameplate and AC drive ratings are consistent with your order.

Check that the product is not damaged during transportation. If you find any parts missing or damaged, contact your supplier or Inovance immediately.

- Precautions for New Users

Read through this user guide carefully before use for the first time. If you have any question concerning product functions or performance, contact Inovance for technical support.

- Directives and standards

The following table lists the certifications, directives, and standards that the product may comply with. For details about the acquired certificates, see the certification marks on the product nameplate.

Certification	Directive		Standard
CE	EMC	2014/30/EU	EN IEC 61800-3
	LVD	2014/35/EU	EN 61800-5-1
	RoHS	2011/65/EU	EN 50581
UL/cUL	-		UL61800-5-1 C22.2 No.274-17

Appllicant Suzhou Inovance Technology Co., Ltd.
AC Drive
Model MD310 series
Made In China
Manufacturer
Suzhou Inovance Technology Co.,Ltd

A급기기 (업무용 방송통신기자재)
이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며,가정외의 지역에서 사용하는 것을 목적으로 합니다.

- Tuning of drive parameters

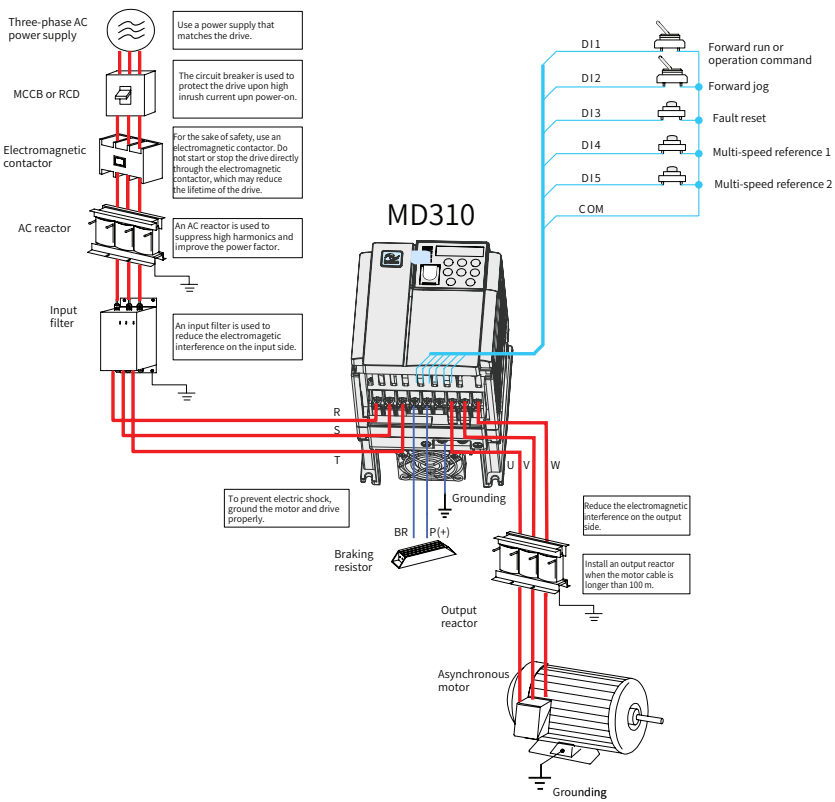
The default setting of the drive are used to check the basic operating conditions easily, which can

be fine-tuned as needed to improve the operation performance.

Parameter tuning can be performed only by qualified personnel who have received relevant training. Improper operation may result in unexpected consequences. Especially during the start phase of commissioning, no unrelated persons should be allowed to touch the machine.

This guide provides a complete list of parameters and function descriptions. Pay attention when you perform parameter tuning with power on. Inovance and authorized distributors can provide product training courses. If you have any questions, contact Inovance technical support.

- Connection to peripheral devices



Connection to peripheral devices

Note:

Do not install capacitor or surge suppression device on the output side of the drive. Failure to

comply can result in faults or damage the capacitor and surge suppression device.

The input/output (main circuit) of the drive can generate harmonics, which may disturb the communication devices around the drive. Therefore, install an anti-interference filter to minimize the disturbance.

For more details on peripheral devices, see their user guides.

- Use of peripheral devices

Instructions for using peripheral devices of MD310

Name	Installation position	Function
Molded case circuit breaker (MCCB) or residual current device (RCD)	Front end of the input circuit	Used to cut off the power supply when overcurrent occurs.
Electromagnetic contactor	Between air switch and AC drive input side	Used to start and stop the AC drive. Do not start and stop the AC drive frequently by switching the contactor on and off (less than twice per minute) or start the AC drive thorough the contactor directly.
AC reactor	AC drive input side	Used to: 1. Improve the power factor on the input side. 2. Eliminate harmonics on the input side and prevent other devices from being damaged due to voltage waveform distortion. 3. Eliminate input current unbalance caused by inter-phase unbalance.
Input filter	AC drive input side	Used to reduce the conduction and radiation interference generated by the AC drive to external devices and reduce conduction interference that generated by the power supply to improve the anti-interference capacity of the AC drive.
Output reactor	AC drive output side and close to the drive	Used to protect the motor insulation and reduce the bearing current.
Common mode filter	AC drive output side and close to the drive	Used to reduce the bearing current.

- Note: For how to select peripheral devices, see "7.3 Selection of Peripheral EMC Devices" and "9.1 Selection of Peripherals and Options".

Revision history

Date	Version	Description
December 2024	A00	◆ First release

About this guide

This user guide is subject to change without notice. Download the latest document by the following means.

- ◆ Contact Inovance agents.
- ◆ Do keyword search under **Service and Support** at http://www.inovance.com.
- ◆ Scan the QR code below to install the app, where you can search for and download the user guide.

Warranty disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for faults or damage that occur during normal operation. Maintenance will be charged after the warranty expires.

Within the warranty period, maintenance will be charged for the following damage:

- ◆ Damage caused by operations not following the instructions in the user guide
- ◆ Damage caused by fire, flood, or unusual voltage
- ◆ Damage caused by unintended use of the product
- ◆ Damage caused by use beyond the specified scope of application of the product
- ◆ Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

For details, see Product Warranty Card.

Contents

1 Fundamental Safety Instructions

1.1 Safety Disclaimer

1) Read and follow the safety instructions when installing, operating, and maintaining the equipment.
2) To ensure personal and equipment safety, observe the notes indicated on the product labels and all the safety instructions in the user guide.
3) "CAUTION", "WARNING", and "DANGER" in the user guide only indicate some of the precautions that need to be followed; they just supplement the safety precautions.
4) Use this equipment according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
5) Inovance shall take no responsibility for any personal injury or property damage caused by improper use.

1.2 Safety Levels and Definitions

"DANGER" indicates that failure to comply with the notice can result in severe personal injury or even death.

"WARNING" indicates that failure to comply with the notice may result in severe personal injury or even death.

"CAUTION" indicates that failure to comply with the notice may result in minor or moderate personal injury or equipment damage.

1.3 Safety Precautions

Unpacking
 ◆ Check whether the packing is intact and whether there is signs of damage, water seepage, damp, and deformation. ◆ Unpack the package by following the package sequence. Do not strike the package with violently. ◆ Check whether there is damage, rust, or injuries on the surface of the equipment and equipment accessories before unpacking. ◆ Check whether the package contents are consistent with the packing list before unpacking.

WARNING

- Do not install the equipment if you find damage, rust, or signs of use on the equipment or accessories upon unpacking.
- Do not install the equipment if you find water seepage or missing or damaged components upon unpacking.
- Do not install the equipment if you find the packing list does not comply with the equipment you received.

Storage and transportation

CAUTION

- Store and transport the product according to the following requirements. The storage temperature and humidity requirements must be met.
- Do not store or transport the drive in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing this product for more than three months. Long-term storage requires stricter protection and necessary inspection.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or affect the equipment adversely.

WARNING

- Use professional loading and unloading tool to carry large-scale or heavy equipment.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.

Installation

WARNING

- Read through the guide and safety instructions before installation.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- Do not install this equipment in places with strong electric or magnetic fields.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.

DANGER

- Installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Installation, wiring, maintenance, inspection, or parts replacement must be carried out by professionals.
- Ensure that the installation personnel is familiar with equipment installation requirements and related technical information.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.

Wiring

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Never perform wiring with power on. Failure to comply can result in electric shock.
- Before wiring, cut off all the power supplies of the equipment. After disconnecting the power supply, wait for at least 10 minutes before further operations because residual voltage still exists in the internal capacitor even after power-off.
- Check that the equipment is grounded properly. Failure to comply can result in electric shock.
- Follow proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or internal circuit of the product.

WARNING

- Do not connect the input power supply to the output end of the equipment. Failure to comply can result in equipment damage or even a fire.
- When connecting a drive to the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used for wiring must meet cross sectional area and shielding requirements. The shield of the cable must be reliably grounded at one end.
- After wiring, make sure there are no fallen screws or exposed wire inside the device.

Power-on

DANGER

- Before power-on, ensuret the equipment is installed and wired properly and the motor can be restarted.
- Before power-on, ensure that the power supply meets requirements. Failure to comply can result in equipment damage or even a fire.
- During power-on, unexpected operations may be triggered on the equipment. Therefore, stay away from the equipment.
- After power-on, do not open the cabinet door and protective cover of the equipment. Failure to comply will result in an electric shock.
- Do not touch any wiring terminals during power-on. Failure to comply can result in electric shock.
- After power-on, do not disassemble any unit or component of the equipment. Failure to comply can result in electric shock.

Operation

DANGER

- Do not touch any wiring terminals during operation. Failure to comply will result in an electric shock.
- Do not remove any part of equipment or the product during operation. Failure to comply may result in an electric shock.
- Do not touch the equipment enclosure, fan, or resistor with bare hands. Failure to comply may result in personal injury.
- Signal detection must be performed by only professionals during operation. Failure to comply can result in personal injury or equipment damage.

WARNING

- Prevent metal or other objects from falling into the device during operation. Failure to comply may result in equipment damage.
- Do not start or stop the equipment by using the contactor. Failure to comply may result in equipment damage.

Maintenance

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power on. Failure to comply can result in electric shock.
- Before maintenance, switch off all the power supplies of the equipment and wait for at least 10 min.

WARNING

- Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not maintain the equipment with power on. Failure to comply can result in electric shock.
- Before inspection and repair, disconnect all the power supplies of the equipment and wait for at least 10 minutes.

WARNING

- Submit the repair request according to the warranty agreement.
- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment in according with the replacement instructions.
- Do not operate damaged equipment. Failure to comply may result in worse damage.
- After the equipment is replaced, check the wiring and set parameters again.

Disposal

WARNING

- Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injuries, or even death.
- Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

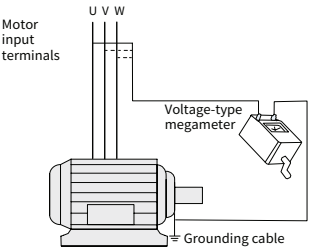
1.4 Precautions

1) Requirements on the residual current device (RCD)

The equipment generates high leakage current during operating, which flows through the protective grounding conductor. Thus install a type-B RCD at primary side of the power supply. When selecting the RCD, take into account the transient and steady-state leakage current to ground, such current may be generated upon start and during operation of the device. Select a specialized RCD which can suppress high harmonics or a general-purpose RCD with relatively high residual current.

2) Motor insulation inspection

Perform insulation inspection when the motor is used for the first time, reused after long-term storage, or during regular inspection, preventing damage to the drive caused by damaged motor winding insulation. Disconnect the motor from the drive during insulation inspection. A 500 V megameter is recommended for the inspection. The insulation resistance measured must be higher than or equal to 5 MΩ.



3) Motor thermal protection

If the rated capacity of the motor selected does not match that of the AC drive, especially when

the AC drive' s rated power is greater than the motor' s rated power, adjust the motor protection parameters or install a thermal relay for protection.

4) Running at frequencies higher than the mains frequency

The drive outputs 0 Hz to 500 Hz frequencies. Take the bearing capacity of the mechanical device into account if you need to operate the drive at frequencies higher than 50 Hz.

5) Vibration of mechanical device

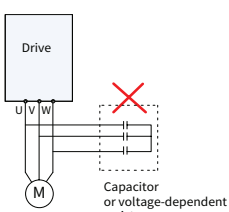
The AC drive may encounter the mechanical resonance point at some output frequencies, which can be avoided by setting the skip frequency.

6) Motor temperature rise and noise

The output of the AC drive is pulse width modulation (PWM) wave with harmonics. Therefore, the motor temperature, noise, and vibration are slightly greater than those when the AC drive runs at the mains frequency (50 Hz).

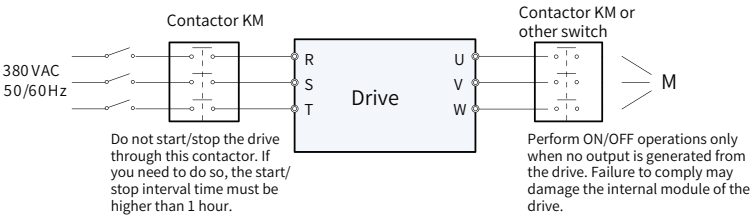
7) Voltage-dependent components or capacitors for improving power factor on the output side

Do not install the capacitor for improving power factor or voltage-dependent resistor for lightening protection on the output side of drive. Failure to comply can result in transient overcurrent that may damage the drive. Do not install such capacitor on the output side.



8) Contactor at the I/O terminal of the AC drive

When a contactor is installed between the input side of the AC drive and the power supply, do not start or stop the drive thorough this contactor. If you need to start/stop the drive thorough this contactor, ensure that the ON/OFF interval at least 1 hour. Service life of the capacitor inside the cabinet unit may be shortened in case of frequent charging/discharging. When a switching device such as a contactor is installed between the output side of the AC drive and the motor, turn on/off the switching device only when the drive does not generate any output. Failure to comply can easily damage the module inside the drive.



9) Violation of rated voltage

Operate the drive within the permissible operating voltage range. Failure to comply can damage the components inside the drive. Use a proper boost or buck device to convert the power supply voltage and input the converted voltage to the drive as needed.

10) Three-phase input changed to two-phase input

Do not change the three-phase input of the AC drive into two-phase input. Failure to comply can result in faults or damage the drive.

11) Lightning shock protection

The drive is built-in with an overcurrent protection device against inductive lightening. In areas with frequent lighting strikes, however, an additional lighting protection device must be installed to the front end of the drive.

12) Altitude-based derating

In places where the altitude is above 1000 m and the cooling effect reduces due to thin air, it is necessary to derate the AC drive during use. Contact the agent or Inovance for details on derating.

13) Special use

If wiring that not described in this manual such as common DC bus is needed, contact Inovance for technical support.

14) Disposal

The electrolytic capacitors on the main circuits and PCBs may explode when they are being burnt. In addition, poisonous gas will be generated from the plastic parts during incineration. Dispose of the AC drive as industrial waste.

15) Applicable motor

- The standard applicable motor is four-pole squirrel-cage asynchronous induction motor. For other types of motor, select a proper AC drive according to the rated motor current.
- For use of a constant frequency motor with the cooling fan and rotor shaft connected coaxially, as the cooling effect of the fan deteriorates when the motor slows down, install an extra exhaust fan or replace with a variable frequency motor in case of motor overtemperature.
- The standard parameters of the applicable motor have been configured into the AC drive. However, you may need to perform motor parameter auto-tuning or modify the default

values as needed. Otherwise, the operation effect and protection performance may be affected.

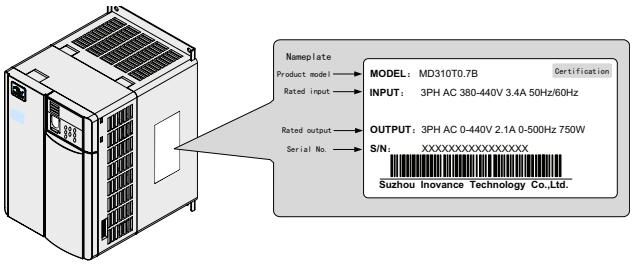
- The AC drive may alarm or even be damaged when short circuit occurs in cables or motor. Therefore, perform an insulation short circuit test when the motor and cables are newly installed or during routine maintenance. During the test, make sure that the AC drive is disconnected from the tested parts.

2 Product Information

2.1 Naming Rules and Nameplate Information

NOTE

The following nameplate is used as an example. The actual nameplate is subject to the product.



MD310 T 0.7 B

Code	Name
MD310	AC drive series

Code	Voltage class
T	Three-phase 380 V

Code	Braking unit
B	Braking unit included

Code	Power rating
0.4	0.4 kW
...	...
18.5	18.5 kW

Figure 2-1 Nameplate and naming rules

2.2 MD310 Series AC Drive

Table 2-1 MD310 series AC drive models and technical data

Drive model	Power capacity (kVA)	Input current (A)	Output current (A)	Applicable motor	
				kW	HP
Three-phase power supply: 380 V to 440 V, 50 Hz/60 Hz Range: 323 V to 484 V (-15% to +10%)					
MD310T0.4B	1.0	1.9	1.5	0.4	0.5
MD310T0.7B	1.5	3.4	2.1	0.75	1
MD310T1.5B	3.0	5.0	3.8	1.5	2
MD310T2.2B	4.0	5.8	5.1	2.2	3
MD310T3.7B	5.9	10.5	9.0	3.7	5

Drive model	Power capacity (kVA)	Input current (A)	Output current (A)	Applicable motor	
				kW	HP
MD310T5.5B	8.9	14.6	13.0	5.5	7.5
MD310T7.5B	11.0	20.5	17.0	7.5	10
MD310T11B	17.0	26.0	25.0	11.0	15
MD310T15B	21.0	35.0	32.0	15.0	20
MD310T18.5B	24.0	38.5	37.0	18.5	25

2.3 Technical Data

Table 2-2 Technical data of the drive

Item		Specifications	
Basic functions	Max. frequency	Vector control: 0 Hz to 300 Hz V/f control: 0 Hz to 500 Hz	
	Carrier frequency	0.5 kHz to 16 kHz The carrier frequency is automatically adjusted based on the load features.	
	Input frequency resolution	Digital setting: 0.01 Hz Analog setting: maximum frequency x 0.025%	
	Control mode	Sensorless vector control (SVC) V/f control	
	Starting torque	Open loop vector control: 0.5 Hz/150% (SVC) V/f: 1.0 Hz/100%	
	Speed regulation range	1:100 (SVC)	1:50 (V/f)
	Speed stability accuracy	±0.5% (SVC)	±1% (V/f)
	Overload capacity	1 hour at 120% of the rated load; 1 minute at 150% of the rated load; 2 seconds at 180% of the rated load	
	Torque boost	Automatic torque boost; manual torque boost: 0.1 % to 30.0%	
	V/f curve	Straight-line V/f curve Multi-point V/f curve N-power (1.2-power, 1.4-power, 1.6-power, 1.8-power, 2-power) V/f curve	
	Separated V/f	Fully separated mode and partially separated mode	
	Acceleration/ Deceleration curve	Straight-line or S-curve acceleration/deceleration Four groups of acceleration/deceleration time, ranging from 0.0s to 6500.0s	

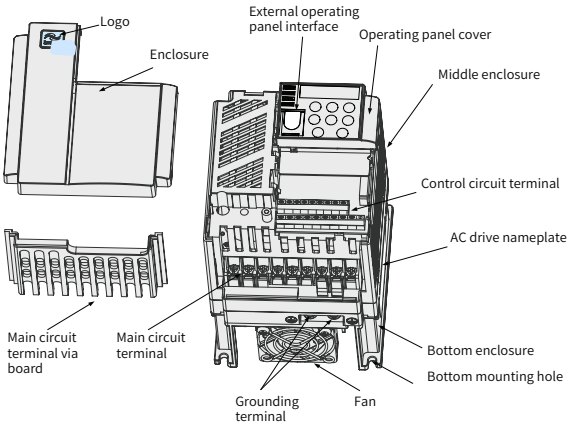
Item		Specifications
Basic functions	DC braking	DC braking frequency: 0.00 Hz to maximum frequency Braking time: 0.0s to 36.0s Braking current: 0.0% to 100.0%
	Jog control	Jog frequency range: 0.00 Hz to 50.00 Hz Jog acceleration/deceleration time: 0.0s to 6500.0s
	Simple PLC, multi-reference operation	The AC drive supports up to 16 speeds through the built-in PLC function or control terminals.
	Built-in PID	Facilitates closed-loop process control.
	Automatic voltage regulation (AVR)	When the mains voltage changes, the output voltage keeps constant automatically.
	Overvoltage/ Overcurrent stall control	Limits the current and voltage automatically during operation to prevent frequent tripping caused by overvoltage/ overcurrent.
	Quick current limit	Minimizes the occurrence of overcurrent to ensure normal operation of the AC drive.
	Torque limit and control	Limits the torque automatically during operation to prevent frequent tripping caused by overcurrent.
Customized function	High performance	Asynchronous motors are controlled through high-performance current vector control technology.
	Power dip ride-through	The load feedback energy compensates the voltage reduction at instantaneous power failure, enabling the AC drive to continue operating within a short time.
	Quick current limit	Prevents frequent overcurrent faults.
	Virtual DI/DO	Five groups of virtual DIs/DOs are supported to implement simple logic control.
	Timing control	Time range: 0.0 min to 6500.0 min
	Motor switchover	The AC drive has two groups of motor parameters and can control up to two motors.
	Multiple fieldbuses available	Two fieldbuses available: Modbus-RTU and CANlink
	Powerful software	Allows users to operate on AC drive parameters and supports virtual oscilloscope function. The internal state of the drive is displayed in the form of graphics through the virtual oscilloscope.

Item		Specifications
Operation	command source	Three sources are available: operating panel, control terminal, and serial communication port. The reference sources can be switched in various ways.
	Frequency source	Ten frequency reference sources are available including digital setting, analog voltage, and analog current, pulse, and serial port. The reference sources can be switched in various ways.
	Auxiliary frequency reference source	Ten auxiliary frequency sources are provided. The auxiliary frequency reference can be used together with the main frequency reference to achieve frequency fine-tuning and frequency superposition.
	Input terminals	◆ Standard: Five DIs, one of which supports up to 20 kHz high-speed pulse input Two AIs that support 0 V to 10 V voltage input or 0 mA to 20 mA current input ◆ Expansion capability Five DIs One AI that supports -10 to +10 V voltage input
	Output terminals	◆ Standard: One high-speed pulse output terminal (open-collector available as option) that supports 0–50 kHz square wave signal output One DO One RO One AO that supports 0 mA to 20 mA current output or 0 V to 10 V voltage output ◆ Expansion capability One DO One RO One AO that supports 0 mA to 20 mA current output or 0 V to 10 V voltage output
Operating panel	LED display	Displays parameters.
	Key locking and function selection	Used to lock the keys partially or completely and limit the availability of some keys to prevent inadvertent operation.
	Protective functions	Providing protections against motor short-circuit detection upon power-on, input/output phase loss protection, overcurrent protection, overvoltage protection, undervoltage protection, overheat protection, and overload protection
	Options	I/O expansion card

Item		Specifications
Environment	Operating location	Indoors without direct sunlight, dust, corrosive gas, combustible gas, oil mist, water vapor, drip, or salty elements
	Altitude	Derating is not required for altitudes below 1000 m. For altitudes between 1000 m and 3000 m, derate 1% for every additional 100 m. The maximum altitude is 3000 m.
	Ambient temperature	-10°C to +40°C (derating required in the range of 40°C to 50°C)
	Humidity	Storage/Ambient humidity: < 95% RH, without condensation
	Vibration	Application scenario: Tested according to IEC 60068-2-6 Vibration amplitude at 5 Hz to 8.4 Hz: 3.5 mm; acceleration at 8.4 Hz to 200 Hz: 1 g; 10 cycles in each of X/Y/Z-axis direction Transportation scenario: Tested according to IEC 60068-2-64 Power spectrum density at 5 Hz to 100 Hz: 0.01 g^2/Hz; power spectrum density at 200 Hz: 0.001 g^2/Hz; Grms: 1.14 g
	Shock	Usage/transportation scenario: Tested according to IEC 60068-2-27 Acceleration: 15 g; pulse width; 11 ms; 18 times in total in X/Y/Z-axis direction
	Storage temperature	-20° C to +60° C
	IP rating	IP20
	Pollution degree	PD2
	Grid type	TN , TT (star-type grid)
	Overvoltage class	OVC III
	Protection class	Class I

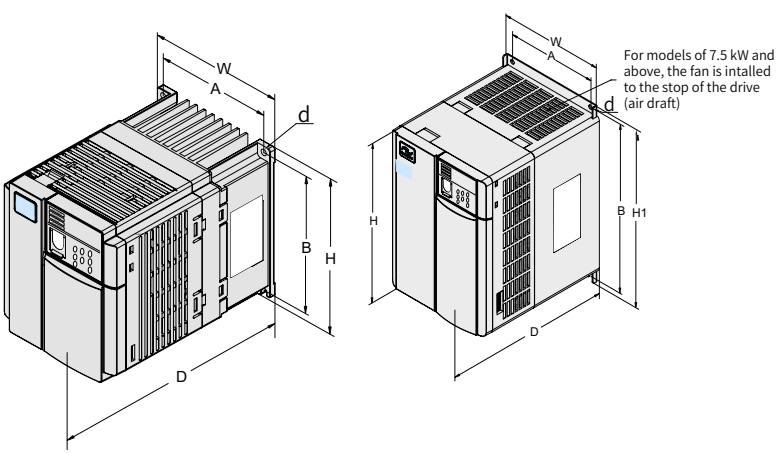
2.4 Outline Drawing and Mounting Hole Dimensions

2.4.1 Outline Drawing



Note: MD310T0.4B and MD310T0.7B models do not have cooling fans.

Figure 2-2 Outline drawing of MD310 series drives



0.4 kW to 2.2 kW models 3.7 kW to 18.5 kW models

Figure 2-3 Outline and mounting dimensions of MD310 series drives

2.4.2 Outline Drawing and Mounting Dimensions of MD310 Series Drives

Table 2-3 Outline and mounting hole dimensions of MD310 series drives

Drive model	Mounting hole (mm)		Outline dimension (mm)				Mounting hole diameter (mm)	Weight (kg)
	A	B	H	H1	W	D	d	
Three-phase power supply: 380 V to 440 V, 50 Hz/60 Hz Range: 323 V to 484 V (-15% to +10%)								
MD310T0.4B	96	118	128	-	108	148	Φ5.0	1.1
MD310T0.7B						148		1.1
MD310T1.5B						158		1.3
MD310T2.2B						158		1.3
MD310T3.7B	108	198	185	209	130	164	Φ5.0	2.3
MD310T5.5B								
MD310T7.5B	122	248	234	260	140	171	Φ6.0	3.4
MD310T11B								
MD310T15B	160	284	270	298	180	175.5	Φ6.0	5.6
MD310T18.5B								

2.5 Options

If any option is needed, specify it in your order.

Table 2-4 Options of MD310 series drives

Name	Model	Function	Remarks
I/O expansion card	MD310-IO1	Five DIs can be extended, one isolated AI3 with voltage input; Can be connected to PT100 and PT1000; One relay output, one DO, and one AO	Available for all models
CAN communication expansion card	MD310-CANL	CANlink communication adapter card	Available for all models
External LED operating panel	MD310-KEY1	External LED display and operating panel	For details, see "Appendix D: Introduction to the MD310-KEY1 External Operating Panel".
Extension cable	MDCAB	Standard 8-core network cable that can be connected to MDKE and MDKE7	3 m as standard

2.6 Routine Maintenance of the AC Drive

2.6.1 Routine Maintenance

The internal components of the drive may be aged due to temperature, humidity, dust, and vibration, leading to potential faults or shortening the service life of the drive. Therefore, it is necessary to carry out routine and regular maintenance.

◆ Routine checklist

1) Check whether the motor generates unusual noise during operation.
2) Check whether the motor is vibrating during operation.
3) Check whether the installation environment of the drive changes.
4) Check whether the cooling fan works properly.
5) Check whether the AC drive is overheated.

◆ Routine cleaning list:

1) Keep the AC drive clean all the time.
2) Clear the dust on the surface of the AC drive to prevent the dust (especially metal chippings) from entering the AC drive.
3) Clear the greasy dirt on the cooling fan of the AC drive.

2.6.2 Regular Inspection

Check the less accessible areas regularly.

◆ Regular checklist:

1) Check and clean air ducts regularly.
2) Check whether bolts are loose.
3) Check whether the AC drive is corroded.
4) Check whether terminals have signs of arc discharge.
5) Perform insulation test on the main circuit.

Note: Before measuring insulation resistance with a megameter (500 VDC megameter recommended), disconnect the main circuit from the AC drive. Do not use an insulation resistance meter to test the insulation of the control circuit. The high voltage test need not be performed again because it has been done before delivery.

2.6.3 Replacement of Quick-wear Parts

The quick-wear parts of the AC drive include the cooling fan and electrolytic capacitor, whose service life is closely related to the operating environment and maintenance conditions. The following table describes the general service life.

Name	Standard replacement interval
Fan	2 to 3 years
Electrolytic Capacitor	4 to 5 years

Note: The service life indicates the time when the parts are used in the following conditions. You can determine when to replace the parts according to the actual operating time.

- Average ambient temperature: 30° C per year
- Load rate: below 80%
- Operating time: less than 20 hours per day

1) Cooling fan (MD310T0.4B and MD310T0.7B models do not have the cooling fan.)

- Possible causes of damage: bearing wear and blade aging
- You can determine when to replace the cooling fan based on whether cracks exist on the blade and whether unusual vibration noise is generated upon start.

2) Electrolytic capacitor

- The possible causes for capacitor damage include unstable input power supply, high ambient temperature, frequent load jump, and aging electrolyte.
- Criterion for determining whether the capacitor needs to be replaced:
  1. Check whether liquid leakage occurs.
  2. Check whether the safety valve has protruded.
  3. Measure the static capacitance and the insulation resistance.

2.6.4 Storage of the Drive

Precautions for the storing AC drives are shown as follows.

- Put the drive in the original packing box provided by Inovance.
- Long-term storage can degrade the electrolytic capacitor. Therefore, the drive must be energized once every 6 months, each time lasting for at least 5 hours. The input voltage must be increased slowly to the rated value with the regulator.

2.7 Warranty Disclaimer

Free maintenance covers only the AC drive itself.

Inovance provides an 18-month warranty (subject to the barcode on the equipment) from the date of manufacturing for failures or damage that occur during normal use of the equipment.

Within the warranty period, maintenance will be charged for the following damage:

1) Damage caused by operations not following the instructions in the guide
2) Damage caused by fire, flood, abnormal voltage, or other disasters
3) Damage caused by unintended use of the product

The maintenance is charged according to the latest Price List of Inovance. If otherwise agreed upon, the terms and conditions in the agreement shall prevail.

3 Installation and Wiring

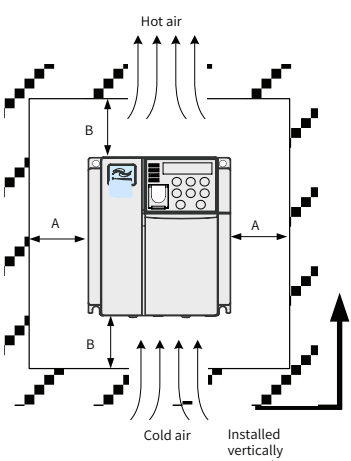
3.1 Mechanical Installation

3.1.1 Installation Environment

1) Ambient temperature: To reduce impact on the service life of the AC drive, the AC drive must operate within the allowable temperature range (–10°C to +40°C).
2) The AC drive generates a large amount of heat during operation. Install the AC drive on the surface of an incombustible object and reserve sufficient space for heat dissipation. Use screws to install the AC drive to the mounting bracket vertically.
3) Install the drive in a place that meets the following requirements:
   1. Vibration not higher than 0.6 g and away from vibration sources such as a punch press
   2. Free from direct sunlight, moisture and water drips
   3. Free from corrosive, explosive and combustible gas
   4. Free from greasy dirt, dust, and metal powder
4) The MD310 series AC drives are built-in products that must be installed in a fireproof cabinet with the enclosure that provides effective electrical and mechanical protection. The installation must conform to local laws and regulations and related IEC requirements.

3.1.2 Mounting Clearances

The clearance that needs to be reserved varies with the power rating of the drive, as shown in the following figure.



Power rating	Dimension	
0.4 kW–15 kW	A≥10mm	B≥100mm
18.5 kW	A≥10mm	B≥200mm

Figure 3-1 Mounting clearance for drives with different power ratings

The MD310 series AC drive dissipates heat from bottom to top. If multiple drives are operating at the same time, install them side by side. If one drive needs to be installed above another one,

install an air guide plate to prevent drives in the lower row from heating those in the upper row and causing faults. The following figure shows the installation method.

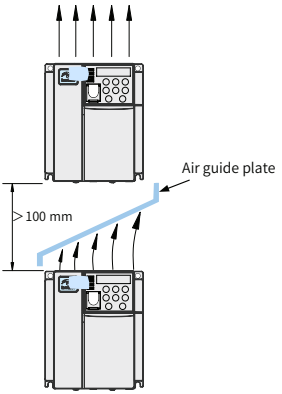


Figure 3-2 Dual-row installation

3.1.3 Mechanical Installation Method and Procedure

The MD310 series AC drive adopts plastic structure that supports backplate mounting, as shown below.

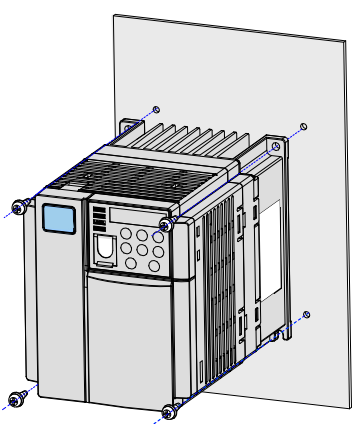


Figure 3-3 Backplate mounting of an AC drive with plastic structure

Pay attention to the following items when installing MD310 series drives.

1) Reserve the installation clearances as specified in Figure 3-1 to ensure sufficient space for heat dissipation. Reserve enough space for heat dissipation of other components in the cabinet.

2) Install the drive vertically upward to facilitate heat dissipation. If multiple drives are installed in the cabinet, install them side by side. For dual-row installation, install an air guide plate as shown in Figure 3-2.

3) The mounting bracket must be made of flame-retardant material.

4) In scenarios with heavy metal powder, install the heatsink outside the cabinet, and ensure that the room inside the fully-sealed cabinet is as large as possible.

3.1.4 Removing and Installing the Lower Cover

The MD310 series AC drive has a plastic enclosure. As shown in the following figure, the plastic enclosure can be dismounted by pushing out the hook with a tool (such as a slotted screwdriver).

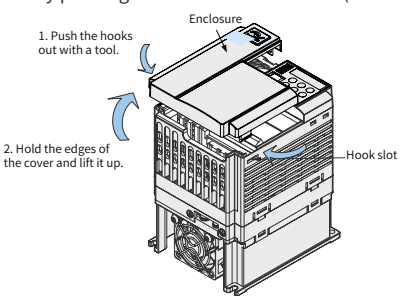


Figure 3-4 Dismounting of the plastic enclosure

3.2 Electrical Installation

3.2.1 Wiring of the Main Circuit

The following diagram shows how to connect the main circuit of the AC drive.

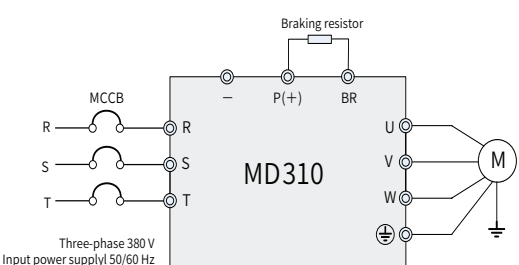


Figure 3-5 Three-phase 380 V main circuit wiring diagram (models of 18.5 kW and below)

3.2.2 Description of Main Circuit Terminals

1) Description of main circuit terminals of the three-phase AC drive

Mark	Name	Description
R, S, T	Input terminals of three-phase power supply	Used to connect the three-phase AC input power supply.
P(+), (-)	Positive and negative terminals of the DC bus	Used to connect the common DC bus.
P(+), BR	Terminals for connecting the braking resistor	Connected to the braking resistor for drives of 18.5 kW and below.
U, V, W	AC drive output terminals	Used to connect the three-phase motor.
⏚	Grounding terminal	Grounding terminal

2) Wiring precautions:

1. Power input terminals R, S, T

- No specific phase sequence is required for wiring on the input side of the drive.

2. DC bus P(+), (-)

- After switching off the AC drive, residual voltage may be present in terminals P(+) and (-) in the DC bus, therefore, wait for at least 10 minutes until the CHARGE indicator is off before further operation. Failure to comply can result in the risk of electric shock.
- The cable length of the braking unit cannot exceed 10 m. Use twisted pair cables or closely-paired cables for parallel connection.
- Do not connect the braking resistor to the DC bus directly. Failure to comply may result in fire accident or damage the drive.

3. Braking resistor connection terminals P(+) and BR

- Connect a braking resistor of the recommended model, and ensure that the cable length of the braking resistor is shorter than 5 m. Otherwise, it may damage the AC drive.

4. Drive output terminals U, V, W

- Do not connect a capacitor or surge suppression device to the output side of the drive. Failure to comply may lead to frequent fault protection or even damage the drive.
- If the motor cable is excessively long, electrical resonance may be generated due to distributed capacitance, which may damage the motor insulation or generate higher leakage current, triggering overcurrent protection. In this case, install an AC output reactor close to the drive when the motor cable length exceeds 100 m.

5. Grounding terminal PE ⏚

- Ground the PE terminal reliably with the grounding cable resistance lower than 0.1 Ω. Failure to comply may result in device malfunction or damage.
- Do not connect the grounding terminal ⏚ to the neutral terminal of the power supply.

- The impedance of the PE conductor must be able to withstand the high short circuit current that may arise when a fault occurs.
- Select the dimension of the PE conductor according to the following table.

Cross-sectional area of a phase conductor (S)	Min. cross-sectional area of protective conductor (Sp)
S ⩽ 16 mm^2	S
16 mm^2 < S ⩽ 35 mm^2	16 mm^2
35 mm^2 < S	S/2

- Use yellow-green cable as the protective grounding conductor.

3.2.3 Power Terminal Mounting Dimensions and Recommended Cross Sectional Area

Note:

1) The information in the table is for reference only. The width of the cross-sectional area selected cannot be greater than the terminal width shown in the figure.
2) Pre-conditions for selecting the cable: For recommended PVC insulated copper conductor or cross-sectional area of the cable under 40°C , see section 12.4 of IEC 60204-1-2005.

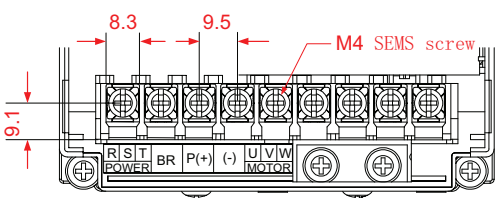


Figure 3-6 Wiring terminal dimensions for models of 2.2 kW and below (unit: mm)

Table 3-1 Cross-sectional area of the cable and terminal model for models of 2.2 kW and below (CE-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (mm^2) <1>	Terminal model	Cable (mm^2) <1>	Terminal model		
MD310T0.4B	1.9	1.5	3 x 0.75	TNS1.25-4S	3 x 0.75	TNR0.75-4	M4	1.2
MD310T0.7B	3.4	2.1	3 x 0.75	TNS1.25-4S	3 x 0.75	TNR0.75-4	M4	1.2
MD310T1.5B	5.0	3.8	3 x 0.75	TNS1.25-4S	3 x 0.75	TNR0.75-4	M4	1.2
MD310T2.2B	5.8	5.1	3 x 0.75	TNS1.25-4S	3 x 0.75	TNR0.75-4	M4	1.2

Table 3-2 Cross-sectional area of the cable and terminal model for models of 2.2 kW and below (UL-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (AWG/ kcmil)<2>	Terminal model	Cable (AWG/ kcmil)<2>	Terminal model		
MD310T0.4B	1.9	1.5	14	TLK2.5-4	14	TLK2.5-4	M4	1.2
MD310T0.7B	3.4	2.1	14	TLK2.5-4	14	TLK2.5-4	M4	1.2
MD310T1.5B	5.0	3.8	14	TLK2.5-4	14	TLK2.5-4	M4	1.2
MD310T2.2B	5.8	5.1	14	TLK2.5-4	14	TLK2.5-4	M4	1.2

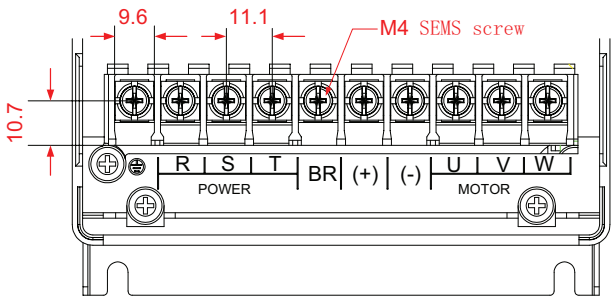


Figure 3-7 Wiring terminal dimensions for models with power rating ranging from 3.7 kW to 5.5 kW (unit: mm)

Table 3-3 Recommended cross-sectional area of the cable and terminal model for models with power rating ranging from 3.7 kW to 5.5 kW (CE-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (mm^2) <1>	Terminal model	Cable (mm^2) <1>	Terminal model		
MD310T3.7B	10.5	9	3 x 1.5	TNS2-4S	3 x 1.5	TNR2-4	M4	1.2
MD310T5.5B	14.6	13	3 x 2.5	TNS2-4S	3 x 2.5	TNR2-4	M4	1.2

Table 3-4 Recommended cross-sectional area of the cable and terminal model for models with power rating ranging from 3.7 kW to 5.5 kW (UL-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (AWG/ kcmil)<2>	Terminal model	Cable (AWG/ kcmil)<2>	Terminal model		
MD310T3.7B	10.5	9	12	TLK4-4	12	TLK4-4	M4	1.2
MD310T5.5B	14.6	13	10	RNBS5-4	10	RNBS5-4	M4	1.2

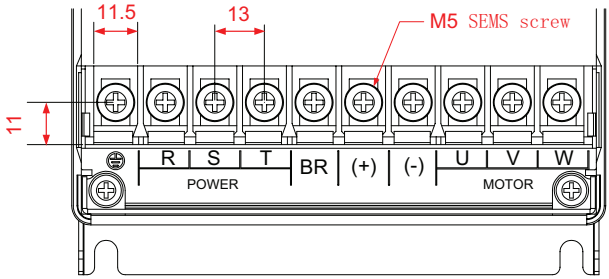


Figure 3-8 Wiring terminal dimensions for models with power rating ranging from 7.5 kW to 11 kW (unit: mm)

Table 3-5 Recommended cross-sectional area of the cable and terminal model for models with power rating ranging from 7.5 kW to 11 kW (CE-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (mm^2) <1>	Terminal model	Cable (mm^2) <1>	Terminal model		
MD310T7.5B	20.5	17	3 x 4	TNS3.5-5	4	TNR3.5-5	M5	2.5
MD310T11B	26	25	3 x 6	TNS5.5-5	6	TNR5.5-5	M5	2.5

Table 3-6 Recommended cross-sectional area of the cable and terminal model for models with power rating ranging from 7.5 kW to 11 kW (UL-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (AWG/ kcmil)<2>	Terminal model	Cable (AWG/ kcmil)<2>	Terminal model		
MD310T7.5B	20.5	17	10	TLK6-5	10	TLK6-5	M5	2.5
MD310T11B	26	25	8	RNBS8-5	8	RNBS8-5	M5	2.5

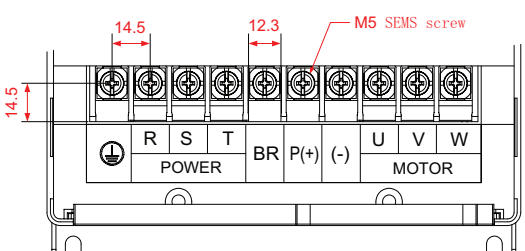


Figure 3-9 Wiring terminal dimensions for models with power rating ranging from 15 kW to 18.5 kW (unit: mm)

Table 3-7 Recommended cross-sectional area of the cable and terminal model for models with power rating ranging from 15 kW to 18.5 kW (CE-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (mm^2) <1>	Terminal model	Cable (mm^2) <1>	Terminal model		
MD310T15B	35	32	3 x 10	TNR8-5	10	TNR8-5	M5	2.5
MD310T18.5B	38.5	37	3 x 10	TNR8-5	10	TNR8-5	M5	2.5

Table 3-8 Recommended cross-sectional area of the cable and terminal model for models with power rating ranging from 15 kW to 18.5 kW (UL-compliant)

Drive model	Rated input current (A)	Rated output current (A)	RST/UVW		Grounding cable		Screw	Tightening torque (N · m)
			Cable (AWG/ kcmil)<2>	Terminal model	Cable (AWG/ kcmil)<2>	Terminal model		
MD310T15B	35	32	6	RNBS14-5	6	RNBS14-5	M5	2.5
MD310T18.5B	38.5	37	6	RNBS14-5	6	RNBS14-5	M5	2.5

Note:

- <1> Applicable to standards in China. 3 x 10 represents one three-core 10 mm^2 cable. The preceding recommended lugs are the TNR and TNS series lugs from Suzhou Yuanli.
  - Observe national or regional regulations during selection. The cables recommended in the preceding table meet the following conditions: PVC insulation and copper conductor. Ambient temperature of 40° C and cable surface temperature of 70° C (Remark: When the ambient temperature exceeds 40°C , contact Inovance.) Cable layout type E is adopted (see IEC60204-1).
  - The recommended values takes overload (1 h at 120% of rated load) into account.
  - If the conditions are different, you need to select the model according to actual conditions.
- <2>: Applicable to AWG standards; 8 represents 8AWG. The preceding recommended cable lugs are TLK and RNB series lugs from KST.
  - Observe national or regional regulations during selection. The cables recommended in the preceding table meet the following conditions: PVC insulation and copper conductor. Ambient temperature of 40° C and cable surface temperature of 75° C (Remark: When the ambient temperature exceeds 40°C , contact Inovance.) Cable layout type E is adopted (see IEC60204-1).
  - The recommended cable takes overload (1 h at 125% of rated load allowed) into account.
  - If the conditions are different, you need to select the model according to actual conditions.

Information of recommended terminals (Suzhou Yuanli)

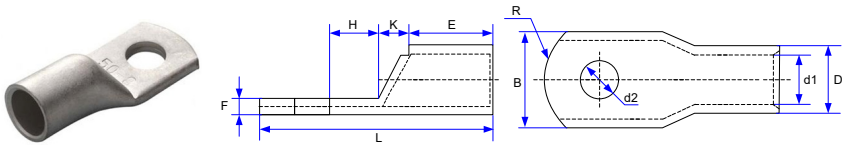


Figure 3-10 Appearance and dimensions of GTNR series round terminals (recommended)

Table 3-9 Models and dimensions of GTNR series terminals (unit: mm)

Model	D	d1	E	H	K	B	d2	F	L	R	Crimping pliers
GTNR2.5-4	4.5	2.9	7.0	5.0	2.0	8.0	4.3	1.0	18.0	5.0	RYO-8 YYT-8 RYO-14
GTNR4-5	5.2	3.6	7.0	6.0	2.0	10.0	5.3	10.0	20.0	7.0	
GTNR6-5	6.0	4.2	9.0	6.0	3.0	10.0	5.3	1.0	23.0	7.0	
GTNR10-6	7.0	5.0	9.0	8.0	3.5	12.4	6.4	1.0	27.0	7.0	

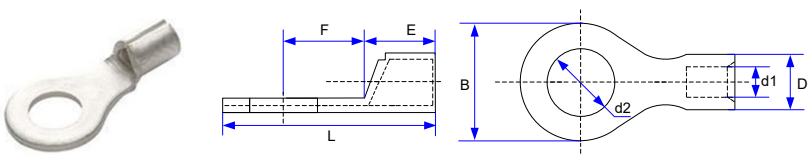


Figure 3-11 Appearance and dimensions of TNR series round terminals (recommended)

Table 3-10 Models and dimensions of TNR series terminals (unit: mm)

Model	Cable size		D	d1	E	F	B	d2	L	Max. current (A)	Crimping pliers
	AWG	mm²									
TNR0.75-4	22–16	0.25–1.0	2.8	1.3	4.5	6.6	8.0	4.3	15.0	10	RYO-8 AK-1M
TNR2-4	16–14	1.04–2.63	4.0	2.3	4.8	7.75	8.5	4.3	16.8	27	
TNR3.5-5	12–10	2.63–4.6	5.0	3.2	6.8	8.2	9.5	5.3	20.0	37	RYO-8
TNR5.5-5	8	2.63–6.64	5.6	3.5	6.8	8.25	9.5	5.3	19.8	48	RYO-8 RYO-14
TNR8-5	8	6.64–10.52	7.2	4.5	8.5	9.3	12.0	5.3	23.8	62	RYO-8 RYO-14 RYO-25

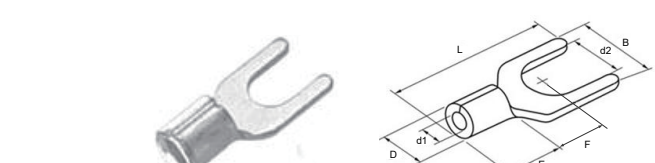


Figure 3-12 Appearance and dimensions of TNS series fork-type terminals (recommended)

Table 3-11 Models and dimensions of TNS series fork-type terminals (unit: mm)

Model	Cross sectional area		D	d1	E	F	B	d2	L	Crimping pliers
	AWG	mm^2								
TNS1.25-4S	22–16	0.5–1.6	3.4	1.9	4.7	6.5	6.4	4.3	16.0	RYO-8 YYT-8
TNS2-4S	16–14	1.0–2.6	4.0	2.4	4.7	6.5	6.4	4.3	16.0	
TNS3.5-5	12–10	2.6–4.6	5.0	3.4	6.4	8.0	8.0	5.3	18.0	
TNS5.5-5	12–10	4.6–6.6	5.6	3.6	6.5	8.0	9.0	5.3	19.5	

Information of recommended terminals (KST)

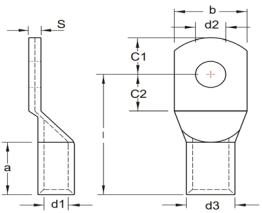


Figure 3-13 Dimensions of TLK series terminals (recommended)

Table 3-12 Models and dimensions of TLK series fork-type terminals (unit: mm)

Model	S	a	b	C1	C2	d1	d2	d3	l
TLK2.5-4	1.25	6.0	7.5	4.0	5.0	2.3	4.3	4.2	13.0
TLK4-4	-	8.0	8.5	4.7	6.0	3.0	4.3	2.0	17.0
TLK6-5	2.4	9.0	10.0	6.5	7.5	3.5	5.5	6.5	21.0

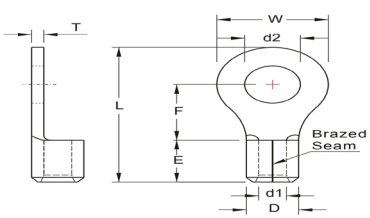


Figure 3-14 Dimensions of RNBS series terminals (recommended)

Table 3-13 Models and dimensions of RNBS series terminals (unit: mm)

Model	d2	W	F	L	E	D	d1	T
RNBS5-4	4.3	7.2	6.1	15.7	6.0	5.6	3.4	1.0
RNBS8-5	5.3	8.8	10.5	23.8	8.5	7.2	4.5	1.2
RNBS14-5	5.3	9.5	13.3	28.2	10.5	9.0	5.8	1.5

3.2.4 Description and Wiring of Control Circuit Terminals

Control circuit terminal arrangement is shown as follows.

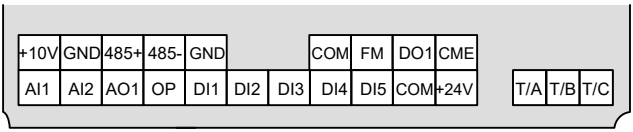


Figure 3-15 Control circuit terminal arrangement

1) Function description of control circuit terminals

Table 3-14 Functions of control circuit terminals

Type	Mark	Name	Function
Power supply	+10V-GND	+10 V power supply	The terminal is used to provide +10 V power supply to an external unit with the maximum output current of 10 mA. Generally used to power up an external potentiometer with resistance ranging from 1 kΩ to 5 kΩ.
	+24 V-COM	+24 V power supply	The terminal is used to provide +24 V power supply to external devices. Generally, it is used to power up the DI/DOs and external sensors. Maximum output current: 200 mA
	OP	Input terminal for external power supply	It is shorted with +24V or COM, determined by jumper J7 on the control board, and shorted with +24V by default. When DI1 to DI5 need to be driven by external signals, OP needs to be connected to external power supply and disconnected from +24 V (remove jumper J7 in this case).
Analog input	AI1-GND AI2-GND	AI1	1. AI1 input range: 0 VDC to 10 VDC/0 mA to 20 mA, as defined by J14 2. AI2 input range: 0 VDC to 10 VDC/0mA to 20 mA, as defined by J4 3. Input impedance: 22.1 kΩ for voltage input or 500 Ω for current input
Digital input	DI1- OP	DI1	1. Optocoupler isolation, compatible with dual-polarity input 2. Input impedance: 2.4 kΩ 3. Voltage range of level input: 9 V to 30 V
	DI2- OP	DI2	
	DI3- OP	DI3	
	DI4- OP	DI4	
	DI5- OP	High-speed pulse input terminal	Besides features of DI1 to DI4, it can also be used for high-speed pulse input. Maximum input frequency: 20 kHz
Digital output	DO1-CME	Digital output 1	Multi-function open-collector output Voltage range: 0 V to 24 V Current range: 0 mA to 50mA
	FM-COM	High-speed pulse output	The output pulse frequency range of FM is 0–50 kHz. By default, CME and COM are shorted by jumper J6.

Type	Mark	Name	Function
Analog output	AO1-GND	Analog output 1	The jumper J5 on the control board determines whether current output or voltage output is used. Output voltage range: 0 V to 10 V Output current range: 0 mA to 20mA
Communication	485+/485-	Communication port	Modbus protocol, RS485 communication bus interface Communication rate: 300 bps to 115200 bps Maximum number of nodes: 32 Termination resistor switch: J8, J15
Relay output	T/A-T/B	NC terminal	Driving capacity of the contact: 250 VAC, 3 A 30 VDC, 1 A
	T/A-T/C	NO terminal	
Auxiliary interface	J1	External operating panel interface	External operating panel MD310-KEY1
	Function expansion card interface	40-core terminal, connected to the interface of the optional card (including I/O expansion cards, PLC cards, and various fieldbus cards)	

2) Wiring of signal input terminals

- AI terminals

Weak analog voltage signals are prone to suffer external interference. Therefore, a shielded cable is required, and the wiring distance must be as short as possible (no longer than 20 m), as shown in Figure 3-16. In scenarios where analog signals are subject to serious disturbance, install a filter capacitor or a ferrite core on the analog signal source, as shown in Figure 3-17.

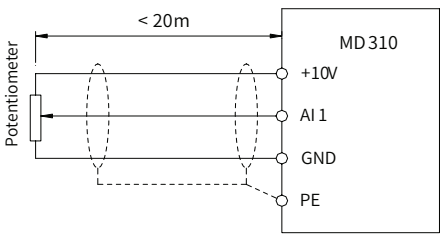


Figure 3-16 Wiring of AI terminals

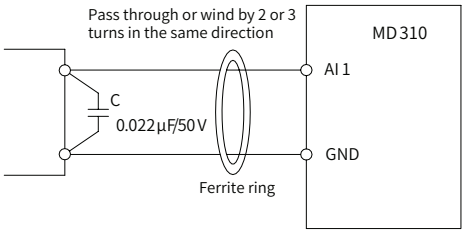


Figure 3-17 Wiring of AI terminals

- DI terminal

The contactor control is recommended. Usually, a shielded cable is required, which should be as short as possible and not longer than 20 m. If an active driving mode is adopted, necessary filtering measures must be taken for the crosstalk of power sources. The recommended wiring method is as follows when an active switch is used.

◆ Sink wiring mode

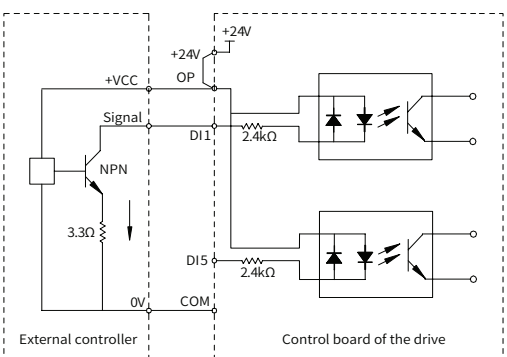


Figure 3-18 Sink wiring

This is the most commonly used wiring mode. OP is shorted to +24V. If an external power supply is used, keep jumper J7 unconnected. Connect the positive pole of the external 24 V power supply to OP and negative pole to DI after passing through the external controller.
Note: In this wiring mode, the DI terminals of different AC drives cannot be connected in parallel. Otherwise, the DI may mal-function. If parallel connection (different AC drives) is required, connect the positive pole of the diode in series to the DI. The diode needs to satisfy this requirement: IF > 10 mA, UF < 1 V.

◆ Source wiring mode

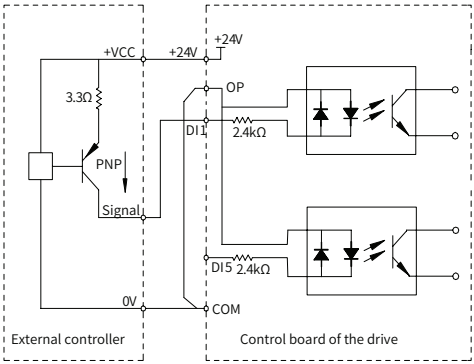


Figure 3-19 Source wiring

In source wiring mode, short the OP on jumper J7 to COM and connect the +24V terminal on the drive to the corresponding DI terminal after passing through the external controller. If an external power supply is used, keep jumper J7 unconnected. Connect the negative pole of the external 24 V power supply to OP and positive pole to DI after passing through the external controller.

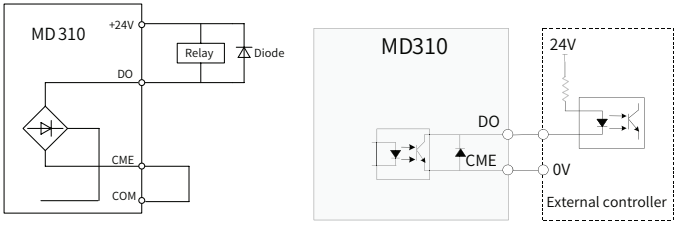
3) Wiring of control signal output terminals

- DO terminals

When the digital output terminal needs to drive the relay, a snubber diode must be installed on two sides of the relay coil, with the driving capacity not higher than 50 mA. Otherwise, the 24 VDC power supply may be damaged.

Note:

1. Do not reverse the polarity of the snubber diode during installation, as shown in the following figure. Otherwise, the 24 VDC power supply will be damaged immediately when the DO terminal generates output.
2. CME and COM are isolated internally. CME has been shorted to COM through jumper J6 by default (in this case, DO1 is driven by the internal 24 V of the AC drive by default). When DO1 needs to be driven by an external power supply, keep J6 unconnected and connect the external power supply to CME.



Using the internal +24 V Using the external 24 V

Figure 3-20 Wiring of DO terminals

3.2.5 Wiring for Application of the AC Drive

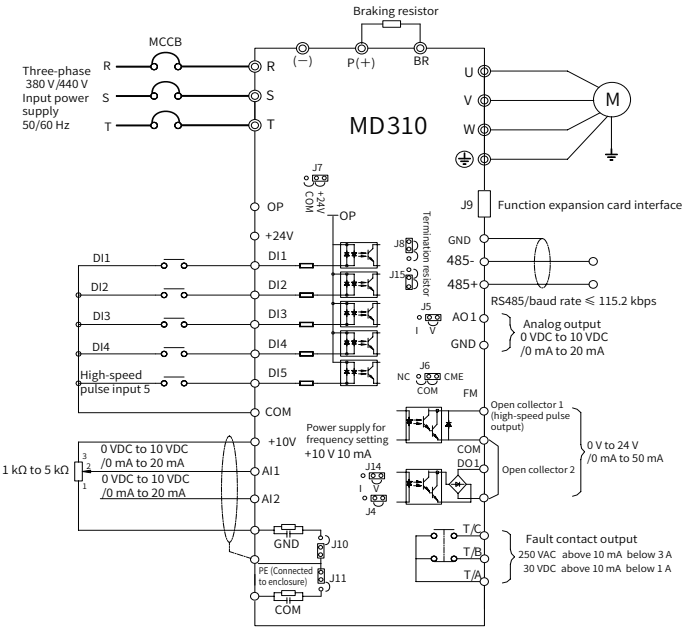


Figure 3-21 Wiring of the AC drive

Note:

1) The terminal " ◎ " represents the main circuit terminal, and " ○ " represents the control circuit terminal.
2) The braking resistor is selected as needed. See details in "9.2 Selection of Braking Unit and Braking Resistor".
3) Route the signal cable and power cable through different routes. If the control cable and power cable must be cross-connected, make them be cross-connected at 90 degrees. Use shielded twisted pair cables for analog signal cables and shielded three-conductor cables for power cables or follow the instructions in the user guide.
4) J15 and J8 are RS485 communication termination resistor jumpers. When connecting the termination resistor, they must be wired to the terminal with silkscreen "485" simultaneously. When the termination resistor does not need to be connected, they must be connect to the NC side simultaneously.
5) T/A, T/B, and T/C are used with a rated operating current of 3 A at 250 VAC operating voltage. In the case of high current or capacitive load, install an intermediate relay. Failure to comply may result in damage to the relay contact.

6) J10: Used to select whether to connect PE to GND. When interference exists, connect PE to GND to enhance the anti-interference capacity.

7) J11: Used to select whether to connect PE to COM. When interference exists, connect PE to COM to enhance the anti-interference capacity.

3.2.6 Cross-sectional Area of Control Circuit Cables and Tightening Torque

- Tubular terminal

Use the tubular terminal with the insulation sleeve.

Expose the conductor by 5 mm in the case of single conductor or twisted pair.

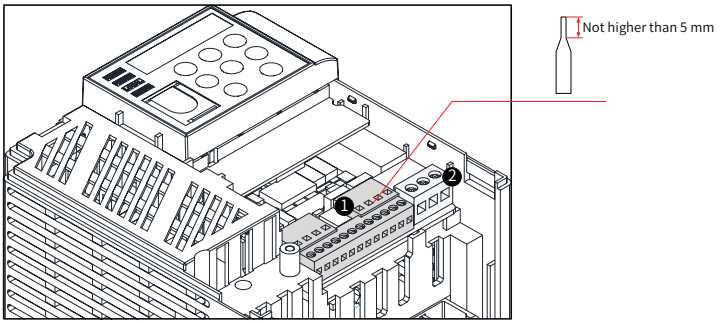


Figure 3-22 Requirements on tubular terminals of the control circuit cable

Table 3-15 Control circuit cable specifications

Control circuit terminals		Single conductor mm^2 (AWG)	Twisted pair mm^2 (AWG)	Tightening torque (N · m)
	1	0.20–0.75 (AWG24–AWG18)		0.20
	2	0.20–0.75 (AWG24–AWG18)		0.51

3.2.7 Post-wiring Inspection

After wiring is done, check the following items.

Table 3-16 Wiring checklist

No.	Item	Checked
1	Power input cables are connected to R, S, and T terminals.	☐
2	Motor input cables are connected to the U, V, and W terminals.	☐
3	The cross-sectional area of the main circuit cables meet the requirements.	☐
4	Check that the heat-shrinkable tubes have been applied to the cable lug copper tubes and fully cover the cable conductor of the main circuit.	☐

No.	Item	Checked
5	Check that the motor output cable does not exceed 50 m. Otherwise, the carrier frequency needs to be reduced through F0-15.	☐
6	The grounding cable is connected properly.	☐
7	The output terminals and control cable terminals are connected properly.	☐
8	The braking resistor and braking unit with proper resistance are wired properly.	☐
9	The control circuit signal cables are shielded twisted pair cables.	☐
10	Optional cards are connected correctly.	☐
11	Control circuit cables and main circuit cables are routed through different routes.	☐
12	There are no screws, gaskets, or exposed cables left inside the product.	☐

4 Operating Panel Display and Application Example

4.1 Operating Panel Interface

You can modify parameters, monitor the working status and start or stop the AC drive through the operating panel. Appearance and functions of the operating panel are shown below.

Figure 4-1 Diagram of the operating panel

1) Function indicator description:

- FWD/REV:
  OFF: Forward
  ON: Reverse
- REMOT: Operating panel/Terminal/Remote control (communication control)
  OFF: Operating panel control
  ON: Terminal control
  Flashing: Remote control
- RUN: Running state
  OFF: Stopped
  ON: Running
- TUNE/TC: Parameter tuning/Torque control/Fault indicator
  ON: Torque mode
  Slow flashing: Tuning
  Fast flashing: Fault

2) Digital display

- The 5-digit LED display is able to display the set frequency, output frequency, all monitoring data, and alarm codes.

3) Description of keys:

Key	Name	Function
PRG	Programming key	Used to enter or exit level I menus.
ENTER	ENTER key	Used to enter the menu interfaces level by level, and confirm the parameter setting.
▲	UP key	Used to increase the data or parameter.

Key	Name	Function
	DOWN key	Used to decrease the data or parameter.
	SHIFT key	Used to select the displayed parameters in turn in the stop or operation state, and the digit to be modified when modifying parameters.
	RUN key	Used to start the drive in the operating panel control mode.
	Stop/Reset	Used to stop the drive when it is in the operating state or reset faults when it is in the fault state. The function of this key is restricted by F7-02.
	Multi-function key	Used as the command source, quick direction switchover, or parameter display as defined by F7-01.

4.2 Parameter View and Modification

The operating panel adopts a three-level menu to perform operations such as parameter setting.

The three-level menus consist of function parameter group (level 1), parameter (level 2), and parameter setpoint (level 3), as shown in the following figure.

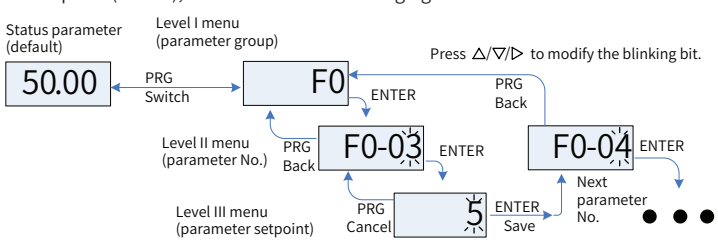


Figure 4-2 Operation procedure of three-level menus

Note: Press PRG or ENTER to return to a level 2 menu when operating on the level 3 menu. The difference is as follows:

After you press ENTER, the system saves the parameter setting first, and then goes back to level 2 menu and shifts to the next parameter.

After you press PRG, the system does not save the parameter setting, but directly returns to level 2 menu of current parameter.

◆ Here is an example of changing the value of F3-02 from 10.00 Hz to 15.00 Hz.

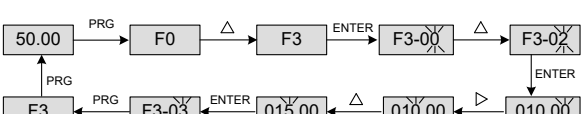


Figure 4-3 Operation example for level 3 menus

In the level 3 menu state, if the parameter is displayed without any blinking digit, this parameter cannot be modified. This may be caused by the following:

1) The parameter is read-only. Such parameters include AC drive type, measured parameters, operation record parameters, and so on.
2) The parameter can be modified only at stop.

4.3 Structure of Parameters

The parameter groups of MD310 are listed in the following table.

Parameter group	Function	Description
F0 to FP	General-purpose AC drive parameters	Compatible with MD210 series parameters
A1 to AC	Enhanced parameter group	Multi-motor parameters, AI/AO characteristics correction, optimization control, PLC card function setting
U0	Running state function code group	Display of AC drive basic characteristics parameters

In the parameter display state, select the parameter group by pressing or , as shown in the following figure.

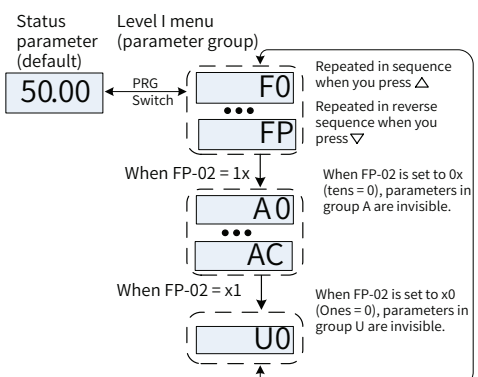


Figure 4-4 Viewing the parameter group

FP-02 is used to control whether to display parameters in groups A and U.

	Default: 11		
FP-02	Setpoint	Tens	Ones
	Function	Selection of group A display	Selection of group U display
	Setting range	0: Hidden 1: Displayed	0: Hidden 1: Displayed

4.4 Quick View of Parameters

The MD310 provides two quick modes for viewing parameters.

1) Up to 30 parameters can be customized to form a customized parameter group. You can determine the function parameters to be displayed through FE group.
2) The MD310 automatically lists the modified parameters.

The operating panel provides three methods for viewing parameters.

Parameter display mode	Display
Function parameter mode	-bASE
User-defined parameter mode	-USEr
User-modified parameter mode	--C--

You can switch among the three parameter display modes by pressing the MF.K key (set F7-01 to 5 and FP-03 to 11 first). The method for viewing and modifying parameters in each mode is the same as the that in the operating panel.

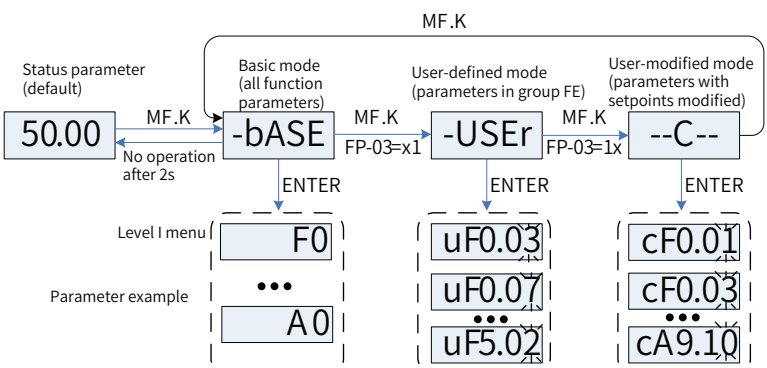


Figure 4-5 Using the MF.K key to switching the parameter display mode

FP-03 is used to determine whether the user-defined group and user-modified group are displayed.

FP-03	Default: 11		
	Setpoint	Tens	Ones
	Function	--C-- User-modified group display	-USEr User-defined group display
	Setting range	0: Hidden 1: Displayed	0: Hidden 1: Displayed

-bASE Basic parameters

Basic parameters include all parameters of the drive. The level 1 menu applies when you enter the basic parameter group.

-USEr User-defined parameter group

The user-defined menu aims to help users to view and modify commonly used parameters quickly. The parameters in user-defined menu is displayed in the form of "uF3.02" (indicating function parameter F3-02). The level 2 menu applies when you enter the user-defined parameter group.

Function parameters in the user-defined menu come from group FE. You can select the function parameter through group FE. When F0.00 is set, it indicates no parameter has been selected. Up to 30 parameters can be set. If "NULL" is displayed when you enter the menu, it indicates the user-defined menu is null.

A total of 16 commonly used parameters are pre-saved in the user-defined menu, as listed in the following table.

F0-01: Motor 1 control mode	F0-02: Command source
F0-03: Main frequency source selection	F0-07: Frequency source superposition
F0-08: Preset frequency	F0-17: Acceleration time 1
F0-18: Deceleration time 1	F3-00: V/f curve setting
F3-01: Torque boost	F4-00: DI1 terminal function
F4-01: DI2 terminal function	F4-02: DI3 terminal function
F5-02: Control board relay function selection (T/A-T/B-T/C)	F5-07: AO1 output selection
F6-00: Start mode	F6-10: Stop mode

You can edit the user-defined menu as needed.

--C-- Composition of user-modified parameter

In user-modified menu, only the parameters that are modified to a non-default value are displayed. The menu is generated by the AC drive automatically. The level 2 menu applies when you enter the user-defined parameter group.

4.5 Definition and Operation of the Multi-function Key

You can define the function (command source switchover or rotation direction switchover) of the MF.K key in F7-01. For details, see the description of F7-01.

4.6 Viewing Status Parameters

In the stop or operation state, you can press the shift key  on the operating panel to view status parameters. Whether parameters are displayed is determined by the binary bits of values converted from the values of F7-03, F7-04, and F7-05. In the stop state, a total of 16 status

parameters can be displayed, as listed in the following table.

F7-05	Parameter displayed on the LED operating panel at stop	bit00: Frequency reference (Hz) bit08: Length bit01: Bus voltage (V) bit09: PLC stage bit02: DI state bit10: Load speed bit03: DO state bit11: PID setting bit04: AI1 voltage (V) bit12: Pulse input frequency bit05: AI2 voltage (V) bit06: AI3 voltage (V) bit07: Counting value	1013H	Real time

Switch the selected parameters in sequence. The following shows how to set parameter values.

Example: Parameters to be displayed are: frequency reference, bus voltage, AI1 voltage, and pulse input frequency.

Then, set the binary data based on the corresponding bits of the data displayed.

F7-05: 0001 0000 0001 0011B

Convert the binary data to hexadecimal data:

F7-05: 1013H

The value set through the operating panel is displayed as F7-05: H.1013.

In the operating state, five operating status parameters are displayed by default: operating frequency, frequency reference, bus voltage, output voltage, and output current. You can set whether other parameters are displayed by setting F7-03 and F7-04.

F7-03	Parameter 1 displayed on LED operating panel during operation	bit00: Running frequency (Hz) bit08: DO output state bit01: Frequency reference (Hz) bit09: AI1 voltage (V) bit02: Bus voltage (V) bit10: AI2 voltage (V) bit03: Output voltage (V) bit11: AI3 voltage (V) bit04: Output current (A) bit12: Counting value bit05: Output power (kW) bit13: Length bit06: Output torque (%) bit14: Load speed display bit07: DI status bit15: PID setting	007DH	Real time
F7-04	Parameter 2 displayed on the LED operating panel during operation	bit00: PID feedback bit08: Linear speed bit01:PLC stage bit09: Current power-on time bit02: Pulse input frequency bit10: Current operating time bit03:Operating frequency (Hz) bit11: Pulse input frequency bit04: Remaining operating time bit12: Reference set through communication bit05: AI1 voltage before calibration bit13: Encoder feedback speed bit06: AI2 voltage before calibration bit07: AI3 voltage before calibration bit14: Display of main frequency X (Hz) bit15: Display of auxiliary frequency Y (Hz)	0801H	Real time

When the AC drive is powered on again after power failure, the parameters selected before power failure are displayed.

Switch the selected parameters in sequence. The following shows how to set parameter values.

Example: Parameters to be displayed are: operating frequency, bus voltage, output voltage, output current, output power, output torque, and PID feedback.

Then, set the binary data based on the corresponding bits of the data displayed.

F7-03: 0000 0000 0111 1101B

F7-04: 0000 0000 0000 0001B

Convert the binary data to hexadecimal data:

F7-03: 007DH

F7-04: 0001H

The value set through the operating panel is displayed as F7-03: H.007D and F7-04: H.0001.

4.7 Starting/Stopping the AC Drive

4.7.1 Selecting the Start/Stop Command Source

There are three start/stop command sources: operating panel control, terminal control, and communication control. Users can select the command source through F0-02.

	Command source		Default: 0	Description
F0-02	Setting range	0	Operating panel control (LED indicator OFF)	Press RUN and STOP to start and stop the drive.
		1	Terminal control (LED indicator ON)	The DI must be assigned with the start/stop function.
		2	Communication control (LED blinking)	Modbus-RTU and CANlink are used.

1) Start/Stop control through the operating panel

Set F0-02 to 0 to enable operating panel control. To start the AC drive, press RUN on the operating panel and the RUN indicator turns on. To stop the AC drive, press STOP on the operating panel and the RUN indicator turns off.

2) Start/Stop control through terminals

This control mode applies when the DIP switch or electromagnetic switch button is used to start or stop the application system or when the dry contact signal is used to start or stop the AC drive.

The switch signal mode is set in F4-11. The input terminal of the start/stop signal is set in F4-00...F4-09. For details, see the description of F4-11 and F4-00 to F4-09.

◆ Example 1: To use the DIP switch as the start/stop switch, connect the forward run switch signal to DI2 and the reverse run switch signal to DI4, as shown below.

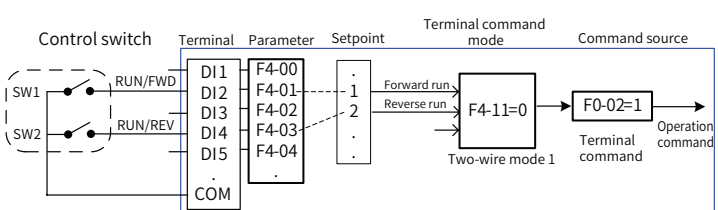


Figure 4-6 Example of terminal control mode

In the preceding figure, when SW1 is ON, forward operation applies. When SW1 is OFF, the drive stops. When SW2 is ON, reverse operation applies. When SW2 is OFF, the drive stops. If SW1 and SW2 are ON or OFF simultaneously, the drive stops.

◆ Example 2: To use the control button as the start/stop switch, connect the start button signal to DI2, the stop button signal to DI3, and the reverse operation button signal to DI4, as shown below.

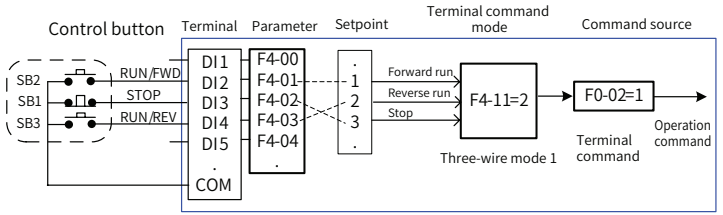


Figure 4-7 Example of terminal control mode

In the preceding figure, SB1 must stay ON during normal start and operation. The AC drive stops immediately after SB1 becomes OFF. The commands from SB2 and SB3 buttons are rising edge-triggered. The operating state of the drive is determined by the final actions on the these three buttons.

3) Start/Stop control

The host controller controls the drive operations through RS485 communication. Set F0-02 to 2, and then you can start or stop the AC drive through communication. Parameters related to communication setting are shown in the following figure.

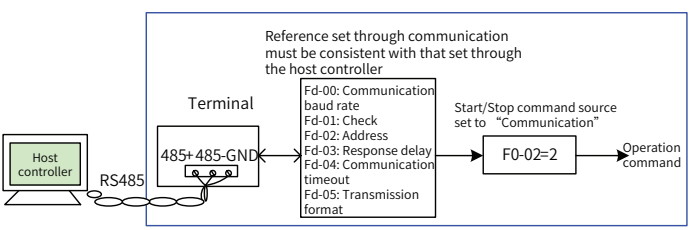


Figure 4-8 Example of communication control

As shown in the preceding figure, if FD-04 is set to a non-zero value, it indicates the AC drive stops automatically after communication timeout fault occurs. This is to prevent the AC drive from getting out of control upon communication line fault. This function applies to some applications.

The communication port of the AC drive supports the Modbus-RTU protocol, and the communication is implemented only when the host controller supports the Modbus-RTU master protocol. For details, see "Appendix A: MD310 Modbus Communication Protocol".

4.7.2 Start Mode

The drive supports two start modes, namely, direct start, and pre-excited start of asynchronous motor. When F6-00 is set to 0, direct start applies. Direct start applies to most of low inertia loads. The frequency drive during start is shown below. Start with DC braking is suitable for loads such as elevators and cranes.

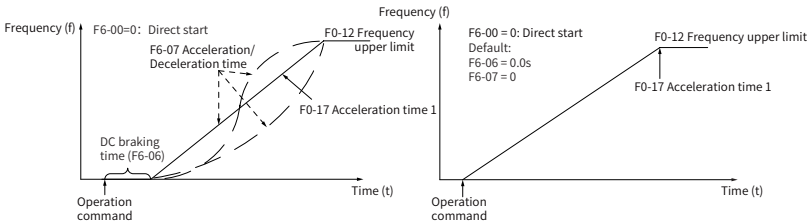


Figure 4-9 Direct start mode

When F6-00 is set to 1, flying start applies. Flying start is suitable for driving mechanical loads with high inertia. The frequency curve during start is shown below. If the load motor still runs based on inertia when the drive starts, you can use flying start to prevent overcurrent upon start.

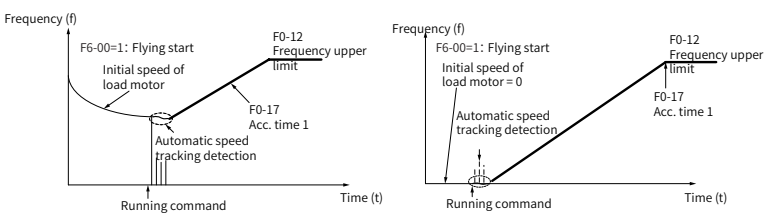


Figure 4-10 Flying start mode

F6-00 = 2 (Pre-excited start)

This mode is applicable only to inductive asynchronous motors. Before start, the drive performs pre-excitation on the motor to improve the responsiveness of the asynchronous motor and fulfill the need for a short acceleration time. The frequency curve during start is shown below.

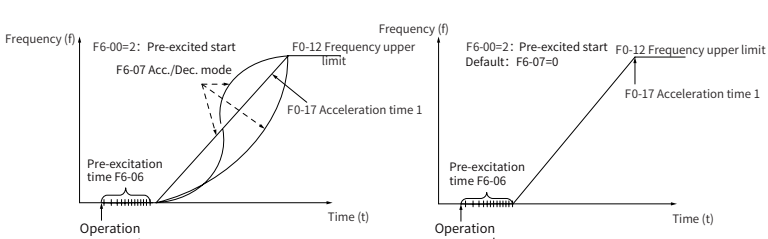


Figure 4-11 Pre-excited start

4.7.3 Stop Mode

The AC drive supports two stop modes, decelerate to stop and coast to stop, as defined by F6-10.

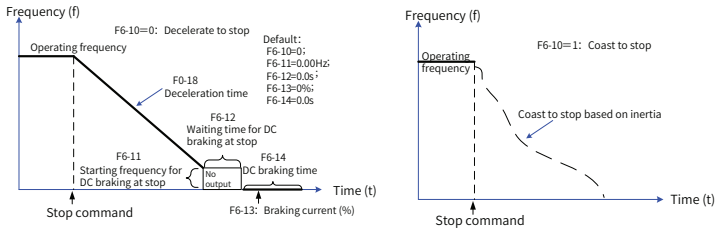


Figure 4-12 Stop mode

4.7.4 Timed Stop Function

The drive supports timed stop. This function is enabled by F8-42 and the timed duration is set in F8-43 and F8-44.

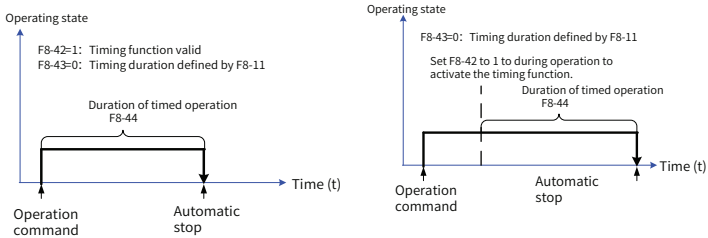


Figure 4-13 Timed stop

You can also set the timed duration through analog input (such as potentiometer signals). For details, see the description of F8-43.

4.7.5 Jog

In certain applications, the drive needs to run in low speed temporarily to facilitate equipment test or other commissioning operations. In this case, you can enable the jog function.

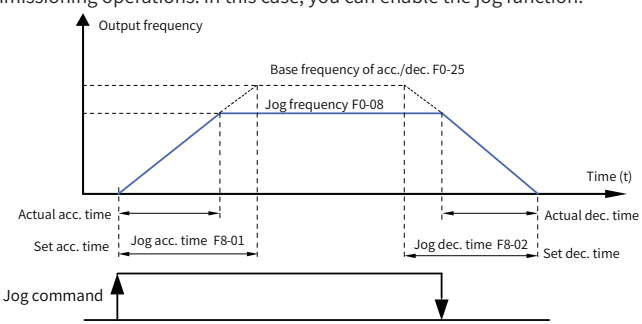


Figure 4-14 Jog

1) Parameter setting and operation through operating panel

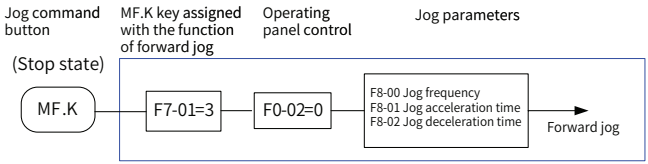


Figure 4-15 Jog through the operating panel

After setting related parameters shown in the preceding figure, press the MF.K key in the stop state to start forward run. When you release the MF.K key, the drive decelerates to stop.

To apply reverse run, set F7-01 to 4 and F8-13 to 0, and then press the MF.K key.

2) Parameter setting and operation through DIs

For equipment that requires frequent jog operations, such as textile machines, it is more convenient to control jog by using keys or buttons. Related parameter settings are shown below.

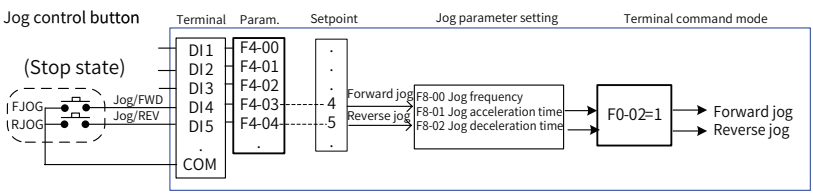


Figure 4-16 Jog through DI

After setting related parameters shown in the preceding figure, keep the FJOG key pressed down to start forward run. When you release the FJOG key, the drive decelerates to stop. Similarly, you can press the RJOG key to apply reverse jog.

4.8 Setting the Running Frequency of the Drive

The AC drive provides two frequency sources, main frequency source X and auxiliary frequency source Y. You can select one frequency source and switch between these two sources. You can also perform superposition on the two sources by setting the calculation formula to meet different control requirements of different scenarios.

4.8.1 Main Frequency Reference Source

Ten main frequency sources are available, which are digital setting (modified by UP/DOWN, non-retentive/retentive at power failure), AI1, pulse input, multi-reference, simple PLC, PID, and communication, as defined by F0-03.

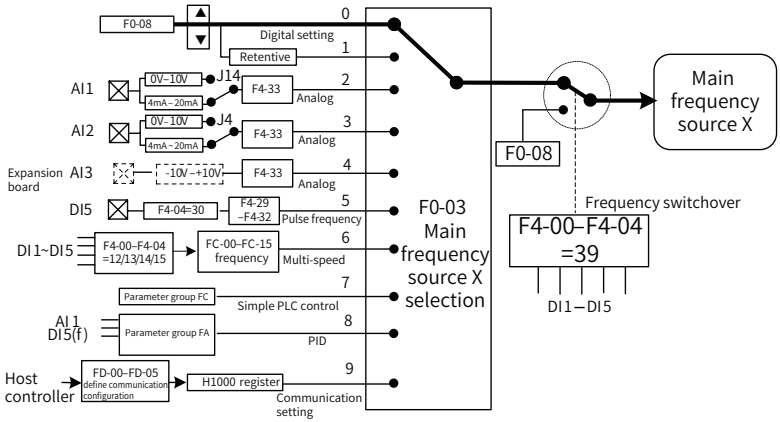


Figure 4-17 Selecting main frequency reference source

According to the preceding figure, the operating frequency of the drive can be set through parameters or manually in real time, as well as analog input, multi-speed references, external feedback signals, internal PID regulator, or the host controller.

For details on parameters related to each source shown in the preceding figure, see the detailed descriptions of related parameters.

4.8.2 Instructions for Use with Auxiliary Frequency Reference

The auxiliary frequency source Y is consistent with the main frequency source, as defined by F0-04.

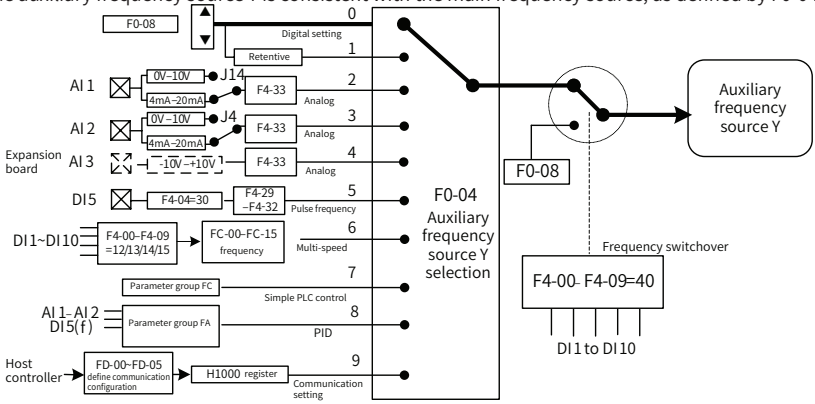


Figure 4-18 Auxiliary frequency reference source

The relationship between the target frequency reference and the main/auxiliary frequency reference source is set in F0-07, as shown below.

1) Main frequency reference source X: The main frequency source is directly used as the source of the target frequency reference.
2) Auxiliary frequency reference source Y: The auxiliary frequency source is directly used as the source of the target frequency reference.
3) Operation on X and Y: Four operation formula are available: X + Y, X – Y, Max. (X, Y), and Min. (X, Y).
4) Frequency switchover: The DI is used to select/switch the preceding three frequency operation formula, as defined by F0-07 shown in the following figure.

The thick lines in the figure represents the default setting. See the related parameter for detailed setting method.

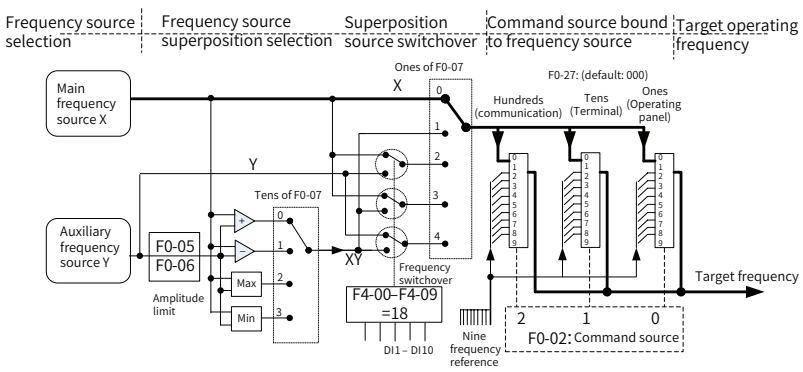


Figure 4-19 Hybrid source based on X and Y

Superposition between the main frequency source X and the auxiliary frequency source Y can be used for closed-loop speed control. For example, using the main frequency source for setting the required frequency and the auxiliary frequency source for automatic adjustment, in conjunction with external DI signals, the required closed-loop control can be implemented.

4.8.3 Binding Between the Running Command Switchover and Frequency Reference

The three command sources can be bound to different frequency sources through F0-27, see details in Figure 4-19. When the specified command source (F0-02) is bound to a frequency binding channel (corresponding bitof F0-27), the main and auxiliary frequency sources X and Y are inactive, only the frequency reference source defined by F0-27 is active.

4.8.4 Frequency Closed-Loop Control in Process Control

The MD310 has a built-in PID regulator. Together with the frequency sources, the PID regulator can implement automatic adjustment during progress control, such as constant temperature, constant pressure, and tension control.

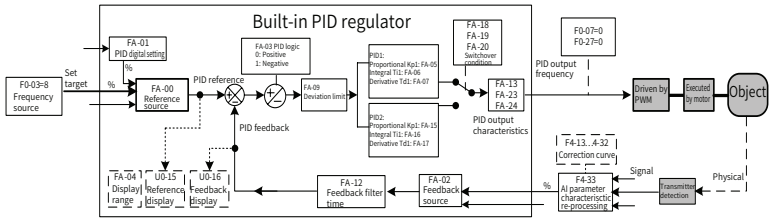


Figure 4-20 Frequency closed-loop control in process control

When PID frequency closed-loop control is implemented, F0-03 must be set to 8. The PID-related parameters are set in group FA, as shown in the preceding figure.

The MD310 has two built-in equivalent PID calculating units. You can set the features, such as adjustment speed and accuracy, for the two units separately based on the actual conditions. Switchover between the two units can be implemented automatically or through the external DI.

4.8.5 Setting the Wobble Frequency Operation Mode

For the textile and chemical fiber processing equipment, the wobble frequency function can be used to improve the uniform density of spindle winding, as shown in the following figure. This function can be achieved by setting parameters FB-00...FB-04. See the description for related parameters for details.

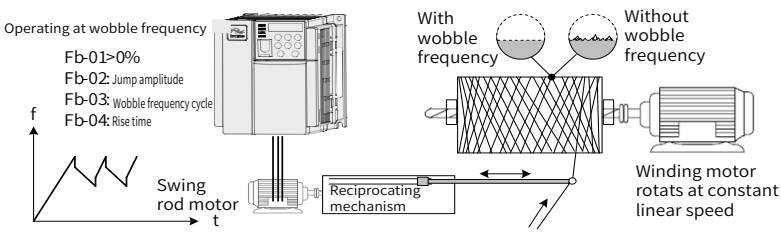


Figure 4-21 Wobble frequency operation mode

4.8.6 Setting Multi-speed Mode

In scenarios where the operating frequency of the AC drive need not be adjusted continuously and only several frequencies are required, multi-speed control can be used. The MD310 supports a maximum of 16 frequencies in multi-speed mode, which are implemented by state combinations of four DI terminals. Set parameters corresponding to DIs to values between 12 and 15. The multi-frequency needed are set based on the multi-frequency table in group FC. In addition, you need to set F0-03 (Main frequency source X selection) to 6 (Multi-reference), as shown below.

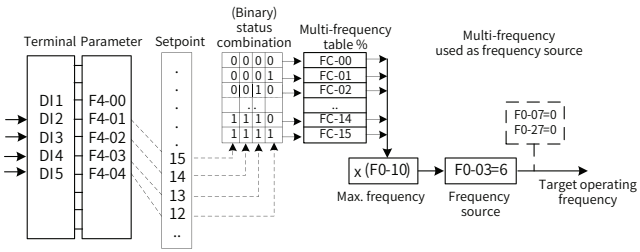


Figure 4-22 Setting multi-speed mode

In the preceding figure, DI2, DI3, DI4, and DI5 are used as the multi-frequency input terminals, which form a four-bit binary number. The state combinations of these terminals represent different frequencies. When (DI2, DI3, DI4, DI5) = (0, 0, 1, 0), the state combination value is 2, corresponding to the value set in FC-02. The target operating frequency is automatically calculated by FC-02 x F0-10.

The MD380 supports a maximum of four DIs to be used as the multi-frequency input terminals. You can also use less than four DI terminals, and the empty bitis calculated as 0.

4.8.7 Setting the Motor Rotating Direction

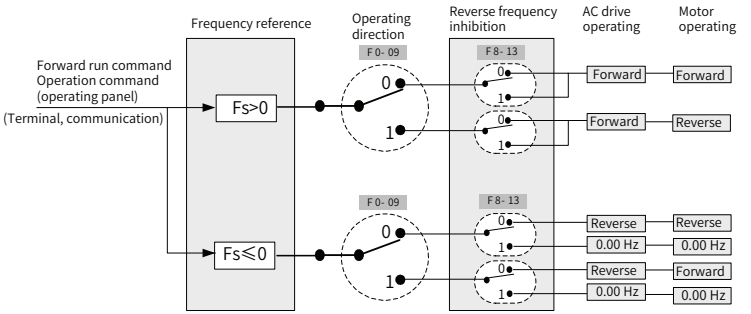
After you restore the default setting of the AC drive, press the RUN key to make the motor rotate forwardly. If the direction of rotation at this time is opposite to the direction required, power off (wait until the main capacitor of the AC drive is completely discharged) and exchange any two phases among UVW to rectify the fault.

In applications where both the forward run and reverse run are needed, change the value of F0-09 and then press the RUN key to make the motor run reversely.

If terminal control is used, to apply reverse run, set F8-13 to 0 to allow reverse control.

When the operating frequency of the drive is set through communication (F0-03 = 9, communication address: 1000H) and reverse run is allowed (F8-13 = 0), reverse run is available if the set frequency Fs is a negative value. If the external command is reverse run or the reference frequency is a negative value, but the "reverse frequency" is inhibited (F8-13 = 1), the drive operates at 0 Hz without output.

In applications where reverse rotation is inhibited, do not change the rotating direction by modifying parameters because the preceding two parameters will be restored when you perform parameter initialization, as shown below.



Note: When Fs ≤ 0 and F8-13 = 1, the drive operates at 0.00 Hz.

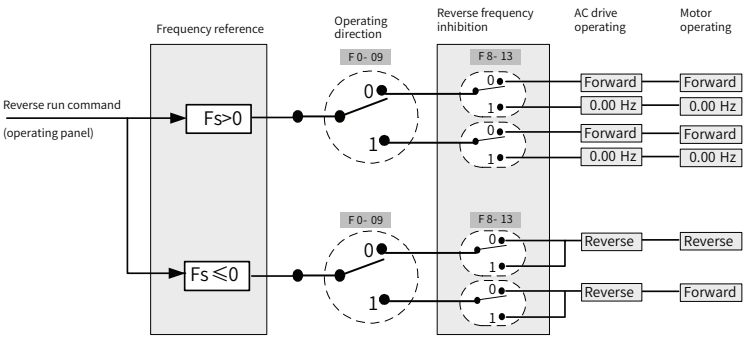


Figure 4-23 Setting the Motor Rotating Direction

4.8.8 Setting the Fixed Length Control Mode

The MD310 has the fixed length control function. The length pulses are sampled by the DI assigned with function 27 (Length count input). The "Actual length" (FB-06) = Number of sampled pulses/ Value of FB-07 (Number of pulses per meter). When the actual length exceeds the length reference (FB-05), the relay output terminal or DO terminal that assigned with function 10 (Length reached) outputs an active signal.

During fixed length control, the length reset operation can be performed through the DI that assigned with function 28 (Length reset), as shown in the following figure.

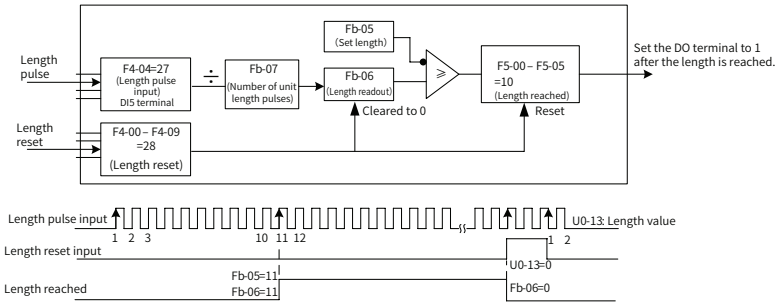


Figure 4-24 Parameter setting in fixed length control mode

Note:

1) Under the fixed length control mode, the length can be calculated only through the number of pulses because the direction cannot be identified.
2) Only DI5 can be assigned with function 27 (Length count input).
3) An automatic stop system can be built by connecting the T/A-T/B signal outputted by the relay assigned with function "Length reached" to the stop input terminal of the AC drive.

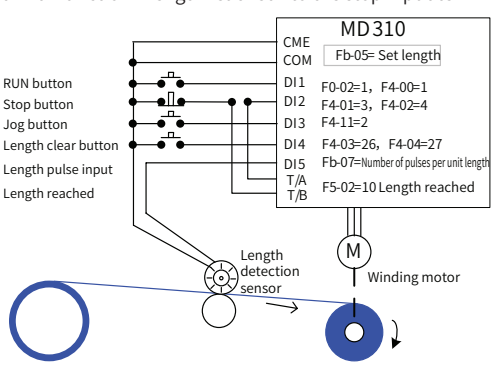


Figure 4-25 Common application example of the fixed length control function

4.8.9 Instructions for Use of Counting Function

The counting value is collected through the DI assigned with function 25. When the counting value reaches the set counting value (FB-08), the DO assigned with function 8 (Set counting value reached) outputs an "ON" signal, and then the counter stops.

When the counting value reaches the designated counting value (FB-09), the DO assigned with function 9 (Designated counting value reached) outputs an "ON" signal and the counter stops until the "Set counting value" is reached.

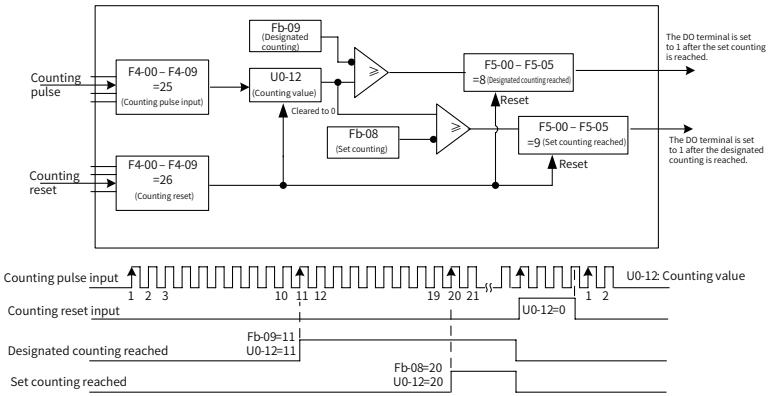


Figure 4-26 Parameter setting in the counting mode

Note:

1) FB-09 cannot be greater than FB-08.
2) DI5 must be used when the pulse frequency is high.
3) One DO can be assigned with either the "counting value reference reach" function or the "designated counting value reach" function, but not both.
4) The counter keeps counting in the RUN/STOP state of the drive until the "Set counting value" is reached. The counting value is retentive upon power failure.
5) When the "Counting value reached" signal is outputted from the DO to the stop input terminal of the drive, an automatic stop system can be formed.

4.9 Setting and Auto-tuning of Motor Parameters

4.9.1 Motor Parameter Setting

When the drive runs in vector control mode (F0-01 = 0), accurate motor parameters are required to ensure satisfactory drive performance and operation efficiency. This is major difference between the vector control mode and V/f control mode (F0-01 = 2).

The motor parameters (motor 1 by default) that need to be set are listed in the following table.

Motor 1 parameters	Parameter	Description
F1-00	Motor type	Asynchronous, variable-frequency asynchronous
F1-01 to F1-05	Rated motor power/voltage/current/ frequency/ speed	Model parameter, manual input
F1-06 to F1-10	Internal equivalent stator resistance, inductance, and rotor inductance	Auto-tuning

For complicated application system with multiple motors, the parameters of motor 2 are listed in the following table.

Motor 2 parameters	Description
A2-00	Asynchronous, variable-frequency asynchronous
A2-01 to A2-05	Model parameter, manual input
A2-06 to A2-10	Auto-tuning

4.9.2 Motor Parameter Auto-tuning

The internal electrical parameters of the controlled motor can be obtained through dynamic auto-tuning, static auto-tuning, and manual input.

Auto-tuning mode	Applicable occasion	Auto-tuning effect
No-load dynamic auto-tuning	Applicable to cases where the motor can be disconnected from the application system.	Best
With-load dynamic auto-tuning	Applies when the asynchronous motor cannot be disconnected from the application system.	Acceptable
Static auto-tuning	Applies when the motor cannot be disconnected from the load and dynamic auto-tuning is not allowed.	Not recommended
Manual parameter input	Applies to asynchronous motors only. Applies when the motor cannot be disconnected from the application system. Copy the auto-tuned motor parameters to F1-00...F1-10.	Acceptable

Perform motor auto-tuning as follows.

The following takes motor 1 as an example to describe motor auto-tuning. The auto-tuning process for motors 2, 3, and 4 is the same and only parameters are changed accordingly.

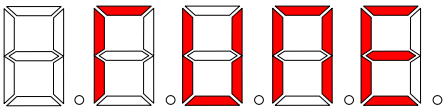
1. If the motor can be disconnected from the load, cut off the power supply, and disconnect the motor from the load to run the motor without load.

2. After power-on, set F0-02 (Command source selection) to 0 (Operating panel control).

3. Enter the motor nameplate parameters (such as F1-00 to F1-05) correctly and enter the following parameters based on the motor used.

Motor selection	parameter
Motor 1	F1-00: Motor type selection F1-01: Rated motor power F1-02: Rated motor voltage F1-03: Rated motor current F1-04: Rated motor frequency F1-05: Rated motor speed
Motor 2	A2-00 to A2-05: Same as above

4. If the motor is an asynchronous motor, set F1-37 (A2-37 in case of motor 2) to 2 and press the ENTER key. In this case, the operating panel displays "TUNE", as shown below.



Next, press the RUN key on the operation panel, and then the motor starts to accelerate/decelerate, run forwardly/reversely, with the indicator turned on. The auto-tuning process lasts for about 2s. When the preceding displayed information disappears, the normal parameter display state applies, indicating parameter auto-tuning is done.

After auto-tuning is done, the following motor parameters are calculated automatically.

Motor selection	parameter
Motor 1	F1-06: Asynchronous motor stator resistance F1-07: Asynchronous motor rotor resistance F1-08: Leakage inductance of asynchronous motor F1-09: Mutual inductance of asynchronous motor F1-10: No-load current of asynchronous motor
Motor 2	A2-06 to A2-10: Same as above

If the motor cannot be disconnected from the load, set F1-37 (Auto-tuning selection) to 3 (Static auto-tuning 2) and then press the RUN key on the operating panel to start motor auto-tuning.

4.9.3 Setting and Switching Multiple Groups of Motor Parameters

The AC drive supports switchover of two groups of motor parameters (parameters for motor 1 and motor 2).

You can select the active motor parameter group through F0-24 or the DI assigned with functions 41 and 42. When the DIs assigned with functions 41 and 42 are active, the setting of F0-24 is deactivated.

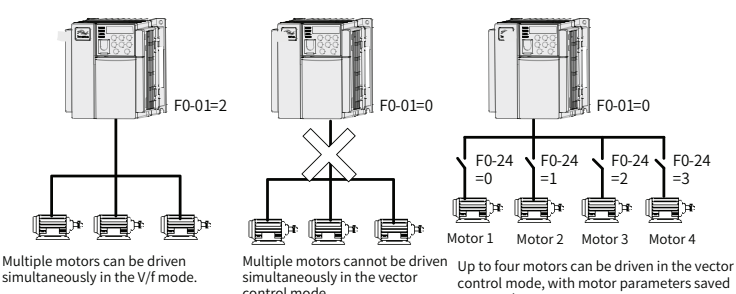


Figure 4-27 Setting and switching multiple groups of motor parameters

4.10 Instructions for Use of DI Terminals

The control board provides five DIs, numbered from DI1 to DI5. You can obtain another five DIs (numbered from DI6 to DI10) by installing an I/O expansion card.

The internal hardware of DIs is configured with a 24 VDC power supply for detection. You only need to short the DI to COM terminal to input the DI signal to the drive.

By default, F4-38 = 0000 and F4-39 = 0000. A DI terminal is active when it is being shorted to COM (logic 1), and inactive when it is not shorted to COM (logic 0).

You can also change the DI terminal active mode. That is, a DI terminal is inactive (logic 0) when being shorted and active (logic 1) when not shorted. In this case, it is necessary to change the corresponding bitof F4-38 and F4-39 to 1. F4-38 and F4-39 correspond to active modes of DI1...DI5 and DI6...DI10 respectively.

The AC drive also provides F4-10 (Software filter time) for the DI signal to improve the anti-interference capacity.

For DI1 to DI3, the AC drive provides the signal delay function, convenient for some applications requiring delay.

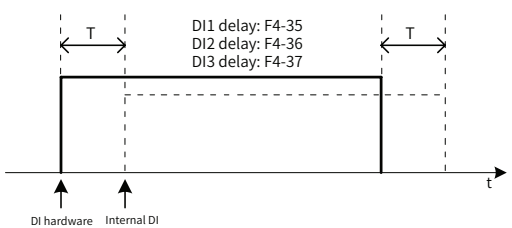


Figure 4-28 Terminal signal delay function

The preceding 10 DIs can be defined in parameters F4-00...F4-09. Each DI can be assigned with a function among the 50 functions. For details, see descriptions of F4-00...F4-09.

The hardware design only allows DI5 to receive high-speed pulse signals. If high-speed pulse counting is required, use DI5.

4.11 Instructions for Use of DO Terminals

The control board provides three DOs, namely FM, DO1, and T/A-T/B-T/C. FM and DO1 are transistor output that used to drive 24 VDC low-voltage circuit; T/A-T/B-T/C are relay output that used to drive 250 VAC control circuit.

You can extend two outputs by connecting an external expansion board, namely DO2 and P/A-P/B-P/C. DO2 is transistor output and PA/PB/PC is relay output.

You can define the functions of DOs by setting F5-01...F5-05 to indicate the operating state and alarm information of the AC drive. There are a total of 40 functions to help achieve specific automatic control requirements.

Name	Parameter	Output characteristics
FM-CME	When F5-00 = 0, F5-06	Transistor, high-speed pulse output of 10 kHz to 50 kHz; driving capacity: 24 VDC, 50 mA
	When F5-00 = 1, F5-01	Transistor; driving capacity: 24 VDC, 50 mA
T/A-T/B-T/C	F5-02	Relay; driving capacity: 250 VAC, 0.2 A/30 VDC, 1 A
P/A-P/B-P/C	F5-03	Expansion card, relay; driving capacity: 250 VAC, 0.2 A/30 VDC, 1 A
DO1-CME	F5-04	Transistor; driving capacity: 24 VDC, 50 mA
DO2-CME	F5-05	Expansion card, transistor; driving capacity: 24 VDC, 50 mA

When F5-00 = 0, the FM terminal is high-speed pulse output. The frequency of output pulses indicates the value of the internal operating parameters. The greater the value is, the higher the output pulse frequency is. 100% of the value corresponds to 50 kHz. The indicated internal parameter is defined by F5-06.

4.12 AI Signal Characteristics and Pre-processing

The AC drive supports a total of three AIs, among which AI1 and AI2 are provided on the control board and AI3 is provided on the external expansion card.

Terminal	Input signal
AI1-GND	If the pin marked "V" of J14 is connected, 0 — 10 VDC signals can be received. If the pin marked with "I" of J14 is connected, 0 — 20 mA signals can be received.
AI2-GND	If the pin marked "V" of J4 is connected, 0 — 10 VDC signals can be received. If the pin marked with "I" of J4 is connected, 0 — 20 mA signals can be received.
AI3-GND	This terminal is provided on the expansion board to receive -10 VDC to +10 VDC signals.

The AI can be used to set the frequency source, torque reference, voltage reference upon separated V/f, and PID setting or feedback. The corresponding relationship between the voltage/current and actual reference/feedback is defined by F4-13...F4-27.

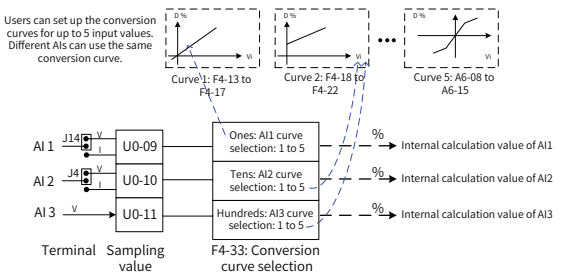


Figure 4-29 Relationship between voltage/current and actual reference/feedback

The sampling value of AI1 terminal can be read in U0-09. The converted calculation value is for internal subsequent calculation and cannot be directly read by the user.

4.12.1 AI Terminal Correction

To improve AI accuracy and ensure that the actual reference voltage is consistent with the voltage sampled by the drive, you need to perform AI correction. For the correction method, see descriptions in group AC.

Parameters in group AC have been auto-corrected by default, and you can perform correction again as needed.

4.12.2 Example of AI1 Verification

1) Input 2.000 V voltage to AI1-GND, and record the value of U0-21.
2) Change the value of AC-00 to 2.000 and AC-01 to the value of U0-21 recorded in the previous step.
3) Input 8.000 V voltage to AI1-GND, and record the value of U0-21.
4) Change the value of AC-02 to 8.000, and change the value of AC-03 to the value of U0-21 recorded in the previous step.
5) The correction process ends.

4.13 Instructions for Use of AO Terminals

The AC drive supports two AOs, where AO1 is equipped on the control board, and AO2 needs to be provided by an external expansion card.

Terminal	Input signal
AO1-GND	If the pin marked "V" of J5 is connected, 0–10 VDC signals can be outputted.
	If the pin marked "I" of J5 is connected, 0–20 mA signals can be outputted.
AO2-GND	This terminal is provided on the expansion card and outputs the signal of 0–10 VDC.

AO1 and AO2 can be used to indicate the internal operating parameters in the analog mode. The parameters indicated are defined by F5-07 and F5-08.

The designated operating parameters can be rectified before output. The rectification characteristic curve is shown in the oblique line below, in which Y = kX + b. In this formula, b represents the zero drift, k represents the gain, Y represents the actual output, and X represents the standard output. k and b of AO1 and AO2 can be set by F5-10...F5-11 and F5-12...F5-13 respectively.

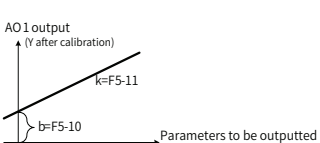


Figure 4-30 AO correction curve

The zero offset coefficients of AO1 and AO2 correspond to 100% of 10 V (or 20 mA), and the zero offset = zero offset coefficient x 10 V (or 20 mA). The standard output refers to the value corresponding to the analog output of 0 V to 10 V (or 0 mA to 20 mA) without zero offset or gain correction.

For example, if the analog output is operating frequency, if the frequency needs to be 0 Hz, and the corrected output needs to be 8 V (or 16 mA), as shown in the following figure, set the zero offset to 80%. If 3 V (or 6 mA) needs to be outputted at maximum frequency, set the gain to -0.50.

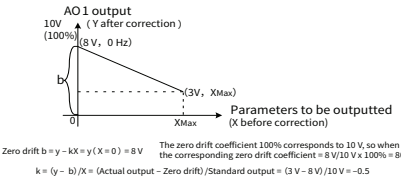


Figure 4-31 Output with zero offset or gain

4.13.1 AO Terminal Correction

To improve AO accuracy and ensure that the actual output voltage of the AC drive is consistent with the target voltage, you need to perform AO correction. For the correction method, see the descriptions of parameters in group AC.

Parameters in group AC have been auto-corrected by default, and you can perform correction again as needed.

4.13.2 Example of AO1 Verification

1) Set F5-07 to 1.
2) Set F0-08 to 10.00 and AC-12 to 2.000 (the result of F0-08 x 10.000/F0-10). Measure the voltage of AO1-GND with a precision instrument.
3) Set F0-08 to 40.00 and AC-14 to 8.000 (the result of F0-08 x 10.000/F0-10). Measure the voltage of AO1-GND with a precision instrument.
4) Write the voltages measured in the preceding two steps to AC-13 and AC-15.
5) The AO1 correction process ends.

4.14 Instructions for Use of Serial Communication

For the hardware communication parameter setting of the communication terminal, see group FD. Set the communication rate and data format of the AC drive to those consistent with the host computer. Failure to comply can result in communication failure.

The MD310 serial port carries built-in Modbus-RTU slave communication protocol. In the host controller, you can view or modify the AC drive parameters and operating status through the serial port, as well as sending operation commands and operating frequency to the drive through the serial port.

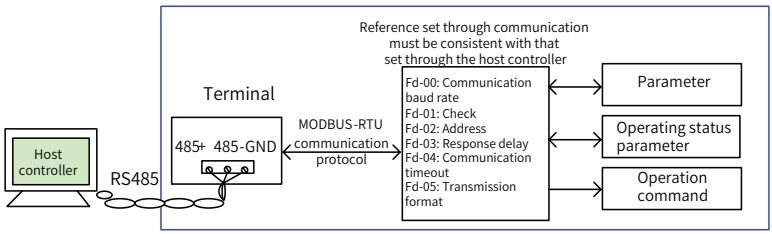


Figure 4-32 Use of serial communication

The MD310 arranges parameters, operating state parameters, and operating commands in the "register parameter address" mode. The host controller can define the protocol of communication data interaction. For details, see "Appendix A: MD310 Modbus Communication Protocol".

4.15 Password Setting

The drive provides the user password protection function. When FP-00 is set to a non-zero value, the password function is enabled. The password takes effect after you exit the parameter editing state. When you press the PRG key again, "------" will be displayed, and you must enter the correct user password to enter the menu.

To cancel the password protection function, enter the menu with the correct password and then set FP-00 to 0.

The following example shows how to change the password to 12345 (represents the blinking digit).

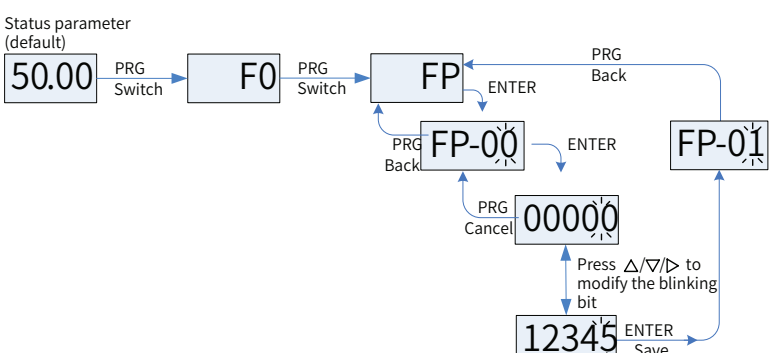


Figure 4-33 Gain setting example

5 Parameter List

If FP-00 is set to a non-zero value (which enables password protection), the parameter menu is accessible only after the correct password is entered in the function parameter mode and user-modified parameter mode. To disable password protection, set FP-00 to 0.

The parameter menu in the user-defined parameter mode is not protected by password.

Groups F and A include standard function parameters. Group U includes the monitoring function parameters.

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F0 Standard functions						
F0-01	0xF001	Motor 1 control mode	0: Sensorless vector control (SVC) 2: V/f control	2	-	At stop
F0-02	0xF002	Command source	0: LCD operating panel/Software tool 1: Terminal 2: Communication	0	-	Real time
F0-03	0xF003	Main frequency source X	0: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, non-retentive upon power failure) 1: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, retentive upon power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication (1000H)	0	-	At stop
F0-04	0xF004	Auxiliary frequency source Y	0: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, non-retentive upon power failure) 1: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, retentive upon power failure) 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication (1000H)	0	-	At stop
F0-05	0xF005	Range selection of auxiliary frequency Y source for superposition	0: Relative to max. frequency 1: Relative to main frequency reference X	0	-	Real time
F0-06	0xF006	Range of auxiliary frequency Y upon superposition	0% to 150%	100	%	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F0-07	0xF007	Frequency superposition selection	Ones: 0: Main frequency X 1: Operation result of X and Y (based on tens) 2: Switchover between X and Y 3: Switchover between X and operation result of X and Y 4: Switchover between Y and operation result of X and Y Tens: 0: X + Y 1: X - Y 2: Max. (X, Y) 3: Min. (X, Y)	0	-	Real time
F0-08	0xF008	Preset frequency	0.00 Hz to 500.00 Hz	50.00	Hz	Real time
F0-09	0xF009	Operating direction	0: Run in the default direction 1: Opposite to the default direction	0	-	Real time
F0-10	0xF00A	Maximum frequency	50.00 Hz to 500.00 Hz	50.00	Hz	At stop
F0-11	0xF00B	Frequency upper limit source	0: F0-12 1: AI1 2: AI2 3: AI3 4: Pulse setting 5: Communication (1000H)	0	-	At stop
F0-12	0xF00C	Frequency upper limit	0.00 Hz to 500.00 Hz	50.00	Hz	Real time
F0-13	0xF00D	Frequency upper limit offset	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F0-14	0xF00E	Frequency lower limit	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F0-15	0xF00F	Carrier frequency	0.8 kHz to 12.0 kHz	6.0	kHz	Real time
F0-16	0xF010	Carrier frequency changes with the temperature	0: Disable 1: Enable	1	-	Real time
F0-17	0xF011	Acceleration time 1	0.0s to 6500.0s	0.0	s	Real time
F0-18	0xF012	Deceleration time 1	0.0s to 6500.0s	0.0	s	Real time
F0-19	0xF013	Acceleration/Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	1	-	At stop
F0-21	0xF015	Auxiliary frequency source offset upon superposition	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F0-22	0xF016	Frequency reference resolution	1: 0.1 Hz 2: 0.01 Hz	2	Hz	N/A
F0-23	0xF017	Retention of frequency set through digital setting upon stop	0: Non-retentive 1: Retentive	0	-	Real time
F0-24	0xF018	Motor parameter group selection	0: Motor parameter group 1 1: Motor parameter group 2	0	-	At stop
F0-25	0xF019	Base frequency for acceleration/deceleration time	0: Max. frequency (F0-10) 1: Frequency reference 2: 100 Hz	0	-	At stop
F0-26	0xF01A	Base frequency for UP/DOWN modification during operation	0: Operating frequency 1: Frequency reference	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F0-27	0xF01B	Bind command source to frequency source	Ones: Frequency source bound to operating panel 0: Not bound 1: Frequency set through digital setting 2: AI1 3: AI2 4: AI3 5: Pulse reference (DI5) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication Tens: Frequency source bound to terminal commands Hundreds: Frequency source bound to communication commands	0	-	Real time
F1: Motor 1 parameters						
F1-00	0xF100	Motor type	0: Common asynchronous motor 1: Variable frequency asynchronous motor	0	-	At stop
F1-01	0xF101	Rated motor power	0.1 kW to 30.0 kW	3.7	kW	At stop
F1-02	0xF102	Rated motor voltage	1 V to 1000 V	380	V	At stop
F1-03	0xF103	Rated motor current	0.01 A to 655.35 A	9.00	A	At stop
F1-04	0xF104	Rated motor frequency	0.01 Hz to 500.00 Hz	0.01	Hz	At stop
F1-05	0xF105	Rated motor speed	1 rpm to 65535 rpm	1460	rpm	At stop
F1-06	0xF106	Asynchronous motor stator resistance	0.001 Ω to 65.535 Ω	1.204	Ω	At stop
F1-07	0xF107	Asynchronous motor rotor resistance	0.001 Ω to 65.535 Ω	0.908	Ω	At stop
F1-08	0xF108	Leakage inductance of asynchronous motor	0.01 mH to 655.35 mH	5.28	mH	At stop
F1-09	0xF109	Mutual inductance of asynchronous motor	0.1 mH to 6553.5 mH	158.6	mH	At stop
F1-10	0xF10A	No-load current of asynchronous motor	0.01 A to 655.35 A	4.24	A	At stop
F1-37	0xF125	Parameter auto-tuning selection	0: Disable 1: Static partial auto-tuning of asynchronous motor 2: Dynamic complete auto-tuning of asynchronous motor 3: Static complete auto-tuning of asynchronous motor	0	-	At stop
F2 Vector control of motor 1						
F2-00	0xF200	Speed loop proportional gain 1	1 to 100	20	-	Real time
F2-01	0xF201	Speed loop integral time 1	0.01 to 10.00	0.50	-	Real time
F2-02	0xF202	Switchover frequency 1	0.00 to 655.35	5.00	-	Real time
F2-03	0xF203	Speed loop proportional gain 2	1 to 100	20	-	Real time
F2-04	0xF204	Speed loop integral time 2	0.01 to 10.00	1.00	-	Real time
F2-05	0xF205	Switchover frequency 2	0.00 to 655.35	10.00	-	Real time
F2-06	0xF206	Slip compensation factor	50 to 200	100	-	Real time
F2-07	0xF207	Filter time constant of speed loop	0.000 to 0.100	0.015	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F2-08	0xF208	Overexcitation gain in vector control	0 to 200	64	-	Real time
F2-09	0xF209	Torque upper limit source in speed control (driving)	0 to 7	0	-	At stop
F2-10	0xF20A	Digital setting of torque upper limit in speed control (driving)	0.0 to 200.0	150.0	-	Real time
F2-11	0xF20B	Torque upper limit source in speed control (braking)	0 to 8	0	-	At stop
F2-12	0xF20C	Digital setting of torque upper limit in speed control (braking)	0.0 to 200.0	150.0	-	Real time
F2-13	0xF20D	M-axis current loop Kp	0 to 60000	10	-	Real time
F2-14	0xF20E	M-axis current loop Ki	0 to 60000	10	-	Real time
F2-15	0xF20F	T-axis current loop Kp	0 to 60000	10	-	Real time
F2-16	0xF210	T-axis current loop Ki	0 to 60000	10	-	Real time
F2-17	0xF211	Speed loop multi-function selection	Ones: Speed loop integral separation enable 0: Disable 1: Enable Tens: Speed loop torque feedforward enable 0: Disable 1: Enable	0	-	At stop
F2-18	0xF212	Torque feedforward gain	20 to 100	80	-	Real time
F2-19	0xF213	Torque feedforward filter time	10 to 200	50	-	Real time
F2-20	0xF214	Reserved	100 to 110	105	-	N/A
F2-21	0xF215	Maximum torque tuning coefficient	50 to 200	80	-	Real time
F2-22	0xF216	Generating power limit mode	0 to 3	0	-	Real time
F2-23	0xF217	Generating power upper limit	0.0 to 200.0	0.0	-	Real time
F3: V/f control parameters						
F3-00	0xF300	V/f curve setting	0: Linear V/f curve 1: Multi-point V/f curve 2: Square V/f curve 3: 1.2-power V/f curve 4: 1.4-power V/f curve 6: 1.6-power V/f curve 8: 1.8-power V/f curve 9: Reserved 10: V/f fully separated 11: V/f partially separated	0	-	At stop
F3-01	0xF301	Torque boost	0.0% to 30.0%	2.0	%	Real time
F3-02	0xF302	Cut-off frequency of torque boost	0.00 Hz to 500.00 Hz	50.00	Hz	At stop
F3-03	0xF303	Multi-point V/f frequency 1	0.00 Hz to 500.00 Hz	0.00	Hz	At stop
F3-04	0xF304	Multi-point V/f voltage 1	0.0% to 100.0%	0.0	%	At stop
F3-05	0xF305	Multi-point V/f frequency 2	0.00 Hz to 500.00 Hz	0.00	Hz	At stop
F3-06	0xF306	Multi-point V/f voltage 2	0.0% to 100.0%	0.0	%	At stop
F3-07	0xF307	Multi-point V/f frequency 3	0.00 Hz to 500.00 Hz	0.00	Hz	At stop
F3-08	0xF308	Multi-point V/f voltage 3	0.0% to 100.0%	0.0	%	At stop
F3-09	0xF309	Slip compensation factor	0.0% to 200.0%	0.0	%	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F3-10	0xF30A	V/f over-excitation gain	0 to 200	64	-	Real time
F3-11	0xF30B	V/f oscillation suppression gain	0 to 100	40	-	Real time
F3-12	0xF30C	Oscillation suppression gain mode	0: Disable 1: Reserved 2: Reserved 3: Enable 4: Reserved	3	-	At stop
F3-13	0xF30D	Voltage source for separated V/f	0: Digital setting (F3-14) 1: AI1 2: AI2 3: AI3 5: Multi-reference 6: Simple PLC 7: PID 8: Communication setting	0	-	Real time
F3-14	0xF30E	Voltage digital setting for separated V/f	0 V to 380 V	0	V	Real time
F3-15	0xF30F	Voltage acceleration time for separated V/f	0.0s to 1000.0s	0.0	s	Real time
F3-16	0xF310	Voltage deceleration time for separated V/f	0.0s to 1000.0s	0.0	s	Real time
F3-17	0xF311	Stop mode for separated V/f	0: Frequency and voltage declined to 0 separately 1: Frequency declined after voltage declined to 0	0	-	At stop
F3-18	0xF312	V/f overcurrent stall action current	50% to 200%	150	%	At stop
F3-19	0xF313	Overcurrent stall enable	0: Disable 1: Enable	1	-	At stop
F3-20	0xF314	Overcurrent stall suppression gain	0 to 100	20	-	Real time
F3-21	0xF315	Current compensation coefficient for overcurrent stall action at multiplied rated frequency	0% to 200%	50	%	At stop
F3-22	0xF316	V/f overvoltage stall action voltage	200.0 V to 810.0 V	760.0	V	At stop
F3-23	0xF317	V/f overvoltage stall enable	0: Inactive 1: Active	1	-	At stop
F3-24	0xF318	V/f overvoltage stall suppression frequency gain	0 to 100	30	-	Real time
F3-25	0xF319	V/f overvoltage stall suppression voltage gain	0 to 100	30	-	Real time
F3-26	0xF31A	Frequency rise limit during overvoltage stall	0 Hz to 50 Hz	5	Hz	At stop
F3-27	0xF31B	Slip compensation time constant	0.1 to 10.0	0.5	-	Real time
F3-33	0xF321	Online torque compensation gain	80 to 150	100	-	At stop
F4 Input terminals						

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F4-00	0xF400	DI1 function selection	0: No function 1: Forward run (FWD) 2: Reverse run (REV) 3: Three-wire operation control 4: Forward jog (FJOG) 5: Reverse jog (RJOG) 6: Terminal UP 7: Terminal DOWN 8: Coast to stop 9: Fault reset (RESET) 10: Operation pause 11: External fault NO input 12: Multi-reference terminal 1 13: Multi-reference terminal 2 14: Multi-reference terminal 3 15: Multi-reference terminal 4 16: Terminal 1 for acceleration/deceleration selection 17: Terminal 2 for acceleration/deceleration selection 18: Frequency source switchover	1	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F4-00	0xF400	DI1 function selection	19: Clear data set by UP/DOWN key or by terminal functioning as UP/DOWN key 20: Operation command switchover 21: Acceleration/Deceleration inhibited 22: PID pause 23: Simple PLC state reset 24: Wobble frequency pause 25: Counter input 26: Counter reset 27: Length input 28: Length reset 29: Torque control inhibition 30: Pulse frequency input (valid only for DI5) 31: Reserved 32: Immediate DC braking 33: External fault NC input 34: Frequency modification enable 35: Inverted PID action 36: External stop terminal 1 37: Control command switchover terminal 2 38: PID integral pause 39: Switchover between main frequency and preset frequency 40: Switchover between auxiliary frequency and preset frequency 41: Motor terminal selection 42: Reserved 43: PID parameter switchover 44: User-defined fault 1 45: User-defined fault 2 46: Speed control/Torque control switchover 47: Emergency stop 48: External stop terminal 2 49: Decelerate to DC braking 50: Clear the current operating time 51: Switchover between two-wire mode and three-wire mode 52: Reverse run inhibited 53: Reserved 54: Reserved 55: Reserved 56: Reserved 57: Reserved 58: Reserved 59: Reserved	1	-	At stop
F4-01	0xF401	DI2 function selection	Same as F4-00	4	-	At stop
F4-02	0xF402	DI3 function selection	Same as F4-00	9	-	At stop
F4-03	0xF403	DI4 function selection	Same as F4-00	12	-	At stop
F4-04	0xF404	DI5 function selection	Same as F4-00	13	-	At stop
F4-10	0xF40A	DI filter time	0.000s to 1.000s	0.010	s	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F4-11	0xF40B	Terminal command mode	0: Two-wire mode 1 1: Two-wire mode 2 2: Three-wire mode 1 3: Three-wire mode 2	0	-	At stop
F4-12	0xF40C	Change rate of terminal UP/DOWN	0.001 Hz/s to 65.535 Hz/s	1.000	Hz/s	Real time
F4-13	0xF40D	Minimum input of AI curve 1	0.00 V to 655.35 V	0.00	V	Real time
F4-14	0xF40E	Percentage corresponding to minimum input of AI curve 1	-100.0% to +100.0%	0.0	%	Real time
F4-15	0xF40F	Maximum input of AI curve 1	0.00 V to 10.00 V	10.00	V	Real time
F4-16	0xF410	Percentage corresponding to the maximum input of AI curve 1	-100.0% to +100.0%	100.0	%	Real time
F4-17	0xF411	AI1 filter time	0.00s to 10.00s	0.10	s	Real time
F4-18	0xF412	Minimum input of AI curve 2	0.00 V to 655.35 V	0.00	V	Real time
F4-19	0xF413	Percentage corresponding to minimum input of AI curve 2	-100.0% to +100.0%	0.0	%	Real time
F4-20	0xF414	Maximum input of AI curve 2	0.00 V to 10.00 V	10.00	V	Real time
F4-21	0xF415	Percentage corresponding to maximum input of AI curve 2	-100.0% to +100.0%	100.0	%	Real time
F4-22	0xF416	AI2 filter time	0.00s to 10.00s	0.10	s	Real time
F4-23	0xF417	Minimum input of AI curve 3	-10.00 V to +10.00 V	-10.00	V	Real time
F4-24	0xF418	Percentage corresponding to minimum input of AI curve 3	-100.0% to +100.0%	-100.0	%	Real time
F4-25	0xF419	Maximum input of AI curve 3	0.00 V to 10.00 V	10.00	V	Real time
F4-26	0xF41A	Percentage corresponding to maximum input of AI curve 3	-100.0% to +100.0%	100.0	%	Real time
F4-27	0xF41B	AI3 filter time	0.00s to 10.00s	0.10	s	Real time
F4-28	0xF41C	Pulse minimum input	0.00 kHz to 655.35 kHz	0.00	kHz	Real time
F4-29	0xF41D	Percentage corresponding to pulse minimum input	-100.0% to +100.0%	0.0	%	Real time
F4-30	0xF41E	Pulse maximum input	0.00 kHz to 20.00 kHz	20.00	kHz	Real time
F4-31	0xF41F	Percentage corresponding to pulse maximum input	-100.0% to +100.0%	100.0	%	Real time
F4-32	0xF420	Pulse filter time	0.00s to 10.00s	0.10	s	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F4-33	0xF421	AI curve	Ones: AI1 curve selection 1: Curve 1 (2 points) 2: Curve 2 (2 points) 1: Curve 1 (2 points) 4: Curve 4 (4 points) 5: Curve 5 (4 points) Tens: AI2 curve selection 1: Curve 1 (2 points) 2: Curve 2 (2 points) 3: Curve 3 (2 points) 4: Curve 4 (4 points) 5: Curve 5 (4 points) Hundreds: AI3 curve selection 1: Curve 1 (2 points) 2: Curve 2 (2 points) 3: Curve 3 (2 points) 4: Curve 4 (4 points) 5: Curve 5 (4 points)	801	-	Real time
F4-34	0xF422	Selection when AI value < minimum input value	Ones: Selection when AI1 value lower than minimum input value 0: Percentage corresponding to the minimum input 1: 0.0% Tens: Selection when AI2 value lower than minimum input value 0: Percentage corresponding to the minimum input 1: 0.0% Hundreds: Selection when AI3 value lower than minimum input value 0: Percentage corresponding to the minimum input 1: 0.0%	0	-	Real time
F4-35	0xF423	DI1 delay time	0.0s to 3600.0s	0.0	s	Real time
F4-36	0xF424	DI2 delay time	0.0s to 3600.0s	0.0	s	Real time
F4-37	0xF425	DI3 delay time	0.0s to 3600.0s	0.0	s	Real time
F4-38	0xF426	DI active mode selection 1	Ones: DI1 0: Active high 1: Active low Tens: DI2 0: Active high 1: Active low Hundreds: DI3 0: Active high 1: Active low Thousands: DI4 0: Active high 1: Active low Ten thousands: DI5 0: Active high 1: Active low	0	-	At stop
F5 Output terminals						
F5-00	0xF500	FM terminal output mode	0: Pulse output (FMP) 1: Analog output (FMR)	0	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F5-01	0xF501	FMR output function selection	0: No output 1: AC Drive operating 2: Fault output (stop upon fault) 3: Frequency-level detection 1 4: Frequency reached 5: Operating at zero speed (no output at stop) 6: Motor overload pre-alarm 7: AC drive overload pre-alarm 8: Set counting value reached 9: Designated counting value reached 10: Length reached 11: Simple PLC cycle completed 12: Accumulative operating time reached 13: Frequency limited 14: Torque limited 15: Ready to run 16: AI1 > AI2 17: Frequency upper limit reached 18: Frequency lower limit reached (no output at stop) 19: Undervoltage status 20: Communication 21: Reserved 22: Reserved 23: Operating at zero speed 2 (output at stop) 24: Accumulative power-on time reached 25: Frequency level detection 2 26: Frequency 1 reached 27: Frequency 2 reached 28: Current 1 reached 29: Current 2 reached 30: Timed duration reached 31: AI1 input limit exceeded 32: Load loss 33: Rotation direction 34: Current Detection 35: Drive temperature reached 36: Software overcurrent 37: Frequency lower limit reached (related to operation) 38: Fault output (stop upon fault) 39: Motor overheat pre-alarm 40: Operating time reached 41: Fault output (no output at undervoltage)	0	-	Real time
F5-02	0xF502	Control board relay (T/A-T/B-T/C) function selection	Same as F5-01	2	-	Real time
F5-03	0xF503	Expansion card relay (P/A-P/B-P/C) function selection	Same as F5-01	0	-	Real time
F5-04	0xF504	DO1 output function selection	Same as F5-01	1	-	Real time
F5-05	0xF505	Function of DO2 on the expansion card	Same as F5-01	4	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F5-06	0xF506	FMP output function selection	0: Operating frequency 1: Frequency reference 2: Output current 3: Output torque (absolute value, a percentage to the motor torque) 4: Output power 5: Output voltage 6: Pulse input (100.% corresponds to 100.0 kHz) 7: AI1 8: AI2 9: AI3 (expansion card) 10: Length 11: Counting value 12: Communication 13: Motor speed 14: Output current (100.% corresponds to 1000.0 A.) 15: Output voltage (100.% corresponds to 1000.0 V) 16: Output torque (signed)	0	-	Real time
F5-07	0xF507	AO1 output function selection	Same as F5-06	0	-	Real time
F5-08	0xF508	AO2 output function selection	Same as F5-06	1	-	Real time
F5-09	0xF509	Maximum frequency of FMP output	0.01 kHz to 50.00 kHz	50.00	kHz	Real time
F5-10	0xF50A	AO1 zero offset coefficient	-100.0% to +100.0%	0.0	%	Real time
F5-11	0xF50B	AO1 gain	10.00 to 10.00	1.00	-	Real time
F5-12	0xF50C	AO2 zero offset coefficient	-100.0% to +100.0%	0.0	%	Real time
F5-13	0xF50D	AO2 gain	10.00 to 10.00	1.00	-	Real time
F5-17	0xF511	FMR output delay	0.0s to 3600.0s	0.0	s	Real time
F5-18	0xF512	RELAY1 output delay	0.0s to 3600.0s	0.0	s	Real time
F5-19	0xF513	RELAY2 output delay	0.0s to 3600.0s	0.0	s	Real time
F5-20	0xF514	DO1 output delay	0.0s to 3600.0s	0.0	s	Real time
F5-21	0xF515	DO2 output delay	0.0s to 3600.0s	0.0	s	Real time
F5-22	0xF516	DO active status selection	Ones: FMR 0: Positive logic 1: Negative logic Tens: RELAY1 0: Positive logic 1: Negative logic Hundreds: RELAY2 0: Positive logic 1: Negative logic Thousands: DO1 0: Positive logic 1: Negative logic Ten thousands: DO2 0: Positive logic 1: Negative logic	0	-	Real time
F6 Start/Stop control						
F6-00	0xF600	Start mode	0: Direct start 1: Flying start 2: Pre-excited start of asynchronous motors	0	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F6-01	0xF601	Frequency for flying start mode	0: Starting from frequency at stop 1: Starting from mains frequency 2: Starting from the maximum frequency 4: Magnetic field directional flying start (set F1-37 to 1 for static auto-tuning)	0	-	At stop
F6-02	0xF602	Speed of speed tracking	1 to 100	20	-	Real time
F6-05	0xF605	DC braking current/Pre-excitation current at start	0% to 100%	50	%	At stop
F6-06	0xF606	DC braking time/Pre-excitation time at start	0.0s to 100.0s	0.0	s	At stop
F6-07	0xF607	Acceleration/Deceleration mode	0: Linear acceleration/deceleration 1: Static S-curve acceleration/deceleration 2: Dynamic S-curve acceleration/deceleration	0	-	At stop
F6-08	0xF608	Time proportion of S-curve at start	0.0% to 100.0%	30.0	%	At stop
F6-09	0xF609	Time proportion of S-curve at end	0.0% to 100.0%	30.0	%	At stop
F6-10	0xF60A	Stop mode	0: Decelerate to stop 1: Coast to stop	0	-	Real time
F6-11	0xF60B	Starting frequency for DC braking at stop	0.00 Hz to 10.00 Hz	0.00	Hz	Real time
F6-12	0xF60C	Waiting time of DC braking at stop	0.0s to 100.0s	0.0	s	Real time
F6-13	0xF60D	DC braking current at stop	0% to 100%	50	%	Real time
F6-14	0xF60E	DC braking time at stop	0.0s to 100.0s	0.0	s	Real time
F6-15	0xF60F	Braking usage rate	0% to 100%	100	%	N/A
F6-16	0xF610	Closed loop current Kp of speed tracking	0 to 1000	500	-	Real time
F6-17	0xF611	Closed loop current Ki of speed tracking	0 to 1000	800	-	Real time
F6-18	0xF612	Current of speed tracking	30 to 200	100	-	At stop
F6-19	0xF613	Limit value of closed loop current lower limit in speed tracking	10 to 100	30	-	At stop
F6-20	0xF614	Voltage rise time of speed tracking	0.5 to 3.0	1.1	-	At stop
F6-21	0xF615	Demagnetization time	0.00 to 5.00	0.50	-	At stop
F6-23	0xF617	Over-excitation mode selection	0 to 2	0	-	Real time
F6-24	0xF618	Over-excitation suppression current	0 to 150	100	-	Real time
F6-25	0xF619	Over-excitation mode gain	1.00 to 2.50	1.25	-	Real time
F6-26	0xF61A	Denominator coefficient of dynamic S-curve overshoot	1 to 100	10	-	Real time
F7 Operating panel and display						
F7-00	0xF700	LED default display check	0: Inactive 1: Active	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F7-01	0xF701	MF.K key function	0: MF.K key disabled 1: Switchover between operating panel control and remote control (terminal or communication) 2: Switchover between forward run and reverse run 3: Forward jog 4: Reverse jog 5: Parameter display mode switchover	5	-	At stop
F7-02	0xF702	STOP/RES key function	0: The STOP/RES key is valid only in the operating panel control mode. 1: The STOP/RES key is active in any operating mode.	1	-	Real time
F7-03	0xF703	Parameter 1 displayed on LED operating panel during operation	bit0: Operating frequency (Hz) bit1: Frequency reference (Hz) bit2: Bus voltage (V) bit3: Output voltage (V) bit4: Output current (A) bit5: Output power (kW) bit6: Output torque (%) bit7: DI input status bit8: DO output status bit9: AI1 voltage(V)bit10: AI2 voltage (V) bit11: AI3 voltage (V) bit12: Counting value bit13: Length value bit14: Load speed display bit15: PID setting	31	-	At stop
F7-04	0xF704	Parameter 2 displayed on the LED operating panel during operation	bit0: PID feedback bit1: PLC stage bit2: Pulse input frequency (kHz) bit3: Operating frequency (Hz) bit4: Remaining operating time bit5: AI1 voltage before correction (V) bit6: AI2 voltage before correction (V) bit7: AI3 voltage before correction (V) bit8: Linear speed bit9: Current power-on time (hour) bit10: Current operating time (min) bit11: Pulse input reference (Hz) bit12: Reference set through communication bit13: Encoder feedback speed bit14: Display of main frequency X bit15: Display of auxiliary frequency Y	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F7-05	0xF705	Parameter displayed on the LED operating panel at stop	bit0: Frequency reference (Hz) bit1: Bus voltage (V) bit2: DI input status bit3: DO output status bit4: AI1 voltage (V) bit5: AI2 voltage (V) bit6: AI3 voltage (V) bit7: Counting value bit8: Length value bit9: PLC stage bit10: Load speed bit11: PID setting bit12: Pulse input reference (kHz)	51	-	At stop
F7-06	0xF706	Load speed display coefficient	0.001 to 65.000	1.000	-	Real time
F7-07	0xF707	Drive heatsink temperature	0° C to 999° C	0	° C	N/A
F7-08	0xF708	Product No.	0.00 to 655.35	0.00	-	N/A
F7-09	0xF709	Accumulative operating time	0 h and 65535 h	0	h	N/A
F7-10	0xF70A	Performance software version	0.00 to 655.35	0.00	-	N/A
F7-11	0xF70B	Function software version	0.00 to 655.35	0.00	-	N/A
F7-12	0xF70C	Number of decimal places for load speed display	Ones: Number of decimal places of U0-14 0: 0 decimal places 1: 1 decimal place 2: 2 decimal places 3: 3 decimal places	20	-	Real time
F7-12	0xF70C	Number of decimal places for load speed display	Tens: Number of decimal places of U0-19/U0-29 1: 1 decimal place 2: 2 decimal places	20	-	Real time
F7-13	0xF70D	Accumulative power-on time	0 h and 65535 h	0	h	N/A
F7-14	0xF70E	Accumulative power consumption	0 kWh to 65535 kWh	0	kWh	N/A
F7-15	0xF70F	Temporary performance software version	0.00 to 655.35	0.00	-	N/A
F7-16	0xF710	Temporary function software version	0.00 to 655.35	0.00	-	N/A
F8 Auxiliary functions						
F8-00	0xF800	Jog frequency	0.00 Hz to 500.00 Hz	2.00	Hz	Real time
F8-01	0xF801	Acceleration time of jog	0.0s to 6500.0s	20.0	s	Real time
F8-02	0xF802	Deceleration time of jog	0.0s to 6500.0s	20.0	s	Real time
F8-03	0xF803	Acceleration time 2	0.0s to 6500.0s	0.0	s	Real time
F8-04	0xF804	Deceleration time 2	0.0s to 6500.0s	0.0	s	Real time
F8-05	0xF805	Acceleration time 3	0.0s to 6500.0s	0.0	s	Real time
F8-06	0xF806	Deceleration time 3	0.0s to 6500.0s	0.0	s	Real time
F8-07	0xF807	Acceleration time 4	0.0s to 6500.0s	0.0	s	Real time
F8-08	0xF808	Deceleration time 4	0.0s to 6500.0s	0.0	s	Real time
F8-09	0xF809	Jump frequency 1	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F8-10	0xF80A	Jump frequency 2	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F8-11	0xF80B	Jump frequency amplitude	0.00 Hz to 500.00 Hz	0.00	Hz	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F8-12	0xF80C	Dead zone time of forward/reverse run	0.0s to 3000.0s	0.0	s	Real time
F8-13	0xF80D	Reverse frequency inhibited	0: Reverse run allowed 1: Reverse run inhibited	0	-	Real time
F8-14	0xF80E	Operation mode when set frequency < frequency lower limit	0: Operating at frequency lower limit 1: Stop 2: Operating at zero speed	0	-	Real time
F8-15	0xF80F	Droop rate	0.00% to 10.00%	0.00	%	Real time
F8-16	0xF810	Accumulative power-on time threshold	0 h and 65000 h	0	h	Real time
F8-17	0xF811	Accumulative operating time threshold	0 h and 65000 h	0	h	Real time
F8-18	0xF812	Startup protection	0: Disable 1: Enable	0	-	Real time
F8-19	0xF813	Frequency detection value 1	0.00 Hz to 500.00 Hz	50.00	Hz	Real time
F8-20	0xF814	Frequency detection hysteresis 1	0.0% to 100.0%	5.0	%	Real time
F8-21	0xF815	Detection frequency amplitude	0.0% to 100.0%	0.0	%	Real time
F8-22	0xF816	Jump frequency enable during acceleration/deceleration	0: Inactive 1: Active	1	-	Real time
F8-25	0xF819	Switchover frequency threshold between acceleration time 1 and acceleration time 2	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F8-26	0xF81A	Switchover frequency threshold between deceleration time 1 and deceleration time 2	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F8-27	0xF81B	Terminal-triggered jog preferred	0: Inactive 1: Active	0	-	Real time
F8-28	0xF81C	Frequency detection value 2	0.00 Hz to 500.00 Hz	50.00	Hz	Real time
F8-29	0xF81D	Frequency detection hysteresis 2	0.0% to 100.0%	5.0	%	Real time
F8-30	0xF81E	Frequency detection value 1	0.00 Hz to 500.00 Hz	50.00	Hz	Real time
F8-31	0xF81F	Frequency detection amplitude 1	0.0% to 100.0%	0.0	%	Real time
F8-32	0xF820	Frequency detection value 2	0.00 Hz to 500.00 Hz	50.00	Hz	Real time
F8-33	0xF821	Frequency detection amplitude 2	0.0% to 100.0%	0.0	%	Real time
F8-34	0xF822	Zero current detection level	0.0% to 300.0%	5.0	%	Real time
F8-35	0xF823	Zero current detection delay	0.01s to 600.00s	0.10	s	Real time
F8-36	0xF824	Output overcurrent limit	0.0% to 300.0%	200.0	%	Real time
F8-37	0xF825	Output current limit violation detection delay	0.00s to 600.00s	0.00	s	Real time
F8-38	0xF826	Current detection value 1	0.0% to 300.0%	100.0	%	Real time
F8-39	0xF827	Detection width 1 for current reach	0.0% to 300.0%	0.0	%	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F8-40	0xF828	Current detection value 2	0.0% to 300.0%	100.0	%	Real time
F8-41	0xF829	Detection width 2 for current reach	0.0% to 300.0%	0.0	%	Real time
F8-42	0xF82A	Timing function	0: Inactive 1: Active	0	-	At stop
F8-43	0xF82B	Timed operation time source	0: F8-44 1: AI1 2: AI2 3: AI3	0	-	At stop
F8-44	0xF82C	Timed operation duration	0.0 min to 6500.0 min	0.0	min	At stop
F8-45	0xF82D	Lower limit of AI1 input voltage protection value	0.00 V to 11.00 V	3.10	V	Real time
F8-46	0xF82E	Upper limit of AI1 input voltage protection value	0.00 V to 11.00 V	6.80	V	Real time
F8-47	0xF82F	Drive temperature reached	0° C to 100° C	75	° C	Real time
F8-48	0xF830	Cooling fan control	0: Operating during operation of the drive 1: Always operating	0	-	At stop
F8-49	0xF831	Wakeup frequency	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F8-50	0xF832	Wakeup delay	0.0s to 6500.0s	0.0	s	Real time
F8-51	0xF833	Sleep frequency	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
F8-52	0xF834	Sleep delay	0.0s to 6500.0s	0.0	s	Real time
F8-53	0xF835	Current operating time reach	0.0 min to 6500.0 min	0.0	min	At stop
F8-54	0xF836	Output power correction coefficient	0.0% to 200.0%	100.0	%	Real time
F8-55	0xF837	Deceleration time for emergency stop	0.0s to 6500.0s	10.0	s	Real time
F8-57	0xF839	Software function regression	0 to 65535	34	-	Real time
F8-58	0xF83A	Searchingfrequencycoefficient in speed tracking	30% to 100%	100%	%	At stop
F9 Fault and protection						
F9-00	0xF900	Motor overload protection selection	0: Disable 1: Enable	1	-	Real time
F9-01	0xF901	Motor overload protection gain	0.20 to 10.00	1.00	-	Real time
F9-02	0xF902	Motor overload pre-alarm coefficient	50% to 100%	80	%	Real time
F9-07	0xF907	Short circuit to ground protection	Ones: Protection against short circuit to ground upon power-on 0: Inactive 1: Active Tens: Protection against short circuit to ground before operation 0: Inactive 1: Active	1	-	Real time
F9-08	0xF908	Starting voltage of braking unit action	310.0 V to 810.0 V	700.0	V	Real time
F9-09	0xF909	Number of automatic fault resets upon fault	0 to 20	0	-	Real time
F9-10	0xF90A	DO action during automatic reset upon fault	0: The DO does not act 1: The DO acts.	0	-	Real time
F9-11	0xF90B	Interval time of automatic fault reset	0.1s to 100.0s	1.0	s	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F9-12	0xF90C	Input phase loss protection	Ones: Input phase loss protection 0: Disable 1: Enable	1	-	Real time
F9-13	0xF90D	Output phase loss protection	Ones: Protection against output phase loss during operation 0: Disable 1: Enable Tens: Protection against output phase loss before operation 0: Disable 1: Enable	1	-	Real time
F9-14	0xF90E	Type of the 1st fault	0: No fault 1: Reserved 2: Overcurrent during acceleration 3: Overcurrent during deceleration 4: Overcurrent during operation at constant speed 5: Overvoltage during acceleration 6: Overvoltage during deceleration 7: Overvoltage during operation at constant speed 8: Pre-charge power fault 9: Undervoltage 10: AC drive overload 11: Motor overload 12: Input phase loss 13: Output phase loss 14: Module overtemperature 15: External fault 16: Communication error 17: Contactor fault 18: Current detection error 19: Motor parameter auto-tuning error 20: Reserved 21: Parameter read/write error 22: AC drive hardware error 23: Motor short-circuited to ground 24: Reserved 25: Reserved 26: Operating time reached 27: User-defined fault 1 28: User-defined fault 2 29: Power-on time reached 30: Load loss 31: PID feedback loss during operation 40: Fast current limit timeout 41: Motor switchover during operation 42: Reserved 43: Reserved 45: Motor over-temperature 55: Slave fault during master/slave control	0	-	N/A
F9-15	0xF90F	Type of the 2nd fault	Same as F9-14	0	-	N/A

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F9-16	0xF910	Type of the 3rd (latest) fault	Same as F9-14	0	-	N/A
F9-17	0xF911	Frequency upon 3rd fault	0.00 Hz to 655.35 Hz	0.00	Hz	N/A
F9-18	0xF912	Current upon 3rd (latest) fault	0.00 A to 655.35 A	0.00	A	N/A
F9-19	0xF913	Bus voltage upon 3rd (latest) fault	0.0 V to 6553.5 V	0.0	V	N/A
F9-20	0xF914	DI state upon 3rd (latest) fault	0 to 65535	0	-	N/A
F9-21	0xF915	DO state upon the 3rd (latest) fault	0 to 65535	0	-	N/A
F9-22	0xF916	AC drive state upon 3rd (latest) fault	0 to 65535	0	-	N/A
F9-23	0xF917	Power-on time upon 3rd (latest) fault	0 to 65535	0	-	N/A
F9-24	0xF918	Operating time upon 3rd (latest) fault	0.0 to 6553.5	0.0	-	N/A
F9-27	0xF91B	Frequency upon the 2nd fault	0.00 Hz to 655.35 Hz	0.00	Hz	N/A
F9-28	0xF91C	Current upon the 2nd fault	0.00 A to 655.35 A	0.00	A	N/A
F9-29	0xF91D	Bus voltage upon the 2nd fault	0.0 V to 6553.5 V	0.0	V	N/A
F9-30	0xF91E	Input terminal state upon the 2nd fault	0 to 65535	0	-	N/A
F9-31	0xF91F	Output terminal state upon the 2nd fault	0 to 65535	0	-	N/A
F9-32	0xF920	AC drive state upon the 2nd fault	0 to 65535	0	-	N/A
F9-33	0xF921	Power-on time upon the 2nd fault	0 to 65535	0	-	N/A
F9-34	0xF922	Operating time upon the 2nd fault	0.0 to 6553.5	0.0	-	N/A
F9-37	0xF925	Frequency upon the 1st fault	0.00 Hz to 655.35 Hz	0.00	Hz	N/A
F9-38	0xF926	Current upon the 1st fault	0.00 A to 655.35 A	0.00	A	N/A
F9-39	0xF927	Bus voltage upon the 1st fault	0.0 V to 6553.5 V	0.0	V	N/A
F9-40	0xF928	Input terminal state upon the 1st fault	0 to 65535	0	-	N/A
F9-41	0xF929	Output terminal state upon the 1st fault	0 to 65535	0	-	N/A
F9-42	0xF92A	AC drive state upon the 1st fault	0 to 65535	0	-	N/A
F9-43	0xF92B	Power-on time upon the 1st fault	0 to 65535	0	-	N/A
F9-44	0xF92C	Operating time upon the 1st fault	0.0 to 6553.5	0.0	-	N/A

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F9-47	0xF92F	Fault protection action selection 1	Ones: Motor overload (Err11) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Tens: Input phase loss (Err12) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Hundreds: Output phase loss (Err13) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Thousands: External fault (Err15) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Ten thousands: Communication error (Err16) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating	0	-	Real time
F9-48	0xF930	Fault protection action 2	Ones: Reserved Tens: Parameter read-write fault (Err21) 0: Coast to stop 1: Stop according to the stop mode Hundreds: Action upon AC drive overload (Err10) 0: Coast to stop 1: Derated operation Thousands: Motor over-temperature (Err25) 0: Coast to stop 1: Stop according to the stop mode Ten thousands: Operating time reached (Err26) 0: Coast to stop 1: Stop according to the stop mode	0	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F9-49	0xF931	Fault protection action 3	Ones: User-defined fault 1 (Err27) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Tens: User-defined fault 2 (Err28) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Hundreds: Power-on time reached (Err29) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating Thousands: Load loss (Err30) 0: Coast to stop 1: Decelerate to stop 2: Continue operating at 7% of the rated motor frequency, and restore to the frequency reference if the load recovers. Ten thousands: PID feedback loss during operation (Err31) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating	0	-	Real time
F9-50	0xF932	Fault protection action 4	Ones: Excessive speed deviation (Err42) 0: Coast to stop 1: Stop according to the stop mode 2: Continue operating	0	-	Real time
F9-51	0xF933	Fault protection action 5	Ones: Overvoltage at stop 0: Automatic reset inhibited 1: Reset automatically after voltage recovered	1	-	Real time
F9-54	0xF936	Frequency for continuing operating upon fault	0: Operating at current frequency 1: Operating at the set frequency 2: Operating at the frequency upper limit 3: Operating at the frequency lower limit 4: Operating at the backup frequency upon error	0	-	Real time
F9-55	0xF937	Backup frequency reference upon error	0.0% to 100.0%	100.0	%	Real time
F9-59	0xF93B	Power dip ride-through function	0: Inactive 1: Keep bus voltage constant 2: Decelerate to stop	0	-	At stop
F9-60	0xF93C	Threshold for recovering from power dip ride-through	80% to 100%	85	%	At stop
F9-61	0xF93D	Duration for judging voltage recovery from power dip ride-through	0.0s to 100.0s	0.5	s	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
F9-62	0xF93E	Threshold for enabling power dip ride-through	60s to 100s	80	s	At stop
F9-63	0xF93F	Protection upon load loss	0: Inactive 1: Active	0	-	Real time
F9-64	0xF940	Load loss detection level	0.0% to 100.0%	10.0	%	Real time
F9-65	0xF941	Load loss detection time	0.0s to 60.0s	1.0	s	Real time
F9-69	0xF945	Detection value for excessive speed deviation	0.0% to 50.0%	20.0	%	Real time
F9-70	0xF946	Detection time for excessive speed deviation	0.0s to 60.0s	0.0	s	Real time
F9-71	0xF947	Power dip ride-through gain Kp	0 to 100	40	-	Real time
F9-72	0xF948	Power dip ride-through integral coefficient Ki	0 to 100	30	-	Real time
F9-73	0xF949	Deceleration time of power dip ride-through	0.0s to 300.0s	20.0	s	At stop
FA PID function						
FA-00	0xFA00	PID setting source	0: FA-01 1: AI1 2: AI2 3: AI3 4: Pulse reference (DI5) 5: Communication (1000H) 6: Multi-reference	0	-	Real time
FA-01	0xFA01	PID setting	0.0% to 100.0%	50.0	%	Real time
FA-02	0xFA02	PID feedback source	0: AI1 1: AI2 2: AI3 3: AI1-AI2 4: Pulse reference (DI5) 5: Communication (1000H) 6: AI1 + AI2 7: Max. (AI1, AI2) 8: Min. (AI1, AI2)	0	-	Real time
FA-03	0xFA03	PID action direction	0: Forward 1: Reverse	0	-	Real time
FA-04	0xFA04	PID reference feedback range	0 to 65535	1000	-	Real time
FA-05	0xFA05	Proportional gain Kp1	0.0 to 1000.0	20.0	-	Real time
FA-06	0xFA06	Integral time Ti1	0.01s to 10.00s	2.00	s	Real time
FA-07	0xFA07	Derivative time Td1	0.000s to 10.000s	0.000	s	Real time
FA-08	0xFA08	PID reverse cut-off frequency	0.00 Hz to 500.00 Hz	0.00	Hz	Real time
FA-09	0xFA09	PID deviation limit	0.0% to 100.0%	0.0	%	Real time
FA-10	0xFA0A	PID derivative limit	0.00% to 100.00%	0.10	%	Real time
FA-11	0xFA0B	PID setting change time	0.00s to 650.00s	0.00	s	Real time
FA-12	0xFA0C	PID feedback filter time	0.00s to 60.00s	0.00	s	Real time
FA-13	0xFA0D	PID output filter time	0.00s to 60.00s	0.00	s	Real time
FA-15	0xFA0F	Proportional gain Kp2	0.0 to 1000.0	20.0	-	Real time
FA-16	0xFA10	Integral time Ti2	0.01s to 10.00s	2.00	s	Real time
FA-17	0xFA11	Derivative time Td2	0.000s to 10.000s	0.000	s	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
FA-18	0xFA12	PID parameter switchover condition	0: Not switched 1: DI 2: Switched automatically based on deviation 3: Switched automatically based on operating frequency	0	-	Real time
FA-19	0xFA13	PID parameter switchover deviation 1	0.0% to 100.0%	20.0	%	Real time
FA-20	0xFA14	PID parameter switchover deviation 2	0.0% to 100.0%	80.0	%	Real time
FA-21	0xFA15	PID initial value	0.0% to 100.0%	0.0	%	Real time
FA-22	0xFA16	Active time of PID initial value	0.00s to 650.00s	0.00	s	Real time
FA-25	0xFA19	PID integral	Ones: Integral separation 0: Inactive 1: Active Tens: 0: Continue integral operation 1: Stop integral operation	0	-	Real time
FA-26	0xFA1A	Detection value of PID feedback loss	0.0% to 100.0%	0.0	%	Real time
FA-27	0xFA1B	Detection time of PID feedback loss	0.0s to 20.0s	0.0	s	Real time
FA-28	0xFA1C	PID operation at stop	0: Disable 1: Enable	0	-	Real time
FB Wobble frequency, fixed length, and counting						
FB-00	0xFB00	Wobble frequency setting mode	0: Relative to the center frequency 1: Relative to the maximum frequency	0	-	Real time
FB-01	0xFB01	Wobble frequency amplitude	0.0% to 100.0%	0.0	%	Real time
FB-02	0xFB02	Jump frequency amplitude	0.0% to 50.0%	0.0	%	Real time
FB-03	0xFB03	Wobble frequency cycle	0.1s to 3000.0s	10.0	s	Real time
FB-04	0xFB04	Triangular wave rising time of wobble frequency	0.1% to 100.0%	50.0	%	Real time
FB-05	0xFB05	Length reference	0 m to 65535 m	1000	m	Real time
FB-06	0xFB06	Actual length	0 m to 65535 m	0	m	N/A
FB-07	0xFB07	Number of pulses per meter	0.1 to 6553.5	100.0	-	Real time
FB-08	0xFB08	Set counting value	1 to 65535	1000	-	Real time
FB-09	0xFB09	Designated counting value	1 to 65535	1000	-	Real time
FC Multi-reference and simple PLC						
FC-00	0xFC00	Multi-reference 0	-100.0% to +100.0%	0.0	%	Real time
FC-01	0xFC01	Multi-reference 1	-100.0% to +100.0%	0.0	%	Real time
FC-02	0xFC02	Multi-reference 2	-100.0% to +100.0%	0.0	%	Real time
FC-03	0xFC03	Multi-reference 3	-100.0% to +100.0%	0.0	%	Real time
FC-04	0xFC04	Multi-reference 4	-100.0% to +100.0%	0.0	%	Real time
FC-05	0xFC05	Multi-reference 5	-100.0% to +100.0%	0.0	%	Real time
FC-06	0xFC06	Multi-reference 6	-100.0% to +100.0%	0.0	%	Real time
FC-07	0xFC07	Multi-reference 7	-100.0% to +100.0%	0.0	%	Real time
FC-08	0xFC08	Multi-reference 8	-100.0% to +100.0%	0.0	%	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
FC-09	0xFC09	Multi-reference 9	-100.0% to +100.0%	0.0	%	Real time
FC-10	0xFC0A	Multi-reference 10	-100.0% to +100.0%	0.0	%	Real time
FC-11	0xFC0B	Multi-reference 11	-100.0% to +100.0%	0.0	%	Real time
FC-12	0xFC0C	Multi-reference 12	-100.0% to +100.0%	0.0	%	Real time
FC-13	0xFC0D	Multi-reference 13	-100.0% to +100.0%	0.0	%	Real time
FC-14	0xFC0E	Multi-reference 14	-100.0% to +100.0%	0.0	%	Real time
FC-15	0xFC0F	Multi-reference 15	-100.0% to +100.0%	0.0	%	Real time
FC-16	0xFC10	Simple PLC operation mode	0: Stop after operating for one cycle 1: Keep final values after operating for one cycle 2: Repeat after operating for one cycle	0	-	Real time
FC-17	0xFC11	Simple PLC retention selection upon power failure	Ones: 0: Non-retentive upon power failure 1: Retentive upon power failure Tens: 0–1: setpoint same as the ones	0	-	Real time
FC-18	0xFC12	Operation time of multi-reference 0 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-19	0xFC13	Acceleration/Deceleration time of multi-reference 0 set by PLC	0 to 3	0	-	Real time
FC-20	0xFC14	Operation time of multi-reference 1 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-21	0xFC15	Acceleration/Deceleration time of multi-reference 1 set by PLC	0 to 3	0	-	Real time
FC-22	0xFC16	Operation time of multi-reference 2 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-23	0xFC17	Acceleration/Deceleration time of multi-reference 2 set by PLC	0 to 3	0	-	Real time
FC-24	0xFC18	Operation time of multi-reference 3 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-25	0xFC19	Acceleration/Deceleration time of multi-reference 3 set by PLC	0 to 3	0	-	Real time
FC-26	0xFC1A	Operation time of multi-reference 4 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-27	0xFC1B	Acceleration/Deceleration time of multi-reference 4 set by PLC	0 to 3	0	-	Real time
FC-28	0xFC1C	Operation time of multi-reference 5 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-29	0xFC1D	Acceleration/Deceleration time of multi-reference 5 set by PLC	0 to 3	0	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
FC-30	0xFC1E	Operation time of multi-reference 6 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-31	0xFC1F	Acceleration/Deceleration time of multi-reference 6 set by PLC	0 to 3	0	-	Real time
FC-32	0xFC20	Operation time of multi-reference 7 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-33	0xFC21	Acceleration/Deceleration time of multi-reference 7 set by PLC	0 to 3	0	-	Real time
FC-34	0xFC22	Operation time of multi-reference 8 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-35	0xFC23	Acceleration/Deceleration time of multi-reference 8 set by PLC	0 to 3	0	-	Real time
FC-36	0xFC24	Operation time of multi-reference 9 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-37	0xFC25	Acceleration/Deceleration time of multi-reference 9 set by PLC	0 to 3	0	-	Real time
FC-38	0xFC26	Operation time of multi-reference 10 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-39	0xFC27	Acceleration/Deceleration time of multi-reference 10 set by PLC	0 to 3	0	-	Real time
FC-40	0xFC28	Operation time of multi-reference 11 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-41	0xFC29	Acceleration/Deceleration time of multi-reference 11 set by PLC	0 to 3	0	-	Real time
FC-42	0xFC2A	Operation time of multi-reference 12 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-43	0xFC2B	Acceleration/Deceleration time of multi-reference 12 set by PLC	0 to 3	0	-	Real time
FC-44	0xFC2C	Operation time of multi-reference 13 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-45	0xFC2D	Acceleration/Deceleration time of multi-reference 13 set by PLC	0 to 3	0	-	Real time
FC-46	0xFC2E	Operation time of multi-reference 14 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time
FC-47	0xFC2F	Acceleration/Deceleration time of multi-reference 14 set by PLC	0 to 3	0	-	Real time
FC-48	0xFC30	Operation time of multi-reference 15 set by PLC	0.0s (h) to 6500.0s (h)	0.0	s (h)	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
FC-49	0xFC31	Acceleration/Deceleration time of multi-reference 15 set by PLC	0 to 3	0	-	Real time
FC-50	0xFC32	PLC operating time unit	0: s (second) 1: h (hour)	0	-	Real time
FC-51	0xFC33	Multi-reference 0 setting mode	0: FC-00 1: AI1 2: AI2 3: AI3 4: Pulse 5: PID 6: F0-08 (Preset frequency), which can be modified by UP/DOWN key	0	0	Real time
FD Communication parameters						
FD-00	0xFD00	Baud rate	Ones: Modbus 0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps Tens: PROFIBUS-DP 0: 115200 bps 1: 208300 bps 2: 256000 bps 3: 512000 bps Hundreds: Reserved Thousands: CANlink baud rate 0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps	5005	-	Real time
FD-01	0xFD01	Data format	0: No check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: No check (8-N-1)	0	-	Real time
FD-02	0xFD02	Local address	0 to 247	1	-	Real time
FD-03	0xFD03	Modbus response delay time	0 ms to 20 ms	2	ms	Real time
FD-04	0xFD04	Serial communication timeout	0.0s to 60.0s	0.0	s	Real time
FD-05	0xFD05	Modbus and PROFIBUS DP communication data format	Ones: Modbus 0: Non-standard Modbus protocol 1: Standard Modbus protocol Tens: PROFIBUS-DP 0: PPO1 format 1: PPO2 format 2: PPO3 format 3: PPO4 format	31	-	Real time
FD-06	0xFD06	Current resolution read through communication	0: 0.01 A (valid when ⩽ 55 kW) 1: 0.1 A	0	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
FD-07	0xFD07	Software tool communication	0 to 1	0	-	Real time
FD-08	0xFD08	Expansion card mode selection	0 to 11	0	-	At stop
FE User-defined parameters						
FE-00	0xFE00	User-defined parameter 0	0 to 65535	0	-	Real time
FE-01	0xFE01	User-defined parameter 1	0 to 65535	0	-	Real time
FE-02	0xFE02	User-defined parameter 2	0 to 65535	0	-	Real time
FE-03	0xFE03	User-defined parameter 3	0 to 65535	0	-	Real time
FE-04	0xFE04	User-defined parameter 4	0 to 65535	0	-	Real time
FE-05	0xFE05	User-defined parameter 5	0 to 65535	0	-	Real time
FE-06	0xFE06	User-defined parameter 6	0 to 65535	0	-	Real time
FE-07	0xFE07	User-defined parameter 7	0 to 65535	0	-	Real time
FE-08	0xFE08	User-defined parameter 8	0 to 65535	0	-	Real time
FE-09	0xFE09	User-defined parameter 9	0 to 65535	0	-	Real time
FE-10	0xFE0A	User-defined parameter 10	0 to 65535	0	-	Real time
FE-11	0xFE0B	User-defined parameter 11	0 to 65535	0	-	Real time
FE-12	0xFE0C	User-defined parameter 12	0 to 65535	0	-	Real time
FE-13	0xFE0D	User-defined parameter 13	0 to 65535	0	-	Real time
FE-14	0xFE0E	User-defined parameter 14	0 to 65535	0	-	Real time
FE-15	0xFE0F	User-defined parameter 15	0 to 65535	0	-	Real time
FE-16	0xFE10	User-defined parameter 16	0 to 65535	0	-	Real time
FE-17	0xFE11	User-defined parameter 17	0 to 65535	0	-	Real time
FE-18	0xFE12	User-defined parameter 18	0 to 65535	0	-	Real time
FE-19	0xFE13	User-defined parameter 19	0 to 65535	0	-	Real time
FE-20	0xFE14	User-defined parameter 20	0 to 65535	0	-	Real time
FE-21	0xFE15	User-defined parameter 21	0 to 65535	0	-	Real time
FE-22	0xFE16	User-defined parameter 22	0 to 65535	0	-	Real time
FE-23	0xFE17	User-defined parameter 23	0 to 65535	0	-	Real time
FE-24	0xFE18	User-defined parameter 24	0 to 65535	0	-	Real time
FE-25	0xFE19	User-defined parameter 25	0 to 65535	0	-	Real time
FE-26	0xFE1A	User-defined parameter 26	0 to 65535	0	-	Real time
FE-27	0xFE1B	User-defined parameter 27	0 to 65535	0	-	Real time
FE-28	0xFE1C	User-defined parameter 28	0 to 65535	0	-	Real time
FE-29	0xFE1D	User-defined parameter 29	0 to 65535	0	-	Real time
FE-30	0xFE1E	User-defined parameter 30	0 to 65535	0	-	Real time
FE-31	0xFE1F	User-defined parameter 30	0 to 65535	0	-	Real time
FP User password						
FP-00	0x1F00	User password	0 to 65535	0	-	Real time
FP-01	0x1F01	Parameter initialization	0: No operation 1: Restore parameters except motor parameters, encoder parameters, and F0-10 (Maximum frequency) to default settings. 2: Clear records 4: Restore user backup parameters 501: Back up current user parameters	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
FP-02	0x1F02	Function parameter display	Ones: Group U display 0: Hidden 1: Displayed Tens: Group A display 0: Hidden 1: Displayed	11	-	Real time
FP-03	0x1F03	Display of individualized parameters	Ones: User-defined parameter group 0: Hidden 1: Displayed Tens: User-modified parameter group display 0: Hidden 1: Displayed	0	-	Real time
FP-04	0x1F04	Parameter modification property	0: Parameters can be modified. 1: Parameters cannot be modified.	0	-	Real time
A0 Torque control parameters						
A0-00	0xA000	Torque control	0: Speed control 1: Torque control	0	-	At stop
A0-01	0xA001	Driving torque upper limit source	0: A0-03 1: AI1 2: AI2 3: AI3 4: Pulse 5: Communication (1000H) 6: Min. (AI1, AI2) 7: Max. (AI1, AI2)	0	-	At stop
A0-02	0xA002	Torque reference source in braking control	0 to 5	0	-	N/A
A0-03	0xA003	Torque upper limit in motoring state	200.0 to 200.0	150.0	-	Real time
A0-04	0xA004	Torque filter	0.0 to 100.0	0.0	-	Real time
A0-05	0xA005	Maximum frequency of torque control in forward direction	0.00 to 655.35	50.00	-	Real time
A0-06	0xA006	Maximum frequency of torque control mode in reverse direction	0.00 to 655.35	50.00	-	Real time
A0-07	0xA007	Torque acceleration time	0.00 to 650.00	0.00	-	Real time
A0-08	0xA008	Torque deceleration time	0.00 to 659.00	0.00	-	Real time
A1 Virtual DI/DO parameters						

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A1-00	0xA100	VDI1 function selection	0: No function 1: Forward run (FWD) 2: Reverse run (REV) 3: Three-wire operation control 4: Forward jog (FJOG) 5: Reverse jog (RJOG) 6: Terminal UP 7: Terminal DOWN 8: Coast to stop 9: Fault reset (RESET) 10: Operation pause 11: External fault NO input 12: Multi-reference terminal 1 13: Multi-reference terminal 2 14: Multi-reference terminal 3 15: Multi-reference terminal 4 16: Terminal 1 for acceleration/deceleration selection 17: Terminal 2 for acceleration/deceleration selection 18: Frequency source switchover 19: Clear data set by UP/DOWN key or by terminal functioning as UP/DOWN key	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A1-00	0xA100	VDI1 function selection	20: Operation command switchover 21: Acceleration/Deceleration inhibited 22: PID pause 23: Simple PLC state reset 24: Wobble frequency pause 25: Counter input 26: Counter reset 27: Length input 28: Length reset 29: Torque control inhibition 30: Pulse frequency input (valid only for DI5) 31: Reserved 32: Immediate DC braking 33: External fault NC input 34: Frequency modification enable 35: Opposite to the PID action direction 36: External stop terminal 1 37: Control command switchover terminal 2 38: PID integral pause 39: Switchover between main frequency and preset frequency 40: Switchover between auxiliary frequency and preset frequency 41: Motor terminal selection 42: Reserved 43: PID parameter switchover 44: User-defined fault 1 45: User-defined fault 2 46: Speed control/Torque control switchover 47: Emergency stop 48: External stop terminal 2 49: Decelerate to DC braking 50: Clear the current operating time 51: Switchover between two-wire mode and three-wire mode 52: Reverse run inhibited 53: Reserved 54: Reserved 55: Reserved 56: Reserved 57: Reserved 58: Reserved 59: Reserved	0	-	At stop
A1-01	0xA101	VDI2 function selection	Same as A1-00	0	-	At stop
A1-02	0xA102	VDI3 function selection	Same as A1-00	0	-	At stop
A1-03	0xA103	VDI4 function selection	Same as A1-00	0	-	At stop
A1-04	0xA104	VDI5 function selection	Same as A1-00	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A1-05	0xA105	VDI state setting mode	Ones: VDI1 0: VDOx state 1: A1-06 Tens: VDI2 0: VDOx state 1: A1-06 Hundreds: VDI3 0: VDOx state 1: A1-06 Thousands: VDI4 0: VDOx state 1: A1-06 Ten thousands: VDI5 0: VDOx state 1: A1-06	0	-	At stop
A1-06	0xA106	VDI state setting	Ones: VDI1 0: Inactive 1: Active Tens: VDI2 0: Inactive 1: Active Hundreds: VDI3 0: Inactive 1: Active Thousands: VDI4 0: Inactive 1: Active Ten thousands: VDI5 0: Inactive 1: Active	0	-	Real time
A1-07	0xA107	Function selection for AI1 used as DI	Same as A1-00	0	-	At stop
A1-08	0xA108	Function selection for AI2 used as DI	Same as A1-00	0	-	At stop
A1-09	0xA109	Function selection for AI3 used as DI	Same as A1-00	0	-	At stop

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A1-10	0xA10A	Active status of AI used as DI	Ones: AI1 0: Active high 1: Active low Tens: AI2 0: Active high 1: Active low Hundreds: AI3 0: Active high 1: Active low	0	-	At stop
A1-11	0xA10B	VDO1 function selection	0: No output 1: AC Drive operating 2: Fault output (stop upon fault) 3: Frequency-level detection 1 4: Frequency reached 5: Operating at zero speed (no output at stop) 6: Motor overload pre-alarm 7: AC drive overload pre-alarm 8: Set counting value reached 9: Designated counting value reached 10: Length reached 11: Simple PLC cycle completed 12: Accumulative operating time reached 13: Frequency limited 14: Torque limited 15: Ready to run 16: AI1 > AI2 17: Frequency upper limit reached 18: Frequency lower limit reached (no output at stop) 19: Undervoltage status 20: Communication 21: Reserved 22: Reserved 23: Operating at zero speed 2 (output at stop) 24: Accumulative power-on time reached 25: Frequency level detection 2 26: Frequency 1 reached 27: Frequency 2 reached 28: Current 1 reached 29: Current 2 reached 30: Timed duration reached 31: AI1 input limit exceeded 32: Load loss 33: Rotation direction 34: Current detection reached 35: Drive temperature reached	0	-	Real time
A1-11	0xA10B	VDO1 function selection	36: Software overcurrent 37: Frequency lower limit reached (related to operation) 38: Fault output (outputted when stop at fault) 39: Motor overtemperature pre-alarm 40: Operating time reached 41: Fault output (no output at undervoltage)	0	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A1-12	0xA10C	VDO2 function selection	Same as A1-11	0	-	Real time
A1-13	0xA10D	VDO3 function selection	Same as A1-11	0	-	Real time
A1-14	0xA10E	VDO4 function selection	Same as A1-11	0	-	Real time
A1-15	0xA10F	VDO5 function selection	Same as A1-11	0	-	Real time
A1-16	0xA110	VDO1 output delay	0.0s to 3600.0s	0.0	s	Real time
A1-17	0xA111	VDO2 output delay	0.0s to 3600.0s	0.0	s	Real time
A1-18	0xA112	VDO3 output delay	0.0s to 3600.0s	0.0	s	Real time
A1-19	0xA113	VDO4 output delay	0.0s to 3600.0s	0.0	s	Real time
A1-20	0xA114	VDO5 output delay	0.0s to 3600.0s	0.0	s	Real time
A1-21	0xA115	Active state of VDO	Ones: VD01 0: Positive logic 1: Negative logic Tens: VD02 0: Positive logic 1: Negative logic Hundreds: VD03 0: Positive logic 1: Negative logic Thousands: VD04 0: Positive logic 1: Negative logic Ten thousands: VD05 0: Positive logic 1: Negative logic	0	-	Real time
A2 Motor 2 control parameters						
A2-00	0xA200	Motor type	0: Common asynchronous motor 1: Variable frequency asynchronous motor	0	-	At stop
A2-01	0xA201	Rated motor power	0.1 kW to 6553.5 kW	0.1	kW	At stop
A2-02	0xA202	Rated motor voltage	1 V to 2000 V	1	V	At stop
A2-03	0xA203	Rated motor current	0.01 A to 655.35 A	0.01	A	At stop
A2-04	0xA204	Rated motor frequency	0.01 Hz to 500.00 Hz	0.01	Hz	At stop
A2-05	0xA205	Rated motor speed	1 rpm to 65535 rpm	1	rpm	At stop
A2-06	0xA206	Asynchronous motor stator resistance	0.001 Ω to 65.535 Ω	0.001	Ω	At stop
A2-07	0xA207	Asynchronous motor rotor resistance	0.001 Ω to 65.535 Ω	0.001	Ω	At stop
A2-08	0xA208	Leakage inductance of asynchronous motor	0.01 mH to 655.35 mH	0.01	mH	At stop
A2-09	0xA209	Mutual inductance of asynchronous motor	0.1 mH to 6553.5 mH	0.1	mH	At stop
A2-10	0xA20A	No-load current of asynchronous motor	0.01 A to 655.35 A	0.01	A	At stop
A2-37	0xA225	Parameter auto-tuning selection	0: Disable 1: Static partial auto-tuning of asynchronous motor 2: Complete auto-tuning of asynchronous motor 3: Static complete auto-tuning of asynchronous motor	0	-	At stop
A2-38	0xA226	Speed loop proportional gain 1	1 to 100	20	-	Real time
A2-39	0xA227	Speed loop integral time 1	0.01 to 10.00	0.50	-	Real time
A2-40	0xA228	Switchover frequency 1	0.00 to 655.35	5.00	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A2-41	0xA229	Speed loop proportional gain 2	1 to 100	20	-	Real time
A2-42	0xA22A	Speed loop integral time 2	0.01 to 10.00	1.00	-	Real time
A2-43	0xA22B	Switchover frequency 2	0.00 to 655.35	10.00	-	Real time
A2-44	0xA22C	Slip compensation factor	50 to 200	100	-	Real time
A2-45	0xA22D	Filter time constant of speed loop	0.000 to 0.100	0.015	-	Real time
A2-46	0xA22E	Overexcitation gain in vector control	0 to 200	64	-	Real time
A2-47	0xA22F	Torque upper limit source in speed control (driving)	0 to 7	0	-	At stop
A2-48	0xA230	Digital setting of torque upper limit in speed control (driving)	0.0 to 200.0	150.0	-	Real time
A2-49	0xA231	Torque upper limit source in speed control (braking)	0 to 8	0	-	At stop
A2-50	0xA232	Digital setting of torque upper limit in speed control (braking)	0.0 to 200.0	150.0	-	Real time
A2-51	0xA233	M-axis current loop Kp	0 to 60000	10	-	Real time
A2-52	0xA234	M-axis current loop Ki	0 to 60000	10	-	Real time
A2-53	0xA235	T-axis current loop Kp	0 to 60000	10	-	Real time
A2-54	0xA236	T-axis current loop Ki	0 to 60000	10	-	Real time
A2-55	0xA237	Speed loop multi-function selection	Ones: Speed loop integral separation enable 0: Disable 1: Enable Tens: Speed loop torque feedforward enable 0: Disable 1: Enable	0	-	At stop
A2-56	0xA238	Torque feedforward gain	20 to 100	80	-	At stop
A2-57	0xA239	Torque feedforward filter time	10 to 200	50	-	Real time
A2-58	0xA23A	Reserved	100 to 110	105	-	At stop
A2-59	0xA23B	Maximum torque tuning coefficient	50 to 200	80	-	Real time
A2-60	0xA23C	Generating power limit mode	0 to 3	0	-	At stop
A2-61	0xA23D	Generating power upper limit	0.0 to 200.0	0.0	-	Real time
A2-62	0xA23E	Motor 2 control mode	0: Sensorless vector control (SVC) 1: V/f control	2	-	At stop
A2-63	0xA23F	Motor 2 acceleration/deceleration time selection	0: Same as motor 1 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4	0	-	Real time
A2-64	0xA240	Motor 2 torque boost	0.0% to 30.0%	0.0	%	Real time
A2-66	0xA242	Motor 2 oscillation suppression gain	0 to 100	40	-	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A5 Control optimization parameters						
A5-00	0xA500	Frequency upper limit for DPWM switchover	0.00 Hz to 650.00 Hz	12.00	Hz	Real time
A5-01	0xA501	PWM modulation mode	0: Asynchronous modulation 1: Synchronous modulation	0	-	Real time
A5-02	0xA502	Dead-zone compensation mode	0: Disabled 1: Compensation mode 1	1	-	Real time
A5-03	0xA503	Random PWM depth	0 to 10	0	-	Real time
A5-04	0xA504	Fast current limit	0: Disable 1: Enable	1	-	Real time
A5-05	0xA505	Overmodulation coefficient	100 to 110	105	-	At stop
A5-06	0xA506	Undervoltage threshold	300.0 V to 600.0 V	350.0	V	Real time
A5-08	0xA508	Low-speed carrier frequency upper limit	0% to 6%	0	%	Real time
A5-09	0xA509	Overvoltage threshold	200.0 V to 900.0 V	820.0	V	At stop
A5-10	0xA50A	Energy-saving mode	0: Inactive 1: Active	0	-	At stop
A6 AI curve setting						
A6-00	0xA600	Minimum input of curve 4	-10.00 V to +10.00 V	0.00	V	Real time
A6-01	0xA601	Percentage corresponding to minimum input of curve 4	-100.0% to +100.0%	0.0	%	Real time
A6-02	0xA602	Curve 4 inflexion 1 input	-10.00 V to +10.00 V	3.00	V	Real time
A6-03	0xA603	Percentage corresponding to input of curve 4 inflection point 1	-100.0% to +100.0%	30.0	%	Real time
A6-04	0xA604	Input of curve 4 inflection point 2	-10.00 V to +10.00 V	6.00	V	Real time
A6-05	0xA605	Percentage corresponding to curve 4 inflection point 2 input	-100.0% to +100.0%	60.0	%	Real time
A6-06	0xA606	Maximum input of curve 4	-10.00 V to +10.00 V	10.00	V	Real time
A6-07	0xA607	Percentage corresponding to maximum input of curve 4	-100.0% to +100.0%	100.0	%	Real time
A6-08	0xA608	Curve 5 minimum input	-10.00 V to +10.00 V	-10.00	V	Real time
A6-09	0xA609	Percentage corresponding to minimum input of curve 5	-100.0% to +100.0%	-100.0	%	Real time
A6-10	0xA60A	Curve 5 inflexion 1 input	-10.00 V to +10.00 V	-3.00	V	Real time
A6-11	0xA60B	Percentage corresponding to input of curve 5 inflection point 1	-100.0% to +100.0%	-30.0	%	Real time
A6-12	0xA60C	Input of curve 5 inflection point 2	-10.00 V to +10.00 V	3.00	V	Real time
A6-13	0xA60D	Percentage corresponding to curve 5 inflection point 2 input	-100.0% to +100.0%	30.0	%	Real time
A6-14	0xA60E	Curve 5 maximum input	-10.00 V to +10.00 V	10.00	V	Real time
A6-15	0xA60F	Percentage corresponding to maximum input of curve 5	-100.0% to +100.0%	100.0	%	Real time
A6-24	0xA618	AI1 jump point	-100.0% to +100.0%	0.0	%	Real time
A6-25	0xA619	AI1 jump amplitude	0.0% to 100.0%	0.5	%	Real time

Param,	Address	Name	Setpoint	Default	Unit	Change mode
A6-26	0xA61A	AI2 jump point	-100.0% to +100.0%	0.0	%	Real time
A6-27	0xA61B	AI2 jump amplitude	0.0% to 100.0%	0.5	%	Real time
A6-28	0xA61C	AI3 jump point	100.0% to 6453.6%	100.0	%	Real time
A6-29	0xA61D	AI3 jump amplitude	0.0% to 100.0%	0.5	%	Real time
AC AI/AO correction						
AC-00	0xAC00	AI1 measured voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-01	0xAC01	AI1 displayed voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-02	0xAC02	AI1 measured voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-03	0xAC03	AI1 displayed voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-04	0xAC04	AI2 measured voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-05	0xAC05	AI2 displayed voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-06	0xAC06	AI2 measured voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-07	0xAC07	AI2 displayed voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-08	0xAC08	AI3 measured voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-09	0xAC09	AI3 displayed voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-10	0xAC0A	AI3 measured voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-11	0xAC0B	AI3 displayed voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-12	0xAC0C	AO1 measured voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-13	0xAC0D	AO1 target voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-14	0xAC0E	AO1 measured voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-15	0xAC0F	AO1 target voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-16	0xAC10	AO2 measured voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-17	0xAC11	AO2 target voltage 1	-10.000 V to +10.000 V	0.000	V	Real time
AC-18	0xAC12	AO2 measured voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
AC-19	0xAC13	AO2 target voltage 2	-10.000 V to +10.000 V	0.000	V	Real time
U0 Monitoring parameters						
U0-00	0x7000	Operating frequency	0.00 Hz to 320.00 Hz	0.00	Hz	N/A
U0-01	0x7001	Frequency reference	0.00 Hz to 320.00 Hz	0.00	Hz	N/A
U0-02	0x7002	Bus voltage	0.0 V to 3000.0 V	0.0	V	N/A
U0-03	0x7003	Output voltage	0 V to 1140 V	0	V	N/A
U0-04	0x7004	Output current	0.00 A to 655.35 A	0.00	A	N/A
U0-05	0x7005	Output power	0.0 kW to 327.67 kW	0.0	kW	N/A
U0-06	0x7006	Output torque	-200.0% to +200.0%	0.0	%	N/A
U0-07	0x7007	DI input state	0 to 32767	0	-	N/A
U0-08	0x7008	DO output state	0 to 1023	0	-	N/A
U0-09	0x7009	AI1 voltage	0.00 V to 10.57 V	0.00	V	N/A
U0-10	0x700A	AI2 voltage	0.00 V to 10.57 V	0.00	V	N/A
U0-11	0x700B	AI3 voltage	0.00 V to 10.57 V	0.00	V	N/A
U0-12	0x700C	Counting value	0 to 65535	0	-	N/A
U0-13	0x700D	Length	0 to 65535	0	-	N/A
U0-14	0x700E	Load speed display	0 to 65535	0	-	N/A
U0-15	0x700F	PID setting	0 to 65535	0	-	N/A
U0-16	0x7010	PID feedback	0 to 65535	0	-	N/A
U0-17	0x7011	PLC stage	0 to 65535	0	-	N/A
U0-18	0x7012	Pulse input frequency	0.00 kHz to 100.00 kHz	0.00	kHz	N/A
U0-19	0x7013	Feedback speed	0.00 Hz to 320.00 Hz	0.00	Hz	N/A
U0-20	0x7014	Remaining operating time	0.0 min to 6500.0 min	0.0	min	N/A
U0-21	0x7015	AI1 voltage before calibration	0.000 V to 10.570 V	0.000	V	N/A

Param,	Address	Name	Setpoint	Default	Unit	Change mode
U0-22	0x7016	AI2 voltage before calibration	0.000 V to 65.535 V	0.000	V	N/A
U0-23	0x7017	AI3 voltage before calibration	-10.570 V to +10.570 V	0.000	V	N/A
U0-24	0x7018	Motor speed	0 m/min to 65535 m/min	0	m/min	N/A
U0-25	0x7019	Current power-on time	0 min to 65535 min	0	min	N/A
U0-26	0x701A	Current operating time	0.0 min to 6553.5 min	0.0	min	N/A
U0-27	0x701B	Pulse input frequency	0 Hz to 65535 Hz	0	Hz	N/A
U0-28	0x701C	Reference set through communication	-100.00% to +100.00%	0.00	%	N/A
U0-30	0x701E	Display of main frequency X	0.00 Hz to 320.00 Hz	0.00	Hz	N/A
U0-31	0x701F	Display of auxiliary frequency Y	0.00 Hz to 320.00 Hz	0.00	Hz	N/A
U0-32	0x7020	Memory address view	0 to 65535	0	-	N/A
U0-34	0x7022	Motor temperature	0° C to 200° C	0	° C	N/A
U0-36	0x7024	Resolver position	0 to 65535	0	-	N/A
U0-37	0x7025	Power factor angle	0.0 to 6553.5	0.0	-	N/A
U0-38	0x7026	ABZ position	0 to 65535	0	-	N/A
U0-39	0x7027	Target voltage upon separated V/f	0 V to 65535 V	0	V	N/A
U0-40	0x7028	Output voltage upon separated V/f	0 V to 65535 V	0	V	N/A
U0-41	0x7029	DI input display	0 to 65535	0	-	N/A
U0-42	0x702A	DO input display	0 to 65535	0	-	N/A
U0-43	0x702B	DI function state display	0 to 65535	0	-	N/A
U0-44	0x702C	Reserved	0 to 65535	0	-	N/A
U0-45	0x702D	Fault information	0 to 65535	0	-	N/A
U0-46	0x702E	Frequency reference (signed)	32768 to 32767	0	-	N/A
U0-47	0x702F	Operating frequency (signed)	32768 to 32767	0	-	N/A
U0-48	0x7030	Transient frequency sent to the drive (signed)	32768 to 32767	0	-	N/A
U0-49	0x7031	Synchronous frequency uploaded by the drive (signed)	32768 to 32767	0	-	N/A
U0-59	0x703B	Frequency reference	-100.00% to +100.00%	0.00	%	N/A
U0-60	0x703C	Operating frequency	-100.00% to +100.00%	0.00	%	N/A
U0-61	0x703D	AC drive operating status	0 to 65535	0	-	N/A
U0-62	0x703E	Remote fault indication	0 to 99	0	-	N/A
U0-63	0x703F	Value sent by master in point-to-point communication	0.00 to 655.35	0.00	-	N/A
U0-64	0x7040	Number of slaves in master/slave control	0 to 65535	0	-	N/A
U0-66	0x7042	Communication expansion card model	0 to 65535	0	-	N/A
U0-67	0x7043	Communication expansion card version	0 to 65535	0	-	N/A
U0-68	0x7044	AC drive state read through DP card	0 to 65535	0	-	N/A
U0-69	0x7045	PROFIBUS-DP card transmission speed	0.00 Hz to 655.35 Hz	0.00	Hz	N/A

Param,	Address	Name	Setpoint	Default	Unit	Change mode
U0-70	0x7046	Speed/rpm	0rpm to 65535rpm	0	rpm	N/A
U0-71	0x7047	Communication card-specific current display	0 to 65535	0	-	N/A
U0-72	0x7048	Communication card error status	0 to 65535	0	-	N/A
U0-73	0x7049	Motor SN	0 to 65535	0	-	N/A
U0-74	0x704A	Actual motor output torque	-3276.7% to +3276.8%	0.0	%	N/A
U0-75	0x704B	Overload state (in torque control mode)	0 to 65535	0	-	N/A
U0-76	0x704C	Low bitof accumulative power consumption fc	0 kWh to 999.9 kWh	0	kWh	N/A
U0-77	0x704D	High bitof accumulative power consumption fc	0 kWh to 65535 kWh	0	1000 kWh	N/A
U0-78	0x704E	Linear speed	0 to 65535	0	-	N/A

6 Parameter Description

Note: F0-03, F0-04, F0-11, F2-11, FA-00, FA-02, and A0-01 are set by 1000H through communication. However, only one parameter can be set through communication at a time. If all the above parameters need to set through communication, use the following method.

Take F0-03 and F0-11 as examples. If F0-03 is set to 9, the operating frequency is controlled by 1000H. Then F0-11 cannot be set to 5 and can be set to 0. In this case, you can modify the value of F0-12 through communication.

Group F0: Basic Function Parameters

F0-01	Motor 1 control mode		Default	2
	Setting range	0	Sensorless vector control (SVC)	
		2	V/f control	

0: Sensorless vector control (SVC)

Indicates the open-loop vector control mode, which is applicable to high-performance control applications. In the applications, one AC drive can drive only one motor. This mode applies to such loads as machine tools, centrifuges, wire drawing machines, and injection molding machines.

2: V/f control

Suitable for applications without strict load requirements or applications where one AC drive is used to drive multiple motors, such as wind turbines and pumps. Applicable to scenarios where one AC drive is used to drive multiple motors.

If the vector control mode is used, motor auto-tuning must be performed because good performance due to vector control depends on correct motor parameters. The vector control mode can be best used only when the motor parameters are properly set. Better performance can be achieved by adjusting speed regulator parameters in group F2 (or group A2 for motor 2).

F0-02	Command source		Default	0
	Setting range	0	LCD operating panel/Software tool (LED OFF)	
		1	Terminal control (LED indicator ON)	
		2	Communication control (LED blinking)	

This parameter is used to select the input channel of the AC drive control commands,

such as run, stop, forward run, reverse run and jog operation.

0: Operating panel control ("REMOT" indicator OFF)

Operation commands are sent by pressing keys RUN and STOP/RES on the operating panel.

1: Terminal control ("REMOTE"indicator ON)

Commands are sent by multi-functional input terminals with functions such as FWD, REV, JOGF,

and JOGR.

2: Communication control ("REMOTE" indicator blinking)

For parameters related to communication, see "Group FD: Communication parameters" and the introduction of the communication cards. The introduction of the communication cards is delivered together with the corresponding communication card and also included in this manual.

F0-03	Main frequency source X		Default	0
	Setting range	0	0: Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, non-retentive upon power failure)	
		1	1: Digital setting (initial value F0-08, changeable by UP/DOWN keys, retentive at power failure)	
		2	AI1	
		3	AI2	
		4	AI3	
		5	Pulse setting (DI5)	
		6	Multi-reference	
		7	PLC	
		8	PID	
		9	Communication, communication address: 1000H	

It is used to select the main frequency source. There are eight main frequency reference sources.

0: Digital setting (non-retentive upon power failure)

The initial value of the frequency reference is the value of F0-08 (Preset frequency). You can change the set frequency by pressing  and  on the operation panel (or using the UP/DOWN function of input terminals).

When the AC drive is powered on again after a power failure, the frequency reference is restored to the value of F0-08.

1: Digital setting (retentive upon power failure)

The initial value of the frequency reference is the value of F0-08 (Preset frequency). The frequency reference of the drive can be changed through  and  keys or UP and DOWN of the multi-functional input terminal.

When the AC drive is powered on again after power failure, the set frequency is the value recorded at the moment of the last power failure through  and  .

Note that F0-23 determines whether the set frequency is memorized or cleared when the AC drive stops. It is related to stop rather than power failure.

2: AI1

3: AI2

4: AI3

The frequency is defined by AI. The MD310 control board provides two analog input (AI) terminals (AI1, AI2). Another AI terminal (AI3) is provided by the I/O expansion card.

Where:

AI1: 0–10 V voltage input or 4–20 mA current input, determined by jumper J14

AI2: 0–10 V voltage input or 4–20 mA current input, determined by jumper J4

AI3: -10 V to +10 V voltage input

The MD310 provides five relationship curves, three of which are linear (point-point) curves and two of which are four-point curves, which can be set through F4-13...F4-27 and parameters in group A6.

F4-33 can be used to set the analog inputs of AI1 to AI3.

When the AI is used as the frequency reference source, 100% of the voltage/current input corresponds to the value of F0-10 (maximum frequency).

5: Pulse setting (DI5)

The frequency is set by DI5 (high-speed pulse).

Specifications of pulse reference signal: 9 V to 30 V (voltage) and 0 kHz to 20 kHz (frequency) Pulse reference can be inputted only through DI5.

You can set the mapping relationship between DI5 input pulse frequency and the frequency in F4-28 to F4-31. The relationship is a two-point linear curve. 100% of the corresponding setting of pulse input corresponds to the value of F0-10 (Maximum frequency).

6: Multi-reference

If multi-reference is selected as the frequency reference source, frequency references are input through different state combinations of the DIs. The MD310 supports a maximum of 16 speeds implemented through 16 status combinations of four DI terminals in group FC. The multiple references indicate percentages to F0-10 (Maximum frequency).

If a DI is used as multi-reference function, you need to perform related setting in group F4. For details, see "Group F4 Input Terminals".

7: Simple PLC

When the simple PLC is used as the frequency source, the operating frequency of the drive can be switched among the 16 frequency references. You can set the hold time and acceleration/deceleration time of the 16 frequency references in "Group FC: Multi-Reference and Simple PLC Function".

8: PID

The output of process PID control is used as the operating frequency. PID control is generally used in on-site closed-loop control, such as constant pressure closed-loop control and constant tension closed-loop control.

When applying PID as the frequency source, you need to set parameters of PID function in group FA.

9: Communication

The main frequency source is set by the host controller through communication.

The MD310 supports Modbus communication.

F0-04	Auxiliary frequency source Y		Default	0
	Setting range	0	Digital setting (preset frequency F0-08 that can be changed by UP or DOWN key, non-retentive upon power failure)	
		1	Digital setting (initial value F0-08, changeable by UP/DOWN keys, retentive at power failure)	
		2	AI1	
		3	AI2	
		4	AI3	
		5	Pulse setting (DI5)	
		6	Multi-reference	
		7	PLC	
		8	PID	
		9	Communication, communication address: 1000H	

When used as an independent frequency reference source (frequency source switched from X to Y), the auxiliary frequency source Y is used in the same way as the main frequency source X (see F0-03).

When the auxiliary frequency source Y is used for superposition (X+Y, switchover between X and X+Y, and switchover between Y and X+Y used as frequency source), pay attention to the following items:

1. If the auxiliary frequency reference is digital setting, the preset frequency (F0-08) does not take effect. You can directly adjust the frequency by pressing  and  on the operating panel (or through the UP/DOWN function of a multi-functional input terminal).

2. If the auxiliary frequency source is analog input (AI1, AI2 and AI3) or pulse input, 100% of the input corresponds to the range of the auxiliary frequency Y (set in F0-05 and F0-06).

3. If the frequency source is pulse input, it is similar to analog input.

Note: The main frequency source X and auxiliary frequency source Y cannot use the same source. That is, F0-03 and F0-04 cannot be set to the same value.

F0-05	Range selection of auxiliary frequency Y source for superposition		Default	0
	Setting range	0	Relative to the maximum frequency	
		1	Relative to main frequency X	
F0-06	Range of auxiliary frequency Y upon superposition		Default	100%
	Setting range		0% to 150%	

If X and Y superposition is used (F0-07 set to 1, 3, or 4), these two parameters are used to set the adjustment range of the auxiliary frequency source.

You can set the auxiliary frequency to be relative to either maximum frequency or main frequency X through F0-05. If relative to main frequency X, the setting range of the auxiliary frequency Y changes with the main frequency X.

F0-07	Frequency superposition selection		Default	0
	Setting range	Ones	Frequency source selection	
		0	X (main frequency source)	
		1	Operation result of X and Y (as defined by tens)	
		2	Switchover between X and Y	
		3	Switchover between X and operation result of X and Y	
		4	Switchover between Y and operation result of X and Y	
		Tens	Operation relationship of X and Y	
		0	X + Y	
		1	X - Y	
		2	Max. (X, Y)	
		3	Min. (X, Y)	

This parameter is used to select frequency reference source. The frequency reference is implemented through superposition of main frequency source X and auxiliary frequency source Y.

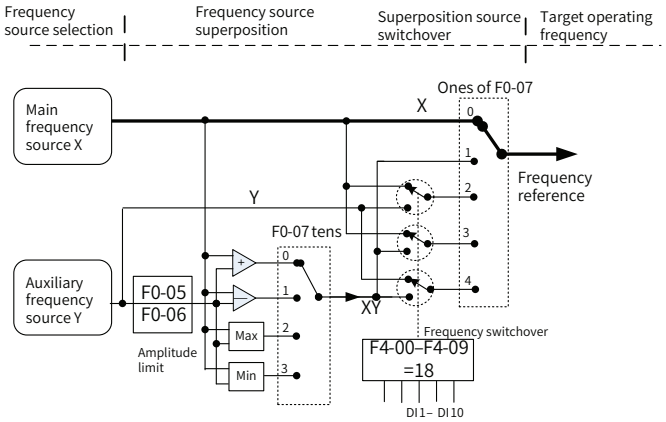


Figure 6-1 Superposition of X and Y

Ones: Frequency source selection

0: Main frequency source X: The main frequency source X is as the target frequency.

1: Operation result of X and Y (as defined by tens): The superposition relationship is determined by tens of this parameter.

2: Switchover between X and Y

When the multi-functional input terminal function 18 (Frequency source switchover) is inactive, the main frequency source X is used as the target frequency.

When the multi-functional input terminal function 18 (Frequency source switchover) is active, the main frequency source Y is used as the target frequency.

3: Switchover between X and operation result of X and Y

When the multi-functional input terminal function 18 (Frequency source switchover) is inactive, the main frequency source X is used as the target frequency.

When the multi-functional input terminal function 18 (Frequency source switchover) is active, the operation result of X and Y is used as the target frequency.

4: Switchover between Y and operation result of X and Y

When the multi-functional input terminal function 18 (Frequency source switchover) is inactive, the auxiliary frequency source Y is used as the target frequency.

When the multi-functional input terminal function 18 (Frequency source switchover) is active, the operation result of X and Y is used as the target frequency.

Tens: Operation relationship of X and Y

0: X+Y: The operation result of main frequency source X + auxiliary frequency Y is used as the target frequency.

1: X - Y: The operation result of main frequency source X - auxiliary frequency Y is used as the target frequency.

2: Max. (X, Y)

The target frequency is the higher absolute value between X and Y.

3: Min. (X, Y)

The target frequency is the lower absolute value between X and Y.

If the frequency source involves X and Y superposition, you can set the frequency offset in F0-21, which is added to the X and Y superposition result to flexibly satisfy various requirements.

F0-08	Preset frequency	Default	50.00 Hz
	Setting range	0.00–maximum frequency (frequency source: digital setting)	

If the frequency source is digital setting or terminal UP/DOWN, the value of this parameter is the initial frequency of the AC drive (digital setting).

F0-09	Running direction selection		Default	0
	Setting range	0	Default direction	
		1	Opposite to the default direction	

You can change the rotation direction of the motor just by modifying this parameter without changing the motor wiring. Modifying this parameter is equivalent to exchanging any two of the motor' s U, V, W wires.

Note: The motor continues to operate in the original direction after parameter initialization. Do not use this function in applications where changing the motor direction is inhibited after system commissioning is done.

F0-10	Maximum frequency	Default	50.00 Hz
	Setting range	50.00 Hz to 500.00 Hz	

When the frequency source is AI, pulse setting (DI5), or multi-reference, 100% of the frequency source is the percentage to the value of F0-10.

The maximum output frequency of the drive is 500 Hz, and the frequency reference resolution is fixed to two decimal places.

F0-11	Frequency upper limit source		Default	0
	Setting range	0	F0-12 setting	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference (DI5)	
		5	Communication,communication address: 1000H	

It is used to set the source of the frequency upper limit, including digital setting (F0-12), AI, pulse setting or communication. When the frequency upper limit is set through AI, 100% of the AI corresponds to the value of F0-12.

If the frequency upper limit is set through AI1, AI2, AI3, DI5 or communication, the setting is similar to that of the main frequency source X. For details, see the description of F0-03.

For example, to avoid runaway in torque control mode in winding application, you can set the frequency upper limit by means of analog input. When the AC drive reaches the upper limit, it will continue to run at this speed.

F0-12	Frequency upper limit	Default	50.00 Hz
	Setting range	F0-14 (Frequency lower limit) to F0-10 (Maximum frequency)	
F0-13	Frequency upper limit offset	Default	0.00 Hz
	Setting range	0.00 Hz to F0-10 (maximum frequency)	

When the source of the frequency upper limit is analog input or pulse setting, the final frequency upper limit is obtained by adding the offset in F0-13 to the frequency upper limit set in F0-11.

F0-14	Frequency lower limit	Default	0.00 Hz
	Setting range	0.00 Hz to F0-12 (frequency upper limit)	

If the frequency reference is lower than the value of this parameter, the AC drive can stop, run at the frequency lower limit, or run at zero speed, as defined by F8-14.

F0-15	Carrier frequency	Default	Model dependent
	Setting range	0.8 kHz to 12.0 kHz	

It is used to adjust the carrier frequency of the AC drive, helping to reduce the motor noise, avoiding the resonance of the mechanical system, and reducing the leakage current to the earth and interference generated by the AC drive.

When the carrier frequency is low, the output current higher order harmonics increase, causing high power loss and temperature rise of the motor.

If the carrier frequency is high, power loss and temperature rise of the motor decline. However, the AC drive has an increase in power loss, temperature rise and interference.

Note that when the carrier frequency is set to the lowest, the overcurrent suppression threshold should be appropriately lowered. Otherwise, a pulse-by-pulse current limit fault will be triggered.

Adjusting the carrier frequency will exert influences on the aspects listed in the following table

Carrier frequency	Low → High
Motor noise	High → Low
Output current waveform	Poor → Good
Motor temperature rise	High → Low
AC drive temperature rise	Low → High
Leakage current	Low → High
External radiation interference	Low → High

The default carrier frequency varies with the AC drive power. If you need to modify the carrier frequency, note that if the set carrier frequency is higher than the default value, it will lead to an increase in temperature rise of the AC drive heatsink. In this case, you need to derate the AC drive. Otherwise, the AC drive may overheat and alarm.

F0-16	Carrier frequency changes with the temperature	Default	0
	Setting range	0: Disable 1: Enable	

It is used to set whether the carrier frequency is adjusted based on the temperature. The AC drive automatically reduces the carrier frequency when detecting that the heatsink temperature is high. The AC drive resumes the carrier frequency to the set value when the heatsink temperature becomes normal. This function reduces the overheat alarms.

F0-17	Acceleration time 1	Default	Model dependent
	Setting range	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	
F0-18	Deceleration time 1	Default	Model dependent
	Setting range	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	

Acceleration time indicates the time required by the AC drive to accelerate from 0 Hz to acceleration/deceleration base frequency defined by F0-25 (t1 in the following figure).

Deceleration time indicates the time required by the AC drive to decelerate from acceleration/deceleration base frequency defined by F0-25 (t2 in following figure) to 0 Hz.

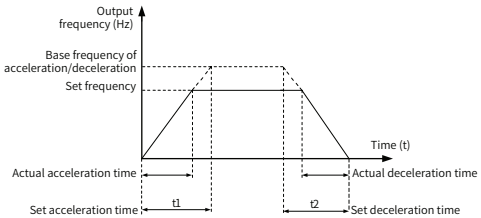


Figure 6-2 Acceleration/Deceleration time

The MD310 provides four groups of acceleration/deceleration time for selection, which can be switched through DI. The following parameters are used to set the acceleration/deceleration time.

Group 1: F0-17, F0-18

Group 2: F8-03, F8-04

Group 3: F8-05, F8-06

Group 4: F8-07, F8-08

F0-19	Acceleration/Deceleration time unit		Default	1
	Setting range	0	1s	
		1	0.1s	
		2	0.01s	

To satisfy requirements of different applications, the MD310 provides three acceleration/deceleration time units, 1s, 0.1s and 0.01s.

- Note:

Modifying parameter F0-19 can change the decimal places of displayed acceleration/deceleration time and corresponding acceleration/deceleration time.

F0-21	Auxiliary frequency source offset upon superposition	Default	0.00 Hz
	Setting range	0.00 Hz to F0-10 (maximum frequency)	

This parameter is valid only when the frequency source is set to "Operation result of X and Y".

In this case, the final frequency is obtained by adding the frequency offset set in F0-21 to the operation result of X and Y.

F0-23	Retention of frequency set through digital setting upon stop		Default	0
	Setting range	0	Non-retentive	
		1	Retentive	

This parameter is valid only when the frequency source is digital setting.

If this parameter is set to 0, the digital setting frequency value resumes to the value of F0-08 (Preset frequency) after the AC drive stops. The modification made by  or  the terminal assigned with UP/DOWN function is cleared.

If this parameter is set to 1, the digital setting frequency value is the set frequency at the moment when the AC drive stops. The modification by using keys  and  or the terminal assigned with UP/DOWN function keeps active.

F0-24	Motor parameter group selection		Default	0
	Setting range	0	Motor parameter group 1	
		1	Motor parameter group 2	

The MD310 can drive two motors at different time. You can set the motor nameplate parameters, independent motor auto-tuning, different control modes, and parameters related to operating performance respectively for the two motors.

Motor parameter group 1 corresponds to groups F1 and F2. Motor parameter group 2 corresponds to parameter group A2.

You can select current motor parameter group in F0-24 or through a DI assigned with the corresponding function. If the motor parameter group selected through F0-24 conflicts with that selected through DI, the one selected by DI applies.

F0-25	Base frequency for acceleration/deceleration time		Default	0
	Setting range	0	Maximum frequency (F0-10)	
		1	Frequency reference	
		2	100 Hz	

Acceleration/Deceleration time indicates the time it takes for accelerating/decelerating from 0 Hz/F0-25 to F0-25/0 Hz. See Figure 6-2 for details.

When F0-25 is set to 1, the acceleration/deceleration time is related to the set frequency. If the set frequency changes frequently, the motor acceleration/deceleration rate also changes.

F0-26	Base value for frequency adjusted by UP/DOWN key during operation		Default	0
	Setting range	0	Operating frequency	
		1	Frequency reference	

This parameter is valid only when the frequency source is digital setting.

It is used to set the base frequency to be modified by  and  keys or the terminal assigned with UP/DOWN function.

If the operating frequency and set frequency are different, there will be a large difference between the AC drive' s performance during the acceleration/deceleration process.

F0-27	Bind command source to frequency source		Default	0000
	Setting range	Ones	Command from the operation panel bound to frequency source	
		0	Not bound	
		1	Digital setting frequency source	
		2	AI1	
		3	AI2	
		4	AI3	
		5	Pulse reference (DI5)	
		6	Multi-reference	
		7	Simple PLC	
		8	PID	
		9	Communication	
		Tens	Command from terminals bound to frequency source (0 to 9, same as ones)	
		Hundreds	Commands from communication bound to frequency source (0 to 9, same as ones)	
		Thousands	Reserved	

It is used to bind the three operating command sources with the nine frequency sources, facilitating synchronous switchover.

For details on the frequency sources, see the description of F0-03 (Main frequency source X selection).

Different operating command sources can be bound to the same frequency source.

If a command source has been bound to a frequency source, the frequency source set in F0-03 to F0-07 no longer takes effect when this command source is active.

Group F1: Motor parameters

F1-00	Motor type		Default	0
	Setting range	0	Common asynchronous motor	
		1	Variable-frequency asynchronous motor	
F1-01	Rated power		Default	Model dependent
	Setting range		0.1 kW to 30.0 kW	
F1-02	Rated voltage		Default	Model dependent
	Setting range		1 V to 1000 V	
F1-03	Rated current		Default	Model dependent
	Setting range		0.01 A to 655.35 A	
F1-04	Rated frequency		Default	Model dependent
	Setting range		0.01 Hz to maximum frequency	
F1-05	Rated speed		Default	Model dependent
	Setting range		1 rpm to 65535 rpm	

Set these parameters according to the motor nameplate no matter whether V/f control or vector control is used.

To achieve better V/f or vector control performance, you need to perform motor auto-tuning. The motor auto-tuning accuracy depends on the correct setting of motor nameplate parameters.

F1-06	Asynchronous motor stator resistance	Default	Model dependent
	Setting range	0.001 Ω to 65.535 Ω	
F1-07	Asynchronous motor rotor resistance	Default	Model dependent
	Setting range	0.001 Ω to 65.535 Ω	
F1-08	Leakage inductance of asynchronous motor	Default	Model dependent
	Setting range	0.01 mH to 655.35 mH	
F1-09	Mutual inductance of asynchronous motor	Default	Model dependent
	Setting range	0.1 mH to 6553.5 mH	
F1-10	No-load current of asynchronous motor	Default	Model dependent
	Setting range	0.01 A to F1-03 (AC drive power ≤ 55 kW)	

These parameters are unavailable on the motor nameplate and are obtained through motor auto-tuning. Only F1-06 to F1-08 can be obtained through static motor auto-tuning. Through complete

motor auto-tuning, current loop PI can be obtained besides the parameters F1-06 to F1-10.

Every time you change F1-01 (Rated motor power) or F1-02 (Rated motor voltage), the AC drive automatically restores values of F1-06 to F1-10 to the parameter setting for the common standard Y series motors.

If motor auto-tuning cannot be performed on site, manually input the values of these parameters according to data provided by the motor manufacturer.

F1-37	Parameter auto-tuning selection		Default	0
	Setting range	0	No operation	
		1	Asynchronous motor static parameter auto-tuning 1	
		2	Asynchronous motor complete parameter auto-tuning	
		3	Asynchronous motor static parameter auto-tuning 2	

0: No operation

1: Static auto-tuning 1
It is applicable to scenarios where complete auto-tuning cannot be performed because the asynchronous motor cannot be disconnected from the load.

Before performing static auto-tuning of asynchronous motor, set the motor type and motor nameplate parameters F1-00 to F1-05 correctly. The drive can obtain parameters of F1-06 to F1-08 by static auto-tuning.

Set this parameter to 1, and then press the RUN key, the AC drive starts static auto-tuning.

2: Complete auto-tuning of asynchronous motor

To perform this type of auto-tuning, ensure that the motor is disconnected from the load.

During the process of complete auto-tuning, the AC drive performs static auto-tuning first and then accelerates to 80% of the rated motor frequency within the acceleration time set in F0-17. The AC drive keeps operating for a certain period and then decelerates to stop within deceleration time set in F0-18.

Before performing complete auto-tuning, properly set the motor type and motor nameplate parameters F1-00 to F1-05 first.

The drive can obtain motor parameters F1-06 to F1-10 and vector control current loop PI parameters F2-13 to F2-16 through complete auto-tuning.

Set this parameter to 2, and press the RUN key. Then, the AC drive starts complete auto-tuning

3: Static auto-tuning 2 for asynchronous motor

This auto-tuning mode applies in encoder-less scenarios. The motor parameters are auto-tuned at a standstill.

Set this parameter to 3, and press the RUN key. Then, the AC drive starts non-load parameter auto-

tuning.

The preceding action is used to perform motor parameter auto-tuning in the operating panel control mode (F0-02 = 0). In addition, the drive also supports motor parameter auto-tuning in terminal control mode and communication control mode.

In terminal control mode (F0-02 = 1), set F1-37 to select the parameter auto-tuning mode, and then close the operating command terminal (DI1, F4-00 = 1 by default). Then, the AC drive performs parameter auto-tuning.

In the communication mode (F0-02 = 2), set F1-37 to select the parameter auto-tuning mode, and then write the run command (write the command word of address 2000H under Modbus protocol to 1) to the control command word to make the drive start parameter auto-tuning.

Features of these three parameter auto-tuning methods are shown in the following table.

Auto-tuning mode	Applicable occasion	Auto-tuning effect
Asynchronous motor complete parameter auto-tuning	This mode applies when the motor can be disconnected from the load easily.	Best
Asynchronous motor static parameter auto-tuning 2	This mode applies when the motor cannot be disconnected from the application system.The slight jitter caused by parameter auto-tuning is within the acceptable range	Acceptable
Asynchronous motor static parameter auto-tuning 1	This mode applies when the motor can be disconnected from the load easily.	Not recommended

Select the best parameter auto-tuning method as needed. (It is recommended to select complete parameter auto-tuning.)

Group F2: Vector control parameters

Parameters in group F2 are active only in vector control.

F2-00	Speed loop proportional gain 1	Default	30
	Setting range	1 to 100	
F2-01	Speed loop integral time 1	Default	0.50s
	Setting range	0.01s to 10.00s	
F2-02	Switchover frequency 1	Default	5.00 Hz
	Setting range	0.00 to F2-05	
F2-03	Speed loop proportional gain 2	Default	20
	Setting range	0 to 100	
F2-04	Speed loop integral time 2	Default	1.00s
	Setting range	0.01s to 10.00s	

F2-05	Switchover frequency 2	Default	10.00 Hz
	Setting range	Switchover frequency 1 (F2-02) to max. output frequency	

Select speed loop PI parameters based on the operating frequency of the drive. If the operating frequency is lower than or equal to "Switchover frequency 1" (F2-02), the speed loop PI parameters are F2-00 and F2-01. If the operating frequency is equal to or higher than "Switchover frequency 2" (F2-05), the speed loop PI parameters are F2-03 and F3-04. If the operating frequency is between F2-02 and F2-05, PI parameters are switched linearly between two groups of PI parameters, as shown below.

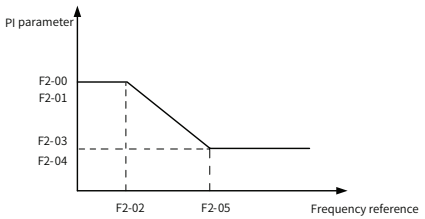


Figure 6-3 PI parameters

By setting the proportional coefficient and integral time of the speed regulator, you can adjust the dynamic response to speed changes in vector control.

Increasing the proportional gain or reducing the integral time can speed up dynamic response of the speed loop. However, an excessively high proportional gain or low integral time may cause system oscillation. Recommended adjustment methods:

If the default setting cannot meet the requirements, make proper adjustment. Increase the proportional gain first to ensure that the system does not oscillate, and then reduce the integral time to ensure that the system has quick response and small overshoot.

- Note: Improper PI parameter settings may lead to excessive speed overshoot. In addition, overvoltage may occur when overshoot drops.

F2-06	Vector control slip gain	Default	100%
	Setting range	50% to 200%	

For SVC, this parameter is used to adjust speed stability accuracy of the motor. When the motor with load runs at a very low speed, increase the value of this parameter; when the motor with load runs at a very large speed, decrease the value of this parameter.

For CLVC, this parameter is used to adjust the output current of the AC drive with the same load.

F2-07	Filter time constant of speed loop	Default	0.015
	Setting range	0.0 to 0.1	

The SVC speed feedback filter time is active only when F0-01 is set to 0. Increasing F2-07 improves motor stability but weakens dynamic responsiveness. Decreasing F2-07 weakens motor stability but improves dynamic responsiveness. Note that setting F2-07 to an excessively low value may cause motor oscillation. The default value of F2-07 applies to most of applications.

F2-08	Overexcitation gain in vector control	Default	0
	Setting range	0 to 200	

During deceleration of the drive, over-excitation control can suppress rise of the bus voltage to avoid overvoltage. The higher the over-excitation gain, the better the suppression effect will be.

Increase the over-excitation gain if overvoltage may easily occur during deceleration. An excessively high over-excitation gain may lead to an increase in output current. Therefore, set this parameter to a proper value in actual applications.

Set the over-excitation gain to 0 in applications with low inertia (the bus voltage will not rise during deceleration) or where there is a braking resistor.

F2-09	Torque limit source in speed control		Default	0
	Setting range	0	F2-10	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference (DI5)	
		5	Communication,communication address: 1000H	
		6	Min. (AI1, AI2)	
		7	Max. (AI1, AI2)	
F2-10	Digital setting of torque upper limit in speed control		Default	150.0%
	Setting range		0.0% to 200.0%	

In the speed control mode, the maximum output torque of the drive is restricted by the torque upper limit source.

When the torque upper limit (F2-09) is set through analog values, pulse input, or communication, 100% of the setpoint corresponds to the value of F2-10, and 100% of the value of F2-10 corresponds to the rated torque of the drive.

For details on AI1, AI2 and AI3, see the description of the AI curves in group F4 (AI curve are selected in F4-33) for details.

For details on the pulse setting, see the description of F4-28 to F4-32.

When the torque upper limit is set through communication, the host controller writes data -100.00% to +100.00% to the communication address 0x1000, where 100.0% corresponds to the value of F2-10. Modbus communication is supported.

F2-11	Torque upper limit source in speed control mode (generating)	Default	0
	Setting range	0: F2-09 and F2-10 1: AI1 2: AI2 3: AI3 4: Pulse setting 5: Communication, communication address: 1000H 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 8: F2-12 The full range of options 1 to 7 is the value of F2-12.	
F2-12	Digital setting of torque upper limit in speed control (generating)	Default	150.0%
	Setting range	0.0% to 200.0%	

In the speed control mode, the maximum output torque of the drive is restricted by F2-09.

F2-11 is used to select the source of the torque upper limit (generating). The torque upper limit (generating) is set by F2-09 and F2-10 when F2-11 is set to 0 by default. When the torque upper limit (F2-09) is set through analog values, pulse input, or communication, 100% of the setpoint corresponds to the value of F2-12, and 100% of the value of F2-12 corresponds to the rated torque of the drive.

For details on AI1, AI2 and AI3, see the description of the AI curves in group F4 (AI curve are selected in F4-33) for details.

For details on the pulse setting, see the description of F4-28 to F4-32.

When the torque upper limit is set through communication, the host controller writes data -100.00% to +100.00% to the communication address 0x1000, where 100.0% corresponds to the value of F2-12. Modbus communication is supported.

F2-13	M-axis current loop Kp	Default	10
	Setting range	0 to 20000	
F2-14	M-axis current loop Ki	Default	10
	Setting range	0 to 20000	
F2-15	T-axis current loop Kp	Default	10
	Setting range	0 to 20000	
F2-16	T-axis current loop Ki	Default	10
	Setting range	0 to 20000	

These are current loop PI parameters for vector control. These parameters are auto-tuned through complete auto-tuning and need not be modified.

Note that the current loop integral regulator does not use the integral time as the dimension. Instead, set the integral gain directly. An excessively high current loop PI gain may lead to oscillation of the entire control loop. Therefore, when current oscillation or torque fluctuation is great, manually decrease the PI proportional gain or integral gain.

F2-17	Speed loop property	Default	00
	Setting range	Ones: Integral separation 0: Inactive 1: Active Tens: Torque feedforward 0: Inactive 1: Active	
F2-18	Torque feedforward gain	Default	80
	Setting range	20 to 100	

Speed loop property F2-17:

Ones: When integral separation is active, the speed overshoot of high inertia load acceleration can be reduced.

Tens: When torque feedforward is active, the speed drop caused by sudden load can be reduced.

Torque feedforward gain F2-18:

This parameter is active only when the torque feedforward is active. The higher the gain, the smaller the sudden load speed drop. The default value applies to most of applications.

F2-19	Torque feedforward filter time	Default	50
	Setting range	10 to 200	

F2-21	Maximum torque coefficient in field weakening area	Default	80%
	Setting range	50% to 200%	

This parameter takes effect only when the motor runs at frequencies above the rated motor frequency. When the motor need to accelerate quickly to twice of rated motor frequency but actual acceleration time is long, decrease the value of F2-21 properly. When the motor runs at frequencies above twice of rated motor frequency with large speed drop after a load is added, increase the value of F2-21 properly. Adjustment of this parameter is not required normally.

F2-22	Generating power limit mode	Default	0
	Setting range	0 to 3	

The generating power upper limit (F2-22) is used to limit the regenerative power of the motor. It can be used to reduce the braking power of the braking resistor (or braking unit). The default value is 0.0% (generating power not limited) and 100% corresponds to the rated power of the motor.

When the braking resistor is too hot, decrease the value of F2-22 to reduce the heat generated

by the braking resistor, but such operation can increase the deceleration time of the motor. It is recommended that the initial value of commissioning start at 100.0%.

F2-23	Generating power upper limit	Default	0.0
	Setting range	0.0 to 200.0	

Group F3: V/f control parameters

Parameters in group F3 are active only in V/f control.

The V/f control mode is applicable to general loads such as wind turbines and water pumps, or applications where one drive is used to drive multiple motors or the rated power of the drive deviates greatly from that of the motor.

F3-00	V/f curve setting		Default	0
	Setting range	0	Linear V/f	
		1	1: Multi-point V/f curve	
		2	Square V/f curve	
		3	1.2: V/f	
		4	1.4: V/f	
		6	1.6: V/f	
		8	1.8: V/f	
		10	V/f fully separated	
		11	V/f partially separated	

0: Linear V/f curve It is applicable to common constant torque load.

1: Multi-point V/f curve It is applicable to special load such as dehydrators and centrifuges. You can get any V/f curve by setting F3-03...F3-08.

2: Square V/f It is applicable to centrifugal loads such as wind turbines and water pumps.

3–8: V/f curve between linear V/f and square V/f

10: V/f fully separated In this mode, the output frequency of the drive is independent of the output voltage. The output frequency is determined by the frequency source and the output voltage is determined by F3-13 (Voltage source for separated V/f).

This mode is applicable to induction heating, inverter power supply and torque motor control applications.

11: V/f partially separated

In this mode, V is in proportion to f. The relationship between V and f can be set through F3-13 and is also related to the rated motor voltage and rated motor frequency in Group F1.

Assume that the voltage source input is X (X = 0%...100%), the relationship between V and f is as follows:

V/f=2 x X x (Rated motor voltage)/(Rated motor frequency)

F3-01	Torque boost	Default	0.0%
	Setting range	0.0%: Automatic torque boost 0.1% to 30%	
F3-02	Cut-off frequency of torque boost	Default	50.00 Hz
	Setting range	0.00 Hz to maximum frequency	

To compensate for the low frequency torque characteristics of V/f control, you can boost the output voltage of the drive operating at low frequency. Note that an excessively high torque boost can lead to motor overtemperature and drive overcurrent.

If the motor is connected to heavy load but does not have sufficient starting torque, increase the value of this parameter. If the motor is connected to light load, decrease the torque boost.

If the torque boost is set to 0.0, the drive performs automatic torque boost. In this case, the drive automatically calculates the torque boost value based on motor parameters.

Cut-off frequency for torque boost: It specifies the frequency under which torque boost is valid, as shown in the following figure.

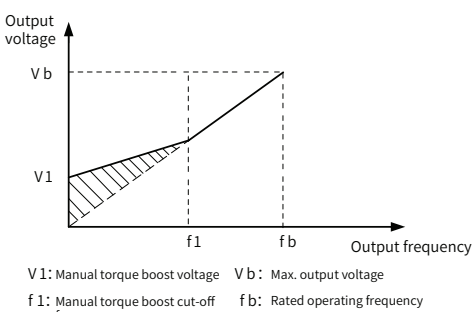


Figure 6-4 Manual torque boost

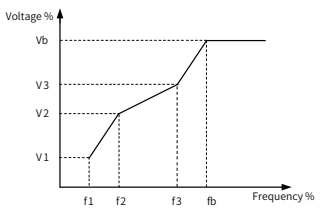
F3-03	Multi-point V/f frequency 1	Default	0.00 Hz
	Setting range	0.00 Hz to F3-05	
F3-04	Multi-point V/f voltage 1	Default	0.0%
	Setting range	0.0% to 100.0%	
F3-05	Multi-point V/f frequency 2	Default	0.00 Hz
	Setting range	F3-03 to F3-07	
F3-06	Multi-point V/f voltage 2	Default	0.0%
	Setting range	0.0% to 100.0%	

F3-07	Multi-point V/f frequency 3	Default	0.00 Hz
	Setting range	F3-05 to Rated motor frequency (F1-04) Note: The rated frequency of motor 2 is A2-04.	
F3-08	Multi-point V/f voltage 3	Default	0.0%
	Setting range	0.0% to 100.0%	

F3-03...F3-08 are used to define the multi-point V/f curve.

The multi-point V/f curve is set based on the motor’ s load characteristic. The following figure shows the setting diagram of V/f curve.

At low frequencies, high voltage may cause overheat or even burn the motor, triggering overcurrent stall or overcurrent protection of the drive.



V1–V3: Voltage percentage of speed 1 to speed 3 in multi-speed V/f mode

f1–f3: Frequency percentage of speed 1 to speed 3 in multi-speed V/f mode

Vb: Rated motor voltage fb: Rated operating frequency of the motor

Figure 6-5 Setting of multi-point V/f curve

F3-09	Slip compensation factor	Default	0.0%
	Setting range	0% to 200.0%	

This parameter is valid only for asynchronous motors.

The V/f slip compensation is used to compensate for the motor speed deviation generated when the load on the asynchronous motor increases, keeping the motor speed stable when the load changes.

If the V/f slip compensation gain is set to 100.0%, the slip compensation applied to the motor with the rated load is the rated motor slip. The drive automatically calculates the rated motor slip based on the motor's rated frequency and rated speed set by parameters in group F1.

The principle of adjusting this parameter is to make the motor speed under rated load the same as the target motor speed. Generally, if the motor speed is different from the target speed, slightly adjust this parameter.

F3-10	V/f over-excitation gain	Default	64
	Setting range	0 to 200	

During deceleration of the drive, over-excitation control can suppress rise of the bus voltage to avoid overvoltage. The higher the over-excitation gain, the better the suppression effect will be. Note that if an excessively high gain can result in overvoltage due to oscillation.

Increase the over-excitation gain if overvoltage may easily occur during deceleration. An excessively high over-excitation gain may lead to an increase in output current. Therefore, set this parameter to a proper value in actual applications.

Set the over-excitation gain to 0 in applications with low inertia (the bus voltage will not rise during deceleration) or where there is a braking resistor.

F3-11	V/f oscillation suppression gain	Default	Model dependent
	Setting range	0 to 100	

Set this parameter to the lowest value possible without affecting oscillation suppression performance. This is to prevent adverse impact on V/f operation. Set the gain to 0 if the motor does not oscillate. Increase the value of this gain only when obvious motor oscillation occurs. The higher the gain, the better oscillation suppression effect will be.

When oscillation suppression is enabled, the motor's rated current and no-load current must be accurate. Otherwise, the V/f oscillation suppression effect can be affected.

F3-13	Voltage source for separated V/f		Default	0
	Setting range	0	F3-14	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse (DI5)	
		5	Multi-reference	
		6	Simple PLC	
		7	PID	
		8	Communication	
		Note: The value 100.0% corresponds to the rated motor voltage (F1-02, A5-02, A6-02).		
F3-14	Voltage digital setting for separated V/f		Default	0 V
	Setting range		0 V to Rated motor voltage	

Separated V/f is generally applicable to scenarios such as induction heating, inverter power supply and motor torque control.

If separated V/f control is used, the output voltage can be set by F3-14 or analog values, multi-reference, PLC, PID or communication. If you set the output voltage through non-digital setting, 100% of the setting corresponds to the rated motor voltage. If a negative percentage is set, its absolute value is used as the effective value.

0: F3-14

The output voltage is set directly in F3-14.

1: AI1
2: AI2
3: AI3

The voltage is set by analog input.

4: Pulse reference (DI5)

The voltage reference is set through the terminal pulse.

Specifications of pulse reference signal: 9 V to 30 V (voltage) and 0 kHz to 20 kHz (frequency)

5: Multi-reference

If the voltage source is multi-reference, parameters in groups F4 and FC must be set to determine the corresponding relationship between the reference signal and the reference voltage. 100.0% of the multi-reference setting in group FC corresponds to the rated motor voltage.

6: Simple PLC

If the voltage source is simple PLC, parameters in group FC must be set to determine the set output voltage.

7: PID

The output voltage is set based on PID closed loop. For details, see the description of PID in group FA.

8: Communication

The voltage is set by the host controller through communication.

The voltage source for separated V/f is set in the same way as the frequency source. For details, see F0-03. 100.0% of the setting in each voltage source corresponds to the rated motor voltage. If the corresponding value is negative, its absolute value is used.

F3-15	Voltage rise time for separated V/f	Default	0.0s
	Setting range	0.0s to 1000.0s	
F3-16	Voltage decline time for separated V/f	Default	0.0s
	Setting range	0.0s to 1000.0s	

Voltage rise time indicates time needed to rise from 0 to rated motor voltage, as shown by t1 in the following figure.

Voltage decline time indicates time needed to decline from rated motor voltage to 0, as shown by t2 in the following figure.

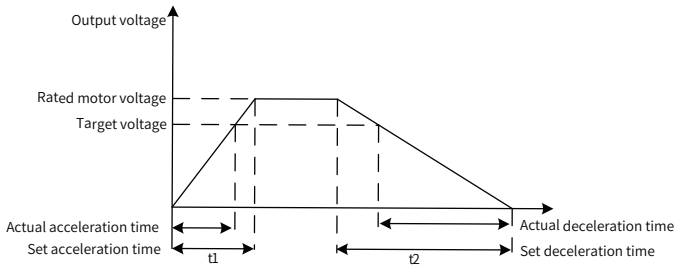


Figure 6-6 Separated V/f

F3-17	Stop mode for separated V/f	Default	0
	Setting range	0: Frequency and voltage declined to 0 separately 1: Frequency declined after voltage declined to 0	

0: Frequency and voltage declined to 0 separately

The output voltage for separated V/f decreases to 0 V based on the voltage decline time (F3-15). The output frequency for separated V/f decreases to 0 Hz based on the decline time (F0-18).

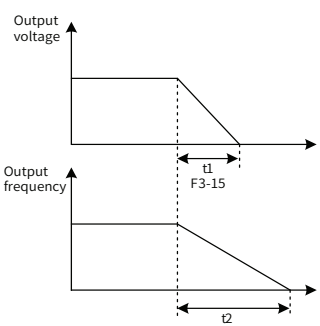


Figure 6-7 Output voltage/frequency declined to 0 upon separated V/f

1: Frequency declined after voltage declined to 0

The output voltage for separated V/f decreases to 0 V based on the voltage decline time (F3-15). The output frequency for separated V/f decreases to 0 Hz based on the decline time (F0-18).

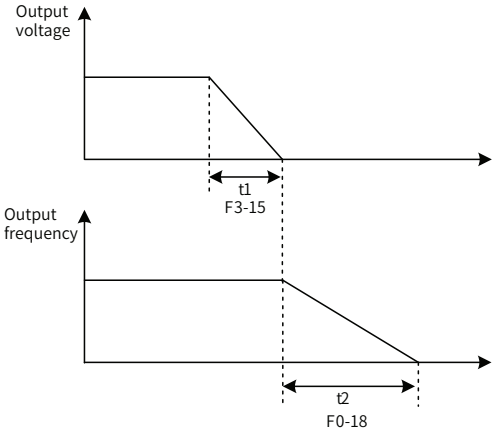


Figure 6-8 Frequency declined after voltage declined to 0

- Output current (torque) limit of the drive

During acceleration, operation at constant speed, and deceleration, if the current exceeds the overcurrent stall action current (default: 150%, indicating 1.5 x Rated current of the drive), the overcurrent stall function is activated. In this case, the output frequency decreases until the current drops below the overcurrent stall action current. Then, the output frequency increases to the target frequency. Therefore, the acceleration time is prolonged. If the actual acceleration time cannot meet your requirement, increase the value of overcurrent stall action current (F3-18) accordingly.

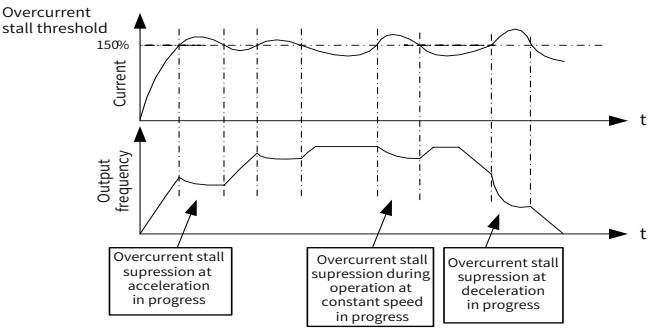


Figure 6-9 Overcurrent stall action

Param.	Name	Default	Value range	Description
F3-18	Overcurrent stall action current	150%	50% to 200%	It indicates the current that the overcurrent stall suppression is enabled.
F3-19	Overcurrent stall suppression	1	0 to 1	0: Inactive 1: Active
F3-20	Overcurrent stall suppression gain	20	0 to 100	When the current exceeds the overcurrent stall action current, the overcurrent stall suppression will be activated, prolonging the actual acceleration time.
F3-21	Current compensation coefficient for overcurrent stall action at multiplied rated frequency	50%	0% to 200%	This parameter reduces the overcurrent stall action current at high speed. It is invalid when the compensation coefficient is set to 50. The action current in the field weakening range corresponds to F3-18.

In high frequency range, the motor driving current is low. If the frequency is lower than the rated frequency, greater motor speed drop will be caused at the same stall current. To improve motor operating performance, you can lower the stall action current when the frequency is higher than the rated frequency. This helps improve the acceleration performance in the applications where high operating frequency and high load inertia are required.

Stall action current above rated frequency = (fs/fn) x k x LimitCur

In the preceding formula, fs represents the operating frequency, fn represents the rated motor frequency, k represents the current compensation coefficient for overcurrent stall action at multiplied rated frequency (F3-21), and LimitCur represents overcurrent stall action current (F3-18).

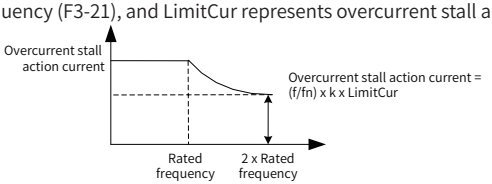


Figure 6-10 Overcurrent stall action at multiplied rated frequency

Note:

150% of the overcurrent stall action current corresponds to 1.5 x rated current of the drive.

For high-power motors with carrier frequency below 2 kHz, the overcurrent stall action current must be reduced. This is because the increase in ripple current will cause the start of pulse-by-pulse current limit before the overcurrent stall suppression function is triggered, resulting in insufficient torque.

- AC drive bus voltage limit (and braking resistor apply voltage setting)

When the bus voltage rises above the overvoltage stall threshold 760 V, it indicates the system is in the generating state (motor speed > output frequency). In this case, overvoltage stall is activated to adjust the output frequency through consuming surplus power, prolonging the actual deceleration time to prevent tripping. If the actual deceleration time cannot satisfy the requirement, increase the over-excitation gain properly.

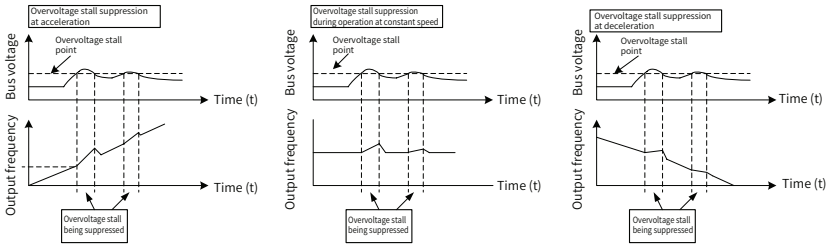


Figure 6-11 Overvoltage stall action

Param.	Name	Default	Value range	Description
F3-22	Action voltage for overvoltage stall	760.0 V	200.0 V to 810.0 V	-
F3-23	Overvoltage stall enable	1	0 to 1	0: Disabled 1: Enabled (overvoltage stall gain activated by default)
F3-24	Frequency gain during overvoltage stall suppression	30	0 to 100	Increasing F3-24 will improve the control effect of the bus voltage, but the output frequency will fluctuate. If the output frequency has great fluctuation, reduce F3-24 properly. Increasing F3-25 can reduce the overshoot of the bus voltage.
F3-25	Voltage gain during overvoltage stall suppression	30	0 to 100	
F3-26	Frequency rise limit during overvoltage stall	5 Hz	0 Hz to 50 Hz	It indicates the maximum frequency rise limit for overvoltage suppression.

Note:

Pay attention to the following when using a braking resistor, braking unit, or regenerative unit:

Set F3-11 (Over-excitation gain) to 0. Otherwise, excessively high current may be generated during operation.

Set F3-23 (Overvoltage stall) to 0. Otherwise, the deceleration time may be prolonged.

Param.	Name	Default	Value range	Description
F3-27	Slip compensation time constant	0.5s	0.1s to 10.0s	When the setpoint is excessively low, overvoltage may occur in the load with high inertia (Err07).

The shorter the slip compensation response time, the quicker the response will be.

Group F4 Input Terminals

The MD310 provides five DI terminals (DI5 can be used as high-speed pulse input) and two analog input (AI) terminals. If more I/O terminals are needed, the optional multi-functional I/O expansion card can be used.

The multi-functional I/O expansion card has five multi-functional DIs (DI6 to DI10) and one AI (AI3).

Param.	Name	Default	Remark
F4-00	DI1 function selection	1: Forward run	Standard
F4-01	DI2 function selection	4: Forward jog	Standard
F4-02	DI3 function selection	9: Reset upon fault	Standard
F4-03	DI4 function selection	12: Multi-speed 1	Standard
F4-04	DI5 function selection	13: Multi-speed 2	Standard
F4-05	DI6 function selection	0	Expansion
F4-06	DI7 function selection	0	Expansion
F4-07	DI8 function selection	0	Expansion
F4-08	DI9 function selection	0	Expansion
F4-09	DI10 function selection	0	Expansion

These parameters are used to set the functions of multi-functional DIs, as described in the following table.

Table 6-1 Function of digital multi-functional input terminals

Setpoint	Function	Description
0	No function	Set 0 for reserved terminals to avoid malfunction.
1	Forward run (FWD) or RUN command	This terminal is used to control forward or reverse operating of the AC drive.
2	Reverse (REV) run or forward/reverse run (Note: When these parameters are set to 1 and 2, F4-11 must also be set.)	
3	Three-wire control	The terminal determines three-wire mode of the AC drive. For details, see the description of F4-11.
4	Forward jog (FJOG)	FJOG indicates forward jog and RJOG indicates reverse jog. The jog frequency, jog acceleration time and deceleration time are described respectively in F8-00, F8-01 and F8-02.
5	Reverse jog (RJOG)	

Setpoint	Function	Description
6	Function as the UP key	If the frequency is determined by external terminals, the terminals with the two functions are used as increment and decrement commands for frequency modification. When the frequency source is digital setting, they are used to adjust the frequency.
7	Function as the DOWN key	
8	Coast to stop	The drive blocks output. In this case, the stop process of the motor is not controlled by the drive. This stop mode is the same as coast-to-stop described in F6-10.
9	Fault reset (RESET)	A terminal is used for fault reset. It has the same function as the RESET key on the keypad. Remote fault reset can be implemented through this function.
10	Pause	The AC drive decelerates to stop, but all the operating parameters are all recorded, such as PLC, wobble frequency and PID parameters. After the terminal signal disappears, the AC drive resumes its status before stop.
11	NO input of external fault	When this signal is sent to the drive, the drive reports Err15 and performs the fault protection action. For more details, see the description of F9-47.
12	Multi-speed reference terminal 1	The setting of 16 multi-references or 16 other references can be implemented through combinations of 16 states of these four terminals.
13	Multi-speed reference terminal 2	
14	Multi-speed reference terminal 3	
15	Multi-speed reference terminal 4	
16	Acceleration/ deceleration time selection terminal 1	Totally four groups of acceleration/deceleration time can be selected through combinations of two states of these two terminals.
17	Acceleration/ deceleration time selection terminal 2	
18	Frequency source switchover	Used to switch between difference frequency sources. The terminal is used to perform switchover between two frequency sources according to the setting in F0-07.
19	Clear data set by UP/ DOWN key or by terminal functioning as UP/DOWN key	If the frequency reference source is digital setting, the terminal is used to clear the modification by using the UP/DOWN function or the UP and DOWN keys on the operating panel, restoring the reference frequency to the value of F0-08.

Setpoint	Function	Description
20	Run command switchover	If the command source is set to terminal control (F0-02 = 1), this terminal is used to perform switchover between terminal control and operating panel control. If the command source is set to communication control (F0-02 = 2), this terminal is used to perform switchover between communication control and operating panel control.
21	Acceleration/ Deceleration inhibited	It enables the drive to maintain current output frequency output without being affected by external signals (except the stop command).
22	PID pause	The PID is deactivated temporarily. The drive maintains the current output frequency without PID adjustment of the frequency source.
23	PLC state reset	When PLC control is started again after a pause, the terminal is used to restore the original state of PLC control for the AC drive.
24	Wobble frequency pause	The AC drive outputs the center frequency, and the wobble frequency function pauses. Wobble function pause
25	Counter input	Used to count pulses.
26	Counter reset	Used to clear the counter.
27	Length counting input	Used to count the length.
28	Length reset	Used to clear the length.
29	Torque control prohibited	Torque control is prohibited, and the drive enters the speed control mode.
30	Pulse input (valid only in DI5)	DI5 is used for pulse input.
31	Reserved	Reserved
32	Immediate DC braking	When this terminal is active, the drive directly switches to the DC braking state.
33	NC of external fault	After the external fault DC signal is sent to the drive, the drive reports Err15 and stops.
34	Frequency modification enable	When DI1 is active, the frequency can be modified. When DI1 is inactive, the frequency cannot be modified.
35	Inverted PID action	After this terminal is active, the PID action direction is opposite to the direction set in FA-03.
36	External stop terminal 1	In operating panel control, this terminal can be used to stop the drive, equivalent to the function of the STOP key on the operating panel.
37	Control command switchover terminal 2	It is used to perform switch between terminal control and communication control. If the command source is terminal control, the system switches to communication control after this terminal is activated.

Setpoint	Function	Description
38	PID integral pause	After this terminal is activated, the PID integral adjustment function pauses. However, the proportional and derivative adjustment functions are still valid.
39	Switchover between main frequency source X and preset frequency	After this terminal is activated, the frequency source X is replaced by the preset frequency set in F0-08.
40	Switchover between auxiliary frequency source Y and preset frequency	After this terminal is enabled, the frequency source Y is replaced by the preset frequency set in F0-08.
41	Motor selection terminal 1	The two groups of motor parameters can be switched through this terminal. See details in Table 6-4.
42	Reserved	Reserved
43	PID parameter switchover	If the PID parameters are switched through DI (FA-18 = 1), the PID parameters are FA-05 to FA-07 when this terminal is inactive or FA-15 to FA-17 when this terminal is active.
44	User-defined fault 1	When user-defined faults 1 and 2 are active, the drive reports Err27 and Err28 and handle the fault as defined by F9-49.
45	User-defined fault 2	
46	Speed control/Torque control switchover	Used to switch between speed control and torque control. When this terminal is inactive, the drive runs in the mode defined in A0-00. When this terminal is active, the drive switches to the another control mode.
47	Emergency stop	When this terminal is active, the drive stops based on the emergency stop time (F8-55).
48	External stop terminal 2	In any control mode (operating panel, terminal or communication), this terminal can be used to make the drive decelerate to stop. In this case, deceleration time 4 applies.
49	Decelerate to DC braking	When this terminal is active, the drive decelerates to the starting frequency of DC braking at stop and then switches to the DC braking state.
50	Clear current operating time	When this terminal is active, the current operating time of the drive is cleared. This function must be used together with F8-42 and F8-53.
51	Two-wire/Three-wire mode switchover	Used to switch between two-wire and three-wire control. If F4-11 is two-wire 1, this terminal is switched to three-wire 1 when the function is active, and so on.
52	Reverse frequency inhibited	When this terminal is active, the reverse frequency is inactive. This function is the same as F8-13.
53 to 59	Reserved	Reserved

The four multi-reference terminals have 16 state combinations, corresponding to 16 reference

values, as listed in the following table. The following table lists the details.

Table 6-2 Description of multi-reference function

K4	K3	K2	K1	Reference	Parameter
OFF	OFF	OFF	OFF	Multi-reference 0	FC-00
OFF	OFF	OFF	ON	Multi-reference 1	FC-01
OFF	OFF	ON	OFF	Multi-reference 2	FC-02
OFF	OFF	ON	ON	Multi-reference 3	FC-03
OFF	ON	OFF	OFF	Multi-reference 4	FC-04
OFF	ON	OFF	ON	Multi-reference 5	FC-05
OFF	ON	ON	OFF	Multi-reference 6	FC-06
OFF	ON	ON	ON	Multi-reference 7	FC-07
ON	OFF	OFF	OFF	Multi-reference 8	FC-08
ON	OFF	OFF	ON	Multi-reference 9	FC-09
ON	OFF	ON	OFF	Multi-reference 10	FC-10
ON	OFF	ON	ON	Multi-reference 11	FC-11
ON	ON	OFF	OFF	Multi-reference 12	FC-12
ON	ON	OFF	ON	Multi-reference 13	FC-13
ON	ON	ON	OFF	Multi-reference 14	FC-14
ON	ON	ON	ON	Multi-reference 15	FC-15

When the frequency source is multi-reference, the value 100% of FC-00...FC-15 correspond to the value of F0-10 (Maximum frequency).

Besides the multi-speed function, the multi-reference can be also used as the PID setting source or the voltage source for separated V/f, satisfying the requirement for switchover among different setpoints.

Table 6-3 Function of acceleration/deceleration time selection terminals

Terminal 2	Terminal 1	Acceleration/Deceleration time selection	Parameter
OFF	OFF	Acceleration time 1	F0-17, F0-18
OFF	ON	Acceleration time 2	F8-03, F8-04
ON	OFF	Acceleration time 3	F8-05, F8-06
ON	ON	Acceleration time 4	F8-07, F8-08

Table 6-4 Function of motor selection terminals

Terminal 1	Motor selection	parameter group
OFF	Motor 1	Groups F1 and F2
ON	Motor 2	Group A2

F4-10	DI filter time	Default	0.010s
	Setting range	0.000s to 1.000s	

These parameters are used to set the software filter time of the DI status. If malfunction may occur due to disturbed DIs, increase the setpoint of this parameter to enhance the anti-interference capability. Note that an excessively high filter time may slow down the DI response.

F4-11	Terminal command mode		Default	0
	Setting range	0	Two-wire mode 1	
		1	Two-wire mode 2	
		2	Three-wire mode 1	
		3	Three-wire mode 2	

This parameter defines mode in which the AC drive is controlled by external terminals.

Note: The following uses DI1, DI2 and DI3 as an example to describe these modes. The functions of DI1, DI2 and DI3 are set in F4-00 to F4-02. For details, see the description of F4-00 to F4-09.

0: Two-line mode 1
This is the most commonly used two-line mode, in which the forward/reverse rotation of the motor is decided by DI1 and DI2.

The parameters are set as below:

Param.	Name	Setpoint	Description
F4-11	Terminal command mode	0	Two-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)

K1	K2	RUN
1	0	FWD
0	1	REV
1	1	STOP
0	0	STOP

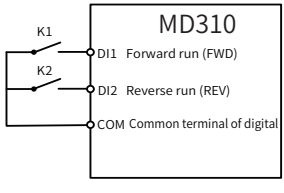


Figure 6-12 Two-wire mode 1

As shown in the preceding figure, when K1 closes in this control mode, forward run applies. When K2 closes, reverse run applies. When K1 and K2 close/open simultaneously, the drive stops.

1: Two-wire mode 2
In this mode, DI1 is used to enable operation and DI2 is used to define the operating direction.

The parameters are set as below:

Param.	Name	Setpoint	Description
F4-11	Terminal command mode	1	Two-wire mode 2
F4-00	DI1 function selection	1	Operation enable
F4-01	DI2 function selection	2	Forward/Reverse run direction

K1	K2	RUN
1	0	FWD
1	1	REV
0	0	STOP
0	1	STOP

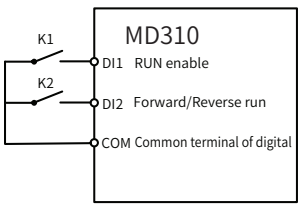


Figure 6-13 Two-wire mode 2

As shown in the preceding figure, when K1 closes and K2 opens in this control mode, forward run applies. When K2 closes, reverse run applies. When K1 opens, the drive stops.

2: Three-wire mode 1
In this mode, DI3 is assigned with the enable function, and DI1 and DI2 are used to define the direction.

The parameters are set as below:

Param.	Name	Setpoint	Description
F4-11	Terminal command mode	2	Three-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)
F4-02	DI3 function selection	3	Three-wire control

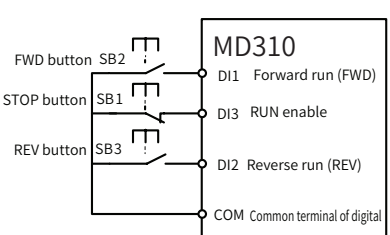


Figure 6-14 Three-wire mode 1

As shown in the preceding figure, when SB1 closes in this control mode, forward run applies when

you press SB2 or reverse run applies when you press SB3. When SB1 opens, the drive stops. During normal start and operation, SB1 must be kept closed to allow SB2 and SB3 to be rising edge-triggered upon close.The operating state of the drive is determined by the final operations on SB1, SB2 and SB3.

3: Three-wire control mode 2
In this mode, DI3 is assigned with the enable function, DI1 is used to send the operation command , and DI2 determines the direction.

The parameters are set as below:

Param.	Name	Setpoint	Description
F4-11	Terminal command mode	3	Three-wire mode 2
F4-00	DI1 function selection	1	Operation enable
F4-01	DI2 function selection	2	Forward/Reverse run direction
F4-02	DI3 function selection	3	Three-wire control

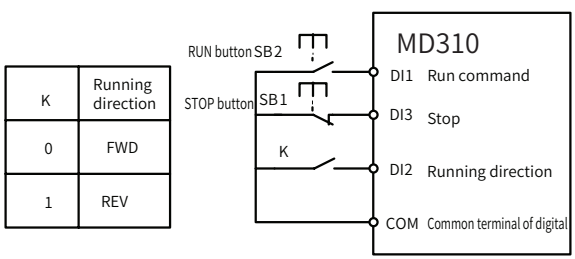


Figure 6-15 Three-wire mode 2

As shown in the preceding figure, if SB1 closes in this control mode, the drive starts operating when you press SB2. Forward run applies when K opens. Reverse run applies when K closes. The drive stops when SB1 opens. SB1 must be kept closed during normal start and operation. The command sent by SB2 is rising edge-triggered when SB2 closes.

F4-12	Change rate of terminal UP/DOWN	Default	1.000 Hz/s
	Setting range	0.001 Hz/s to 65.535 Hz/s	

It is used to adjust frequency change value per second when the frequency is adjusted through terminal UP/DOWN.

F4-13	Minimum input of AI curve 1	Default	0.00 V
	Setting range	0.00 V to F4-15	

F4-14	Percentage corresponding to minimum input of AI curve 1	Default	0.0%
	Setting range	-100.00% to +100.0%	
F4-15	Maximum input of AI curve 1	Default	10.00 V
	Setting range	F4-13 to 10.00 V	
F4-16	Percentage corresponding to the maximum input of AI curve 1	Default	100.0%
	Setting range	-100.00% to +100.0%	
F4-17	AI1 filter time	Default	0.10s
	Setting range	0.00s to 10.00s	

The preceding parameters are used to define the relationship between the analog input voltage and the corresponding setpoint.

When the AI voltage is higher than the set "Maximum input" (F4-15), the analog voltage is calculated based on the "Maximum input". Similarly, when the analog input voltage is lower than the set "Minimum input" (F4-13), the analog voltage is calculated based on the minimum input or 0.0%, as defined by F4-34.

When the analog current input is used, 1 mA current corresponds to 0.5 V voltage.

The parameter AI1 filter time is used to set the software filter time of AI1. If the analog input may be easily disturbed on site, increase the filter time to stabilize the detected analog value. Note that an excessively high AI filter time can slow down the responsiveness of analog detection. Set this parameter properly based on actual conditions.

The definition of the nominal value corresponding to 100.0% of the analog input varies with actual applications.

Two typical setting examples are shown in the following figure.

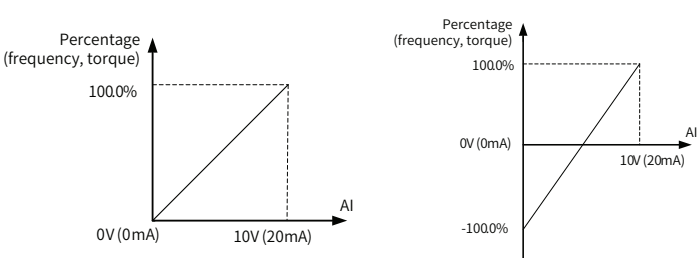


Figure 6-16 Relationship between analog input and corresponding setting

F4-18	Minimum input of AI curve 2	Default	0.00 V
	Setting range	0.00 V to F4-20	
F4-19	Percentage corresponding to minimum input of AI curve 2	Default	0.0%
	Setting range	-100.00% to +100.0%	
F4-20	Maximum input of AI curve 2	Default	10.00 V
	Setting range	F4-18 to 10.00 V	
F4-21	Percentage corresponding to maximum input of AI curve 2	Default	100.0%
	Setting range	-100.00% to +100.0%	
F4-22	AI2 filter time	Default	0.10s
	Setting range	0.00s to 10.00s	

The method for setting curve 2 is same as that of curve 1.

F4-23	Minimum input of AI curve 3	Default	-10.00 V
	Setting range	0.00s to F4-25	
F4-24	Percentage corresponding to minimum input of AI curve 3	Default	-100.0%
	Setting range	-100.00% to +100.0%	
F4-25	Maximum input of AI curve 3	Default	10.00 V
	Setting range	F4-23 to 10.00 V	
F4-26	Percentage corresponding to maximum input of AI curve 3	Default	100.0%
	Setting range	-100.00% to +100.0%	
F4-27	AI3 filter time	Default	0.10s
	Setting range	0.00s to 10.00s	

The method for setting curve 3 is same as that of curve 1.

F4-28	Pulse minimum input	Default	0.00 kHz
	Setting range	0.00 kHz to F4-30	
F4-29	Percentage corresponding to pulse minimum input	Default	0.0%
	Setting range	-100.00% to +100.0%	
F4-30	Pulse maximum input	Default	20.00 kHz
	Setting range	F4-28 to 20.00 kHz	
F4-31	Percentage corresponding to maximum pulse input	Default	100.0%
	Setting range	-100.00% to +100.0%	

F4-32	Pulse filter time	Default	0.10s
	Setting range	0.00s to 10.00s	

These parameters are used to set the relationship between DI5 pulse input and corresponding setting.

The pulse frequency can be inputted only from DI5.

The method for setting this function is similar to that of curve 1.

F4-33	AI curve		Default 321
	Setting range	Ones	Ones: AI1 curve selection
		1	Curve 1 (2 points, see F4-13 to F4-16)
		2	Curve 2 (2 points, see F4-18 to F4-21)
		3	Curve 3 (2 points, see F4-23 to F4-26)
		4	Curve 4 (4 points, see A6-00 to A6-07)
		5	Curve 5 (4 points, see A6-08 to A6-15)
		Tens	AI2 curve selection (1 to 5, same as above)
		Hundreds	AI3 curve selection (1 to 5, same as above)

The ones, tens, and hundreds are respectively used to select the corresponding curves of AI1, AI2 and AI3. Any one of the five curves can be selected for AI1, AI2, and AI3.

Curve 1, curve 2 and curve 3 are all 2-point curves, which are set in group F4. Curve 4 and curve 5 are both 4-point curves, which are set in group A6.

The MD310 provides two AIs as standard. AI3 is provided by an optional expansion card.

The ones of this parameter is used to select the corresponding curve of AI1. Any of the five curves can be selected for AI1

Curve 1, curve 2 and curve 3 are all 2-point curves, which are set in group F4. Curve 4 and curve 5 are both 4-point curves, which are set in group A6.

F4-34	Selection when AI value < minimum input value		Default 000
	Setting range	Ones	Selection when AI1 value < minimum input value
		0	Corresponding to minimum input setting
		1	0.0%
		Tens	Selection when AI2 value < minimum input (0 to 1, same as above)
		Hundreds	Selection when AI3 value < minimum input (0 to 1, same as above)

This parameter is used to determine the corresponding setting when the analog input voltage is lower than the set minimum value.

The ones, tens, and hundreds of this parameter respectively correspond to AI1, AI2 and AI3.

Ones = 0: When AI1 input is lower than the minimum input, the corresponding setting of the minimum input (F4-14, F4-19, F4-24) is used.

Ones = 1: When AI1 input is lower than the minimum input, the corresponding value of this analog input is 0.0%.

F4-35	DI1 delay time	Default	0.0s
	Setting range	0.0s to 3600.0s	
F4-36	DI2 delay time	Default	0.0s
	Setting range	0.0s to 3600.0s	
F4-37	DI3 delay time	Default	0.0s
	Setting range	0.0s to 3600.0s	

These parameters are used to set the delay of the drive when the status of DI terminals changes.

Currently, only DI1, DI2 and DI3 support the delay function.

F4-38	DI active mode selection 1		Default	00000
	Setting range	Ones	DI1 active mode	
		0	Active high	
		1	Active low	
		Tens	DI2 active status setting (0 to 1, same as above)	
		Hundreds	DI3 active status setting (0 to 1, same as above)	
		Thousands	DI4 active status setting (0 to 1, same as above)	
		Ten thousands	DI5 active status setting (0 to 1, same as above)	
F4-39	DI active mode selection 2		Default	00000
	Setting range	Ones	DI6 active mode	
		0	Active high	
		1	Active low	
		Tens	DI7 active status setting (0 to 1, same as above)	
		Hundreds	DI8 active status setting (0 to 1, same as above)	
		Thousands	DI9 active status setting (0 to 1, same as above)	
		Ten thousands	DI10 active status setting (0 to 1, same as above)	

These two parameters are used to set the active mode of the DI.

When "active high" is selected, the DI is active when connected to the COM terminal and inactive when disconnected from the COM terminal.

When "active low" is selected, the DI is inactive when connected to COM and active when

disconnected from COM.

Group F5: Output terminals

The MD310 provides an analog output (AO) terminal, a digital output (DO) terminal, a relay output terminal and a FM terminal (used as high-speed pulse output or open-collector digital signal output) as standard. If these output terminals cannot satisfy requirements, use an optional I/O expansion card that provides an AO terminal (AO2), a relay terminal (relay 2) and a DO terminal (DO2).

F5-00	FM terminal output mode		Default	0
	Setting range	0	Pulse output (FMP)	
		1	Digital output (FMR)	

The FM terminal is a programmable multiplexing terminal that can be used as the high-speed pulse output (FMP) terminal or open collector digital output terminal (FMR).

When used as the high-speed pulse output terminal (FMP), the maximum frequency of the output pulse is 50 kHz. For details on the FMP functions, see the description of F5-06.

F5-01	FMR function (open collector output terminal)	Default	0
F5-02	Control board relay function selection (T/A-T/B-T/C)	Default	2
F5-03	Expansion card relay (P/A-P/B-P/C) function selection	Default	0
F5-04	DO1 function (open collector output terminal)	Default	1
F5-05	Function of DO2 on the expansion card	Default	4

These five parameters are used to select the functions of the five DOs, among which T/A-T/B-T/C and P/A-P/B-P/C are the relays on the control board and the expansion card respectively.

The functions of the multi-functional output terminals are described in the following table.

Setpoint	Function	Description
0	No output	The output terminal has no function.
1	Drive operating	The AC drive is operating and generates output frequency (can be zero). In this case, the "ON" signal is outputted.
2	Fault output (stop)	When the AC drive stops due to a fault, the "ON" signal is outputted.
3	Frequency-level detection FDT1 output	See the descriptions of F8-19 and F8-20.
4	Frequency reached	See the description of F8-21.
5	Operating at zero speed (no output at stop)	If the AC drive runs with the output frequency of 0, the "ON" signal is outputted. If the AC drive is in the stop state, the "OFF" signal is outputted.

Setpoint	Function	Description
6	Motor overload pre-alarm	The drive judges whether the motor load exceeds the overload pre-alarm threshold before performing the protection action. If the pre-alarm threshold is exceeded, the "ON" signal is outputted. For motor overload parameters, see the descriptions of F9-00 to F9-02.
7	Drive overload pre-alarm	The "ON" signal is outputted 10s before the AC drive performs overload protection.
8	Counting value reached	The "ON" signal is outputted when the counting value reaches the value set in FB-08.
9	Designated counting value reached	The "ON" signal is outputted when the counting value reaches the value set in FB-09. For the counting function, see "Group FB: Wobble frequency, fixed length and counting".
10	Length reached	The "ON" signal is outputted when the detected actual length exceeds the value set in FB-05.
11	PLC cycle completed	When the simple PLC completes one cycle, the terminal outputs a pulse signal with a width of 250 ms. When the simple PLC completes one cycle, the terminal outputs a pulse signal with a width of 250 ms.
12	Accumulative operating time reached	If the accumulative operating time of the drive exceeds the time set in F8-17, the "ON" signal is outputted.
13	Frequency limit reached	If the set frequency exceeds the frequency upper limit or lower limit and the output frequency of the drive reaches the upper limit or lower limit, the "ON" signal is outputted.
14	Torque limited	When the drive is in speed control, when the output torque reaches the torque limit and the drive is in the stall protection state, the "ON" signal is outputted.
15	Ready to run	If the main circuit and control circuit of the drive are stabilized, no fault is detected, and the drive is in the operational state, the "ON" signal is outputted.
16	AI1 > AI2	When AI1 value is higher than AI2 value, the "ON" signal is outputted.
17	Frequency upper limit reached	If the operating frequency reaches the upper limit, the "ON" signal is outputted.
18	Frequency lower limit reached (no output at stop)	If the operating frequency reaches the lower limit, the "ON" signal is outputted. In the stop state, the "OFF" signal is outputted.
19	Undervoltage state output	If the drive is in undervoltage state, the "ON" signal is outputted.
20	Communication	See the communication protocol.
21 to 22	Reserved	Reserved

Setpoint	Function	Description
23	Operating at zero speed 2 (output available at stop)	If the output frequency of the AC drive is 0, the "ON" signal is outputted. In the stop state, the "ON" signal is also outputted.
24	Accumulative power-on time reached	If the AC drive accumulative power-on time (F7-13) exceeds the value set in F8-16, the "ON" signal is outputted.
25	Frequency-level detection FDT2 output	See the descriptions of F8-28 and F8-29.
26	Frequency 1 reached	See the descriptions of F8-30 and F8-31.
27	Frequency 2 reached	See the descriptions of F8-32 and F8-33.
28	Current 1 reached	See the descriptions of F8-38 and F8-39.
29	Current 2 reached	See the descriptions of F8-40 and F8-41.
30	Timing reached	If the timing function (F8-42) is enabled, the terminal outputs the "ON" signal after the current operating time of the AC drive reaches the set time.
31	AI1 input limit exceeded	When the AI1 value is higher than F8-46 or lower than F8-45, the "ON" signal is outputted.
32	Load loss	When the drive is in the load loss state, the "ON" signal is outputted.
33	Reverse run	If the AC drive is in the reverse run state, the "ON" signal is outputted.
34	Zero current state	See the descriptions of F8-34 and F8-35.
35	Drive temperature reached	If the heatsink temperature of the inverter module (F7-07) reaches the module temperature threshold set in F8-47, the "ON" signal is outputted.
36	Software current limit exceeded	See the descriptions of F8-36 and F8-37.
37	Frequency lower limit reached (Output generated even at stop)	If the operating frequency reaches the lower limit, the "ON" signal is outputted. In the stop state, the "ON" signal is also outputted.
38	Alarm output	When a fault occurs on the AC drive and the AC drive continues to run, the terminal outputs the alarm signal.
39	Reserved	Reserved
40	Current operating time reached	If the current operating time of the AC drive exceeds the time set in F8-53, the "ON" signal is outputted.
41	Fault output (no output at undervoltage)	When a fault, except the undervoltage fault, occurs on the AC drive, the "ON" signal is outputted.

F5-06	FMP output function selection (pulse output terminal)	Default	0
F5-07	AO1 output function selection	Default	0
F5-08	AO2 output function selection	Default	1

The output pulse frequency of the FMP terminal ranges from 0.01 kHz to F5-09 (Maximum FMP output frequency). The value of F5-09 is between 0.01 kHz and 50.00 kHz.

The output range of AO1 and AO2 is 0 V to 10 V or 0 mA to 20 mA.

The relationship between pulse and analog output range and corresponding functions is listed in the following table.

Setpoint	Function	Range (Corresponding to pulse or analog output range 0.0%–100.0%)
0	Operating frequency	0 to maximum output frequency
1	Frequency reference	0 to maximum output frequency
2	Output current	0 to 2 times the rated motor current
3	Output torque (absolute value)	0 to 2 times the rated motor torque
4	Output power	0 to 2 times the rated motor power
5	Output voltage	0 to 1.2 x rated voltage of the drive
6	Pulse input (100% corresponds to 20.00 kHz.)	0.01 kHz to 20.00 kHz
7	AI1	0 V to 10 V
8	AI2	0 V to 10 V or 0 mA to 20 mA
9	AI3	-10 V to +10 V
10	Length	0 to maximum set length
11	Counting value	0 to maximum counting value
12	Communication	0.0% to 100.0%
13	Motor speed	0 to rotational speed corresponding to maximum output frequency
14	Output current (100% corresponds to 100.00 A)	0.00 A to 100.00 A
15	Bus voltage (100% corresponds to 1000.0 V.)	0.0 V to 1000.0 V
16	Output torque (actual value)	-2 x rated motor torque to +2 x rated motor torque

F5-09	Maximum frequency of FMP output	Default	50.00 kHz
	Setting range	0.01 kHz to 50.00 kHz	

If the FM terminal is used for pulse output, this parameter is used to set the maximum frequency of

pulse output.

F5-10	AO1 zero offset coefficient	Default	0.0%
	Setting range	-100.0% to +100.0%	
F5-11	AO1 gain	Default	1.00
	Setting range	-10.00 to +10.00	
F5-12	AO2 zero offset coefficient of expansion card	Default	0.00%
	Setting range	-100.0% to +100.0%	
F5-13	AO2 gain of expansion card	Default	1.00
	Setting range	-10.00 to +10.00	

These parameters are used to correct the zero drift of analog output and the output amplitude deviation. They can also be used to define the required AO curve.

If "b" represents zero offset, "k" represents gain, "Y" represents actual output, and "X" represents standard output, the actual output is as follows.

$$Y = kX + b$$

The zero offset coefficient 100% of AO1 and AO2 corresponds to 10 V (or 20 mA). The standard output refers to the value corresponding to the analog output of 0 V to 10 V (or 0 mA to 20 mA) with no zero offset or gain correction.

Example: If the analog output is the operating frequency, and it is expected that the output is 8 V when the frequency is 0 and 3 V at the maximum frequency, the gain shall be set to -0.50, and the zero offset shall be set to 80%.

F5-17	FMR output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	
F5-18	RELAY1 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	
F5-19	RELAY2 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	
F5-20	DO1 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	
F5-21	DO2 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	

These parameters are used to set the delay time of output terminals FMR, relay 1, relay 2, DO1 and DO2 from status change to actual output.

F5-22	DO valid status selection		Default	00000
	Setting range	Ones	Active state of FMR	
		0	Positive logic	
		1	Negative logic	
		Tens	RELAY1 active status setting (0 to 1, same as above)	
		Hundreds	RELAY2 active status setting (0 to 1, same as above)	
		Thousands	DO1 active status setting (0 to 1, same as above)	
		Ten thousands	DO2 active status setting (0 to 1, same as above)	

This parameter is used to set the logic of output terminals FMR, relay 1, relay 2, DO1 and DO2.

0: Positive logic
The digital output terminal is active when being connected to the corresponding common terminal, and inactive when being disconnected from it.

1: Negative logic
The digital output terminal is inactive when being connected to the corresponding common terminal, and active when being disconnected from it.

Group F6 Start/Stop control parameters

F6-00	Start mode		Default	0
	Setting range	0	Direct start	
		1	Flying start	
		2	Pre-excitation start (AC asynchronous motor)	

0: Direct start

1: Flying start

In flying start, the drive detects the speed and direction of the motor first, and then starts to run at the tracked motor frequency. It is applicable to restart upon instantaneous power failure of large-inertia load. In this start mode, ensure that the motor parameters in group F1 are set correctly.

2: Pre-excitation start of asynchronous motor

This mode is active only for asynchronous motors and used to build magnetic field before the motor starts.

For pre-excitation current and pre-excitation time, see the descriptions of F6-05 and F6-06.

F6-01	Speed tracking mode		Default	0
	Setting range	0	Starting from the stop frequency	
		1	Starting from mains frequency	
		2	Starting from the maximum frequency	
		4	Magnetic field directional speed tracking (set F1-37 to 1 for static auto-tuning)	

To complete the speed tracking process in the shortest time, select the motor speed tracking mode of the drive.

0: Track down from the frequency at power failure, which is usually used.

1: Starting from the mains frequency
This mode is applicable to scenarios where the motor is restarted after stop for a long time. Note that if you select 1 when the AC drive is switched from the mains frequency to the variable frequency, and the actual operating frequency of the drive before switching is higher than the set frequency after switching, the drive will be in the generating state, leading to stop due to overvoltage.

2: Tracking down from the maximum frequency, used by general generating loads generally

F6-02	Speed of speed tracking	Default	20
	Setting range	1 to 100	

It is used to select the speed tracking speed during flying start. But an excessively high setpoint may lead to unstable tracking.

F6-05	DC braking current/Pre-excitation current at start	Default	50%
	Setting range	0% to 100%	
F6-06	DC braking time/Pre-excitation time at start	Default	0.0s
	Setting range	0.0s to 100.0s	

DC braking at start is generally used during restart of the AC drive after the motor stops. Pre-excitation is used to make the AC drive build magnetic field for the asynchronous motor before startup to improve the responsiveness.

This parameter is active only when direct start is used. In this case, the AC drive performs DC braking at the set braking current first, and starts run after the DC braking time elapses. If the set DC braking time is 0, direct start without DC braking applies. The larger the DC braking current, the higher the braking force is.

If the starting mode is pre-excitation start (F6-00 = 3), the drive establishes the magnetic field based on the set pre-excitation current first, and starts to run after the set pre-excitation time elapses. If the pre-excited time is 0, the AC drive starts directly without pre-excitation.

The DC braking current or pre-excitation current at start is a percentage to the rated current of the motor.

F6-07	Acceleration/ Deceleration mode		Default	0
	Setting range	0	Linear acceleration/deceleration	
		1	Static S-curve acceleration/deceleration	
		2	Dynamic S-curve acceleration/deceleration	

This parameter defines the frequency change mode during start and stop of the drive.

0: Linear acceleration/deceleration

The output frequency increases or decreases linearly. The MD310 provides four group of acceleration/deceleration time, which can be selected in F4-00 to F4-08.

1: Static S-curve acceleration/deceleration

The output frequency increases or decreases based on the S curve on the condition that target frequency is fixed. This mode is suitable for applications requiring smooth start or stop, such as elevators and conveyors.

2: Dynamic S-curve acceleration/deceleration

When the target frequency changes dynamically in real time, the output frequency increases or decreases based on the S-curve. This mode is applicable to applications requiring smooth operation and quick response in real time.

Note: The dynamic S-curve time and target frequency cannot be too large. The acceleration/ deceleration time is greater than 100s or the target frequency is greater than 6 x rated motor frequency. The dynamic S-curve is inactive at the start. The dynamic S-curve is automatically switched to the linear acceleration/deceleration mode.

F6-08	Time proportion of S-curve at start	Default	30.0%
	Setting range	0.0% to (100.0% - F6-09)	
F6-09	Time proportion of S-curve at end	Default	30.0%
	Setting range	0.0% to (100.0% - F6-08)	

F6-08 and F6-09 respectively define the time proportions at the start and end. They must satisfy the following requirement: F6-08 + F6-09 ⩽ 100.0%

In the following figure, t1 is defined by F6-08, within which the change rate of the output frequency increases gradually. t2 is the time defined in F6-09, within which the output frequency variation slope gradually decreases to 0. For the time between t1 and t2, the variation slope of output frequency is fixed. That is, the output frequency increases or decreases linearly.

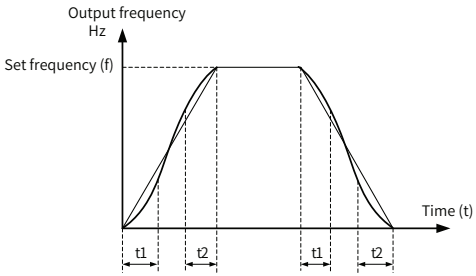


Figure 6-17 Static S-curve acceleration/deceleration

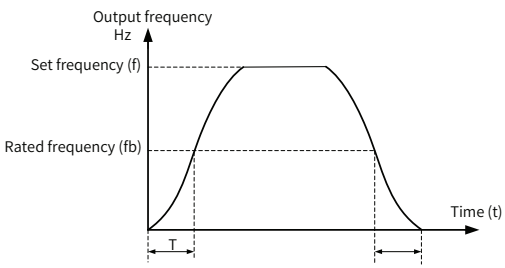


Figure 6-18 Dynamic S-curve acceleration/deceleration

F6-10	Stop mode		Default	0
	Setting range	0	Decelerate to stop	
		1	Coast to stop	

0: Decelerate to stop

After the stop command becomes active, the AC drive decreases the output frequency based on the deceleration time, and stops when the frequency is reduced to 0.

1: Coast to stop

After the stop command becomes active, the drive stops output immediately and the motor coasts to stop based on the mechanical inertia.

F6-11	Starting frequency for DC braking at stop	Default	0.00 Hz
	Setting range	0.00 Hz to 10.00 Hz	
F6-12	Waiting time of DC braking at stop	Default	0.0s
	Setting range	0.0s to 100.0s	

F6-13	DC braking current at stop	Default	50%
	Setting range	0% to 100%	
F6-14	DC braking time at stop	Default	0.0s
	Setting range	0.0s to 100.0s	

Starting frequency of DC braking at stop: During the process of decelerate-to-stop, the drive starts DC braking when the operating frequency is lower than the value of this parameter.

Waiting time of DC braking at stop: The drive stops outputs and wait until the waiting time elapses before starting DC braking output again. The drive starts DC braking output directly without waiting.

DC braking current at stop:This parameter specifies the output current at DC braking and is a percentage to the rated motor current. The larger the value, the better the DC injection braking effect, but the stronger the motor and AC drive will be overheated.

DC braking time at stop: This parameter specifies the hold time of DC braking. If it is set to 0, DC braking is disabled.

The process of DC braking at stop is shown below.

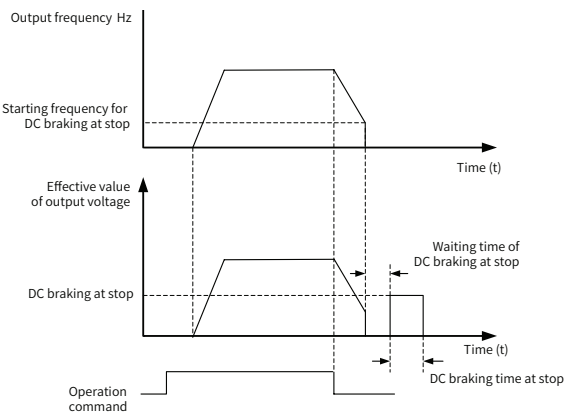


Figure 6-19 DC braking at stop

F6-18	Current of speed tracking	Default	Model dependent
	Setting range	30% to 200%	

This parameter can limit the speed tracking current. The maximum current during speed tracking is limited to the value of "Speed tracking current". Note that an excessively low setpoint can affect the speed tracking performance.

Note:

(1) If the motor is light-load or has low inertia during speed tracking, the motor speed may be increased to a speed higher than that before stop and then decelerate to the target frequency during tracking. Solution: Reduce the speed tracking current in F6-18 properly to reduce the output torque during speed tracking.

(2) In some back-to-back applications, speed tracking cannot be applied, as the motor may be suddenly accelerated or decelerated by another motor during speed tracking.

F6-21	Demagnetization time	Default	Model dependent
	Setting range	0.0s to 5.0s	

When the motor coasts to stop or stops at fault, the rotor winding of the motor remains magnetic within a short period of time and attenuates based on the constant time of the motor rotor time. If the motor starts immediately after stop, overcurrent may occur. This parameter automatically updates the default value based on the motor power.

The demagnetization time is the minimum interval between stop and start. This parameter takes effect only after the speed tracking function is enabled. An excessively low setpoint may easily lead to overvoltage.

F6-22	Min. output frequency	Default	0.00 Hz
	Setting range	0.00 Hz to F6-11 (Starting frequency for DC braking at stop)	

During start, the operating frequency accelerates from the lowest output frequency. During stop, the operating frequency decreases to 0 after reaching the lowest output frequency.

When the frequency source is PID, the minimum output frequency is inactive. The forward/reverse rotation process is not affected by the minimum output frequency.

Group F7: Operating Panel and Display

F7-01	MF.K key function		Default	5
	Setting range	0	MF.K key disabled	
		1	Switchover between operating panel control and remote control (terminal I/O control or communication control)	
		2	Switchover between forward run and reverse run	
		3	Forward jog	
		4	Reverse jog	
		5	Parameter display mode switchover	

MF.K key refers to multi-function key. You can set the function of the MF.K key by using this parameter. You can switch between operation and stop through this key.

0: MF.K key disabled

1: Switchover between operating panel control and remote control

You can perform switchover from the current command source to the operation panel control (local operation). If the current command source is operation panel control, this key is invalid.

2: Switchover between forward run and reverse run

You can change the direction of the frequency reference through the MF.K key. It is active only when the command source is operating panel control.

3: Forward jog

You can perform forward JOG (FJOG) by using the MF.K key.

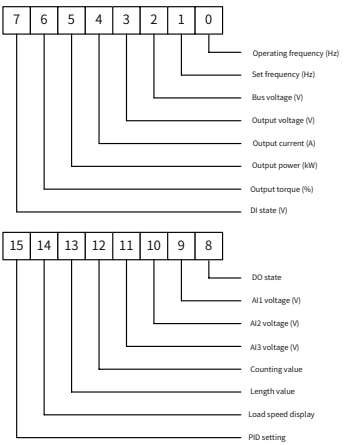
4: Reverse jog

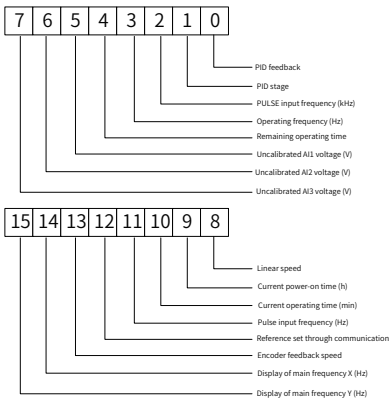
You can perform reverse JOG (RJOG) by using the MF.K key.

5: Parameter display mode switchover

This function is used together with FP-03.

F7-02	STOP/RES key function		Default	1
	Setting range	0	The STOP/RES key is valid only in the operating panel control mode.	
		1	The STOP/RES key is valid in any operation mode.	

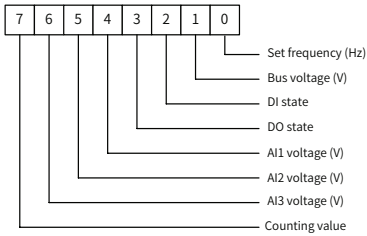
F7-03	Parameter 1 displayed on LED operating panel during operation	Default	1F
	Setting range	0x0 to 0xFFFF	 If a parameter needs to be displayed during operation, set its corresponding bitto 1. After converting the binary number to a hexadecimal equivalent, set F7-03 to this hexadecimal equivalent. For example, if the parameters to be displayed are: operating frequency, bus voltage, output voltage, output current, output power, and output torque, then bit00, bit02 to bit06 are 1, and other bits are 0. The corresponding binary is 0000 0000 0111 1101. The hexadecimal equivalent is 0x7D. In this case, set F7-03 to 0x7D.

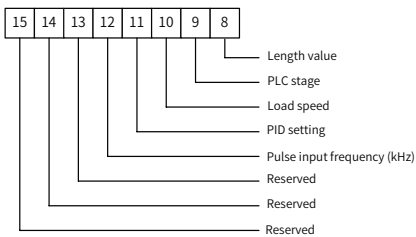
F7-04	Parameter 2 displayed on LED operating panel during operation		Default	0
	Setting range	0x0 to 0xFFFF	 If a parameter needs to be displayed during operation, set its corresponding bitto 1. After converting the binary number to a hexadecimal equivalent, set F7-04 to this hexadecimal equivalent. For example, if the parameters to be displayed are PID feedback, PLC stage, remaining operating time, then bit00, bit01, and bit04 are 1, and other bits are 0. The corresponding binary is 0000 0000 0001 0011. The hexadecimal equivalent is 0x13. In this case, set F7-04 to 0x13.		

These two parameters are used to set the parameters that can be viewed when the AC drive is in the operating state.

You can view a maximum of 32 operating state parameters that are displayed from the lowest bitof F7-03.

F7-05	Parameter displayed on the LED operating panel at stop		Default	0
	Setting range	0x0 to 0xFFFF		





If a parameter needs to be displayed when the AC drive stops, set its corresponding bitto 1. After converting the binary number to a hexadecimal equivalent, set F7-05 to the hexadecimal equivalent.
For example, if the parameters to be displayed are frequency reference, bus voltage, AI1 voltage, and pulse input frequency, then bit00, bit01, bit04, and bit12 is 1 and other bits are 0. The binary value is 0001 0000 0001 0011. The hexadecimal equivalent is 0x1013. In this case, set F7-04 to 0x1013.

F7-06	Load speed display coefficient	Default	1.0000
	Setting range	0.0001 to 6.5000	

This parameter is used to adjust the relationship between the output frequency of the AC drive and the load speed. For details, see the description of F7-12.

F7-07	Drive heatsink temperature	Default	0°C
	Setting range	0° C to 999° C	

Displays temperature of the IGBT module.

The IGBT overtemperature protection threshold of the IGBT varies with the model.

F7-09	Accumulative operating time	Default	0 h
	Setting range	0 h and 65535 h	

It is used to display the accumulative operating time of the AC drive. When the operating time reaches the value of F8-17, the terminal assigned with DO function 12 outputs the "ON" signal.

F7-10	Performance software version	Default	-
	Setting range	-	
F7-11	Function software version	Default	-
	Setting range	-	
F7-12	Decimal places of monitored speed	Default	21
	Setting range	Ones: Number of decimal places of U0-14 0: 0 decimal places 1: 1 decimal place 2: 2 decimal places 3: 3 decimal places Tens: Number of decimal places of U0-19/U0-29 1: 1 decimal place 2: 2 decimal places	

Ones:

F7-12 is used to set the number of decimal places for load speed display. The following gives an example to explain how to calculate the load speed:

Assume that F7-06 (Load speed display coefficient) is 2.000 and F7-12 is 2 (2 decimal places), then the load speed is U0-24 x 2.000 (two decimal places reserved).

When the drive is in the stop state, the load speed in the stop state is 60 x 50.00/2 x 2.000 = 3000.0 (one decimal place) under the following conditions:
Frequency reference = 50.00 Hz
Number of motor pole pairs = 2
F7-06 = 2.000
F7-12 = 1 (one decimal place)

The display range of monitored speed is 1:65000. Take the resolution and range into account during use. Adjust the number of decimal places as needed.

Tens:

1: U0-19/U0-29 are displayed with one decimal place.

2: U0-19/U0-29 are displayed with two decimal places.

F7-13	Accumulative power-on time	Default	-
	Setting range	0 h and 65535 h	

These parameters display the accumulative power-on time of the drive since the delivery.

If the time reaches the set power-on time (F8-17), the terminal assigned with DO function 24 outputs the "ON" signal.

F7-14	Accumulative power consumption	Default	-
	Setting range	0 kWh to 65535 kWh	

The accumulative power consumption of the AC drive until now is displayed.

Group F8: Auxiliary Functions

F8-00	Jog frequency	Default	2.00 Hz
	Setting range	0.00 Hz to maximum frequency	
F8-01	Acceleration time of jog	Default	20.0s
	Setting range	0.0s to 6500.0s	
F8-02	Deceleration time of jog	Default	20.0s
	Setting range	0.0s to 6500.0s	

These parameters are used to define the set frequency and acceleration/deceleration time of the AC drive when jogging.

If jog is adopted, F6-00 must be set to 0 (Direct start) and F6-10 must be set to 0 (Decelerate to stop).

F8-03	Acceleration time 2	Default	Model dependent
	Setting range	0.0s to 6500.0s	
F8-04	Deceleration time 2	Default	Model dependent
	Setting range	0.0s to 6500.0s	
F8-05	Acceleration time 3	Default	Model dependent
	Setting range	0.0s to 6500.0s	
F8-06	Deceleration time 3	Default	Model dependent
	Setting range	0.0s to 6500.0s	
F8-07	Acceleration time 4	Default	Model dependent
	Setting range	0.0s to 6500.0s	
F8-08	Deceleration time 4	Default	Model dependent
	Setting range	0.0s to 6500.0s	

The MD310 provides four groups of acceleration/deceleration time, that is, the preceding three groups of acceleration/Deceleration time and the group defined by F0-17/F0-18.

Definitions of four groups of acceleration/deceleration time are completely the same. For details, see the descriptions of F0-17 and F0-18.

You can switch between the four groups of acceleration/deceleration time through different state combinations of DI terminals. For more details, see the descriptions of F4-01 to F4-05.

F8-09	Jump frequency 1	Default	0.00 Hz
	Setting range	0.00 Hz to maximum frequency	

F8-10	Jump frequency 2	Default	0.00 Hz
	Setting range	0.00 Hz to maximum frequency	
F8-11	Jump frequency amplitude	Default	0.00 Hz
	Setting range	0.00 Hz to maximum frequency	

If the set frequency is within the frequency jump range, the actual operating frequency is the frequency close to the jump frequency. The drive can avoid the mechanical resonance point of the load through the jump frequency.

The MD310 supports two jump frequencies. If the jump frequency amplitude is set to 0, the frequency jump function is disabled.

The following figure shows the principle of the jump frequency and jump amplitude. For details, see Figure 6-20.

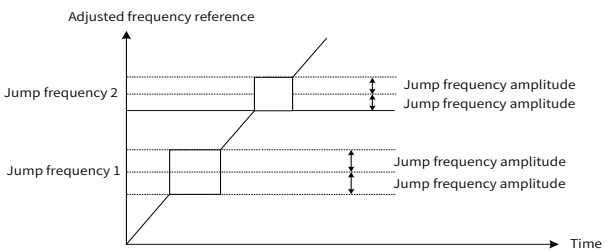


Figure 6-20 Jump frequency

F8-12	Dead zone time of forward/ reverse run	Default	0.0s
	Setting range	0.00s to 3000.0s	

Defines the transition time at 0 Hz output during switchover between forward run and reverse run, as shown below.

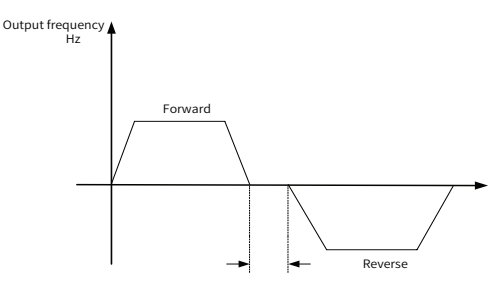


Figure 6-21 Forward/Reverse run dead-zone time

F8-13	Reverse frequency inhibited		Default	0
	Setting range	0	Inactive	
		1	Active	

When the frequency defined by communication or analog reference is a negative value, the motor operating direction changes. The frequency in this case is called "reverse frequency".

You can set whether to allow the motor to operate in reverse state through this parameter. When reverse operation of the motor is not allowed, set F8-13 to 1. When reverse operation of the motor is allowed, set F8-13 to 0.

F8-14	Operation mode when set frequency < frequency lower limit		Default	0
	Setting range	0	Operating at frequency lower limit	
		1	Stop	
		2	Operating at zero speed	

When the set frequency is lower than the frequency lower limit, the operating state of the drive can be selected through this parameter. The MD310 provides three operation modes to satisfy requirements of various applications.

F8-15	Droop control	Default	0.00 Hz
	Setting range	0.00 Hz to 10.00 Hz	

This function is used for balancing the workload allocation when multiple motors are used to drive the same load.

The output frequency of the drive decreases when the load increases. In t his case, when multiple motors are used to drive the same load, the motor output frequency in the load decreases, which reduces the load on the motor and balancing the loads on multiple motors.

This parameter indicates the frequency drop value of the drive when it outputs the rated load.

F8-16	Accumulative power-on time threshold	Default	0 h
	Setting range	0 h and 65000 h	

If the accumulative power-on time (F7-13) reaches the value (not 0) set in this parameter, the corresponding DO outputs the "ON" signal. The following shows the related application.

Example: Together with the virtual DI/DO function, to implement the function that the AC drive reports an alarm when the actual accumulative power-on time reaches the threshold of 100 hours, perform the following setting:

Scheme:

Set VDI1 to user-defined fault 1: A1-00 = 44.

Set the validity state of VDI1. The setting source is VDO1 A1-05 = 0000.

Assign VDO1 with the function of power-on time reached: A1-11= 24.

Set the accumulative power-on time threshold to 100 h: F8-16 = 100.

Then, the drive reports Err29 when the accumulative power-on time reaches 100 hours.

F8-17	Accumulative operating time threshold	Default	0 h
	Setting range	0 h and 65000 h	

It is used to set the operating time of the AC drive.

If the accumulative operating time (F7-09) reaches the value set in this parameter, the multi-functional DO terminal outputs the "ON" signal.

F8-18	Startup protection		Default	0
	Setting range	0	Disabled	
		1	Enable	

This parameter is used to set whether to enable the safety protection function.

If this parameter is set to 1, the drive does not respond to the operation command that activated the moment upon power-on. In this case, cancel the operation command and activate the operation command again.

In addition, the AC drive does not respond to the operation command activated upon fault reset of the drive. The operation protection can be disabled only after the operation command is canceled.

In this way, the risk caused by motor responding to operation commands upon power-on or fault reset can be prevented.

F8-19	Frequency detection value (FDT1)	Default	50.00 Hz
	Setting range	0.00 Hz to maximum frequency	
F8-20	Frequency detection hysteresis (FDT1)	Default	5.0%
	Setting range	0.0% to 100.0% (FDT1 level)	

If the operating frequency is higher than the frequency detection value, the multi-functional DO outputs the "ON" signal. If the operating frequency is lower than the detection value, the "ON" signal outputted by the DO is canceled.

These two parameters are respectively used to set the detection value of output frequency and hysteresis value upon cancellation of the output. The value of F8-20 is a percentage to F8-19. The following figure describes the FDT function.

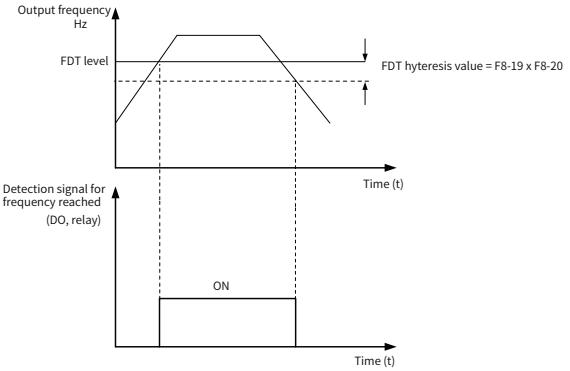


Figure 6-22 FDT level

F8-21	Frequency detection width	Default	0.0%
	Setting range	0.00% to 100% (maximum frequency)	

If the drive operating frequency is within the certain range of the target frequency, the multi-functional DO outputs the "ON" signal.

This parameter is used to set the range within which the output frequency is detected to reach the set frequency. The value of this parameter is a percentage to the maximum frequency. The following shows the diagram for frequency reach.

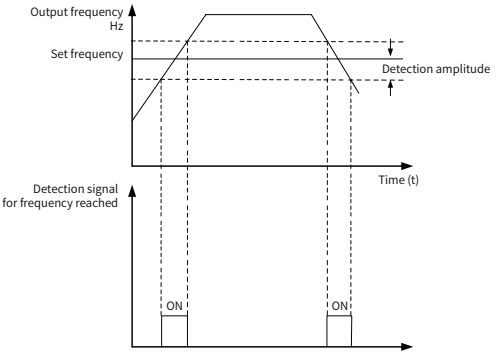


Figure 6-23 Frequency detection amplitude

F8-22	Jump frequency state during acceleration/deceleration	Default	1
	Setting range	0: Inactive 1: Active	

This parameter is used to set whether the jump frequency is active during acceleration/deceleration. When the jump frequency is active and the operating frequency is within the jump frequency range, the actual operating frequency jumps over the set jump frequency threshold. The following figure shows the diagram when the jump frequency is active during acceleration/deceleration.

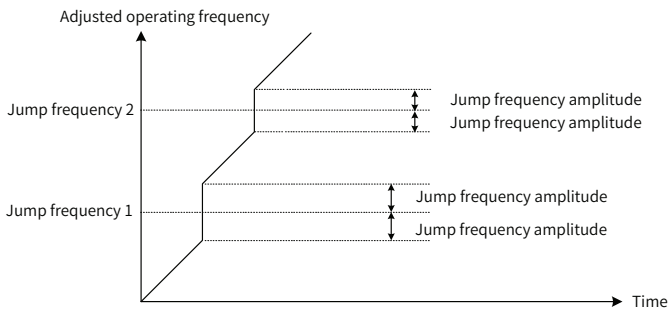


Figure 6-24 Diagram when the jump frequency is active during acceleration/deceleration

F8-25	Frequency threshold for switching between acceleration time 1 and acceleration time 2	Default	0.00 Hz
	Setting range	0.00 Hz to maximum frequency	
F8-26	Frequency threshold for switching between deceleration time 1 and deceleration time 2	Default	0.00 Hz
	Setting range	0.00 Hz to maximum frequency	

This function is active when acceleration/deceleration time switchover is not performed through the DI. It is used to select different groups of acceleration/deceleration time based on the operating frequency during operating of the AC drive.

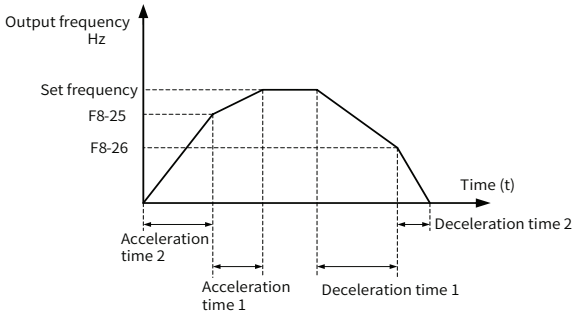


Figure 6-25 Acceleration/Deceleration time switchover

The preceding figure show the acceleration/deceleration time switchover. During acceleration, if the operating frequency is lower than the value of F8-25, acceleration time 2 is selected. If the operating frequency is higher than the value of F8-25, acceleration time 1 is selected.

During deceleration, if the operating frequency is higher than the value of F8-26, deceleration time 1 is selected. If the operating frequency is lower than the value of F8-26, deceleration time 2 is selected.

F8-27	Terminal-triggered jog preferred	Default	0
	Setting range	0: Inactive 1: Active	

This parameter is used to set whether terminal-triggered jog is preferred.

If terminal-triggered jog is preferred, the drive switches to the corresponding state if terminal jog command occurs during operation.

F8-28	Frequency detection value (FDT2)	Default	50.00 Hz
	Setting range	0.00 Hz to maximum frequency	
F8-29	Frequency detection hysteresis (FDT2)	Default	5.0%
	Setting range	0.0% to 100.0% (FDT2 level)	

This frequency detection function is the same as FDT1. For details, see the descriptions of F8-19 and F8-20.

F8-30	Frequency detection value 1	Default	50.00 Hz
	Setting range	0.00 Hz to maximum frequency	
F8-31	Frequency detection amplitude 1	Default	0.0%
	Setting range	0.0% to 100.0% (maximum frequency)	
F8-32	Frequency detection value 2	Default	50.00 Hz
	Setting range	0.00 Hz to maximum frequency	

F8-33	Frequency detection amplitude 2	Default	0.0%
	Setting range	0.0% to 100.0% (maximum frequency)	

If the output frequency of the drive is within the positive and negative amplitudes of the frequency detection value, the multi-functional outputs the "ON" signal.

The MD310 provides two groups of frequency detection parameters, including frequency detection value and detection range, as shown in the following figure.

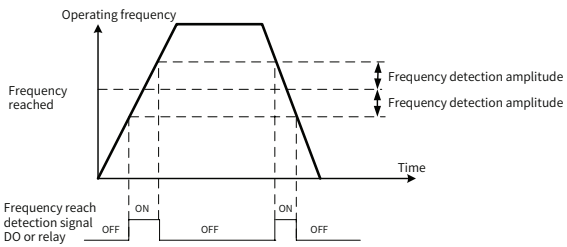


Figure 6-26 Frequency detection diagram

F8-34	Zero current detection level	Default	5.0%
	Setting range	0.0% to 300.0% (rated motor current)	
F8-35	Zero current detection delay	Default	0.10s
	Setting range	0.01s to 600.00s	

If the output current of the drive is equal to or lower than the value of F8-34 and the duration exceeds the time set in F8-35, the multi-functional DO output the "ON" signal. The following figure shows the zero current detection.

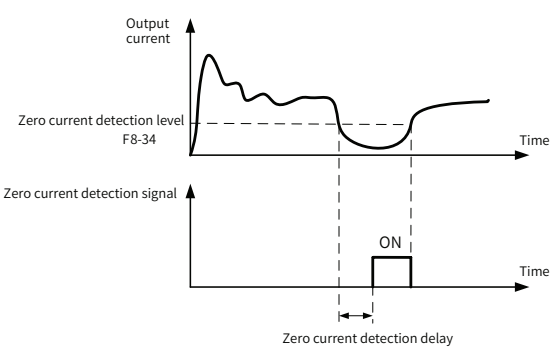


Figure 6-27 Zero current detection

F8-36	Output overcurrent limit	Default	200.0%
	Setting range	0.0% (no detection) 0.1% to 300.0% (rated motor current)	
F8-37	Output current limit violation detection delay	Default	0.00s
	Setting range	0.00s to 600.00s	

If the output current of the drive is equal to or higher than the overcurrent threshold set in F8-36 and the duration exceeds the detection delay set in F8-37, the multi-functional DO outputs the "ON" signal. The following figure shows the output overcurrent detection function.

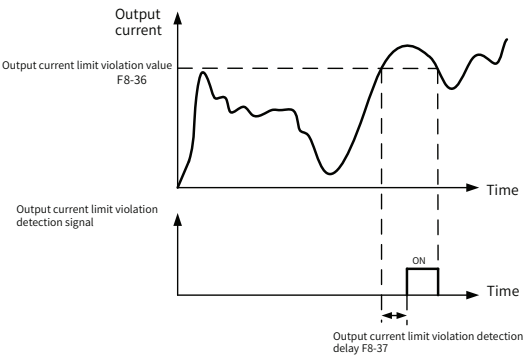


Figure 6-28 Output overcurrent detection

F8-38	Current detection value 1	Default	100.0%
	Setting range	0.0% to 300.0% (rated motor current)	
F8-39	Current detection width 1	Default	0.0%
	Setting range	0.0% to 300.0% (rated motor current)	
F8-40	Current detection value 2	Default	100.0%
	Setting range	0.0% to 300.0% (rated motor current)	
F8-41	Current detection width 2	Default	0.0%
	Setting range	0.0% to 300.0% (rated motor current)	

If the output current of the drive is within the positive and negative current detection width, the multi-functional DO outputs the "ON" signal.

The MD310 provides two groups of detection current threshold and detection current amplitude parameters, as shown in the following figure.

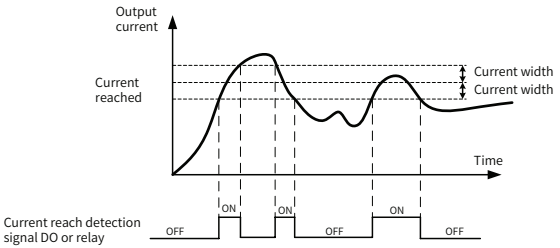


Figure 6-29 Current detection diagram

F8-42	Timing function		Default	0
	Setting range	0	Inactive	
		1	Active	
F8-43	Timed operation time source		Default	0
	Setting range	0	F8-44	
		1	AI1	
		2	AI2	
		3	AI3	
		100% of the analog input range corresponds to the value of F8-44.		
F8-44	Timed operation duration		Default	0.0 min
	Setting range	0.0 min to 6500.0 min		

These parameters are used to implement the AC drive timing function.

If the timing function is enabled, the drive starts timing upon start. When the set duration is reached, the drive stops automatically, with the multi-functional DO outputs the "ON" signal.

The drive starts timing from 0 each time it starts and the remaining duration can be viewed in U0-20.

The timing duration is set in F8-43 and F8-44, in unit of minute.

F8-45	Lower limit of AI1 input voltage protection value	Default	3.10 V
	Setting range	0 V to F8-46	
F8-46	Upper limit of AI1 input voltage protection value	Default	6.80 V
	Setting range	F8-45 to 11.00 V	

When the AI1 value is higher than the value of F8-46 or lower than the value of F8-47, the multi-functional DO outputs the "ON" signal, indicating that AI1 input is within the set range.

F8-47	Drive temperature reached	Default	75° C
	Setting range	0° C to 100° C	

When the heatsink temperature of the drive reaches this temperature, the multi-functional DO outputs the "ON" signal, indicating that the IGBT module temperature reaches the threshold.

F8-48	Cooling fan control	Default	0
	Setting range	0: Operating during operation of the drive 1: Always operating	

It is used to set the operation mode of the fan. If this parameter is set to 0, the fan works during operation of the drive. When the drive stops, the cooling fan works if the heatsink temperature is higher than 40°C and stops if the heatsink temperature is lower than 40°C .

If this parameter is set to 1, the cooling fan keeps working after power-on.

F8-49	Wakeup frequency	Default	0.00 Hz
	Setting range	F8-51 (sleep frequency) to F0-10 (maximum frequency)	
F8-50	Wakeup delay	Default	0.0s
	Setting range	0.0s to 6500.0s	
F8-51	Sleep frequency	Default	0.00 Hz
	Setting range	0.00 Hz to wakeup frequency (F8-49)	
F8-52	Sleep delay	Default	0.0s
	Setting range	0.0s to 6500.0s	

This group of parameters are used to implement the sleep and wakeup functions of the drive in the water supply application.

When the drive is operating, if the set frequency is lower than or equal to the sleep frequency set in F8-51, the drive enters the sleep state and automatically stops after the delay set in F8-52 elapses.

When the drive is in the sleep state and the current operation command is active, if the set frequency is higher than or equal to the wakeup frequency set in F8-49, the drives starts operating after the wakeup delay set in F8-50 elapses. Note that if the operation command is active for the first time in the stop state (non-sleep state), the drive starts as long as the set frequency is higher than or equal to F8-51.

Generally, set the wakeup frequency equal to or higher than the sleep frequency. If the wakeup frequency and sleep frequency are set to 0.00 Hz, the sleep and wakeup functions are disabled.

When the sleep function is enabled, if the frequency source is PID, whether PID operation is performed in the sleep state is determined by FA-28. In this case, set FA-28 to 1.

F8-53	Current operating time reach	Default	0.0 min
	Setting range	0.0 min to 6500.0 min	

If the current operating time reaches the value set in this parameter, the multi-functional DO outputs the "DO" signal., indicating that the current operating time is reached.

F8-54	Output power correction coefficient	Default	100.0%
	Setting range	0.0% to 200.0%	

When the output power (U0-05) is not equal to expected value, perform linear correction on the output power through this value.

F8-55	Emergency stop time	Default	0.1s
	Setting range	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	

When the DI assigned with function 47 (Emergency stop) is active, the drive stops as defined by F8-55 (Emergency stop time).

F8-57	Software function regression	Default	34
	Setting range	0 to 65535	
Setpoint	bit0	Inverted sleep/wakeup function	1: OFF 0: ON
	bit1	Speed tracking direction judgment	1: ON 0: OFF
	bit2	Reverse run inhibited in fast speed tracking	1: ON 0: OFF
	bit3	Min. frequency for speed frequency sweeping	1: 2 Hz 0: 5 Hz
	bit4	Reserved	-
	bit5	Frequency display during pre-tracking of speed	1: Operating frequency displayed as 0 0: Frequency displayed in real tim for flying start

F8-58	Searchingfrequencycoefficient in speed tracking	Default	100%
	Setting range	30% to 100%	

The starting frequency of the speed tracking mode is the maximum frequency set by the AC drive x starting frequency coefficient of the speed tracking mode.

Group F9: Fault and Protection

F9-00	Motor overload protection selection		Default	1
	Setting range	0	Inhibited	
		1	Enable	
F9-01	Motor overload protection gain		Default	1.00
	Setting range		0.20 to 10.00	

F9-00 = 0: The motor overload protection function is disabled. The motor may be damaged due to overheating. Therefore, it is suggested that a thermal relay be installed between the AC drive and the motor.

F9-00 = 1: The AC drive determines whether the motor is overloaded according to the inverse time-lag curve of motor overload protection.

The inverse time-lag curve of motor overload protection is: 220% x F9-01 x Rated motor current (if the load remains at this value for 1 min, the drive reports the motor overload fault); or 150% x F9-01 x Rated motor current (if the load remains at this value for 60 min, the drive reports the motor overload fault)

Set F9-01 properly based on the actual motor overload capacity. If the value of F9-01 is set too large, damage to the motor may result because the motor overheats but the AC drive does not alarm.

F9-02	Motor overload pre-alarm coefficient	Default	80%
	Setting range	50% to 100%	

To effectively protect different motors, set this parameter based on motor overload capability. The motor overload protection curve is an inverse time lag curve, as shown in the following figure.

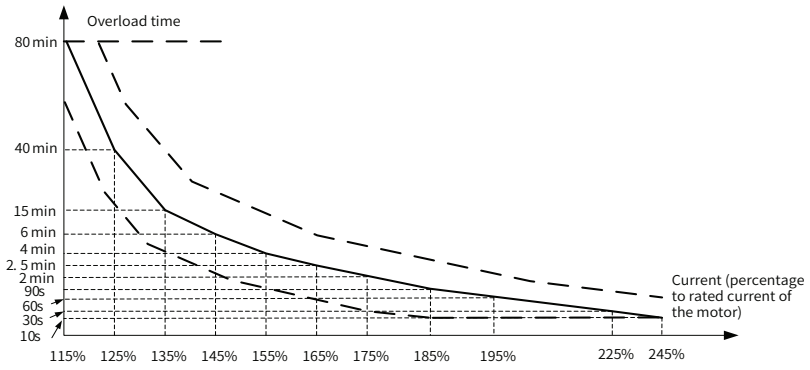


Figure 6-30 Inverse time-lag curve

1) Overload (Err11) is reported when the operating current reaches 175% of the rated motor

current and the motor runs at this current for 2 minutes, or when the operating current reaches 115% of the rated motor current and the motor runs at this current for 80 minutes.

Example: The rated motor current is 100 A.

If F9-01 is set to 1.00, when the motor operating current reaches 125 A (125% of 100 A) and the motor runs at 125 A for 40 minutes, the AC drive reports an overload fault.

If F9-01 is set to 1.20, when the motor operating current reaches 125 A (125% of 100 A) and the motor runs at 125 A for 48 minutes (40 x 1.2), the AC drive reports an overload fault.

The maximum overload time is 80 minutes and the minimum overload time is 10 seconds.

2) The following shows an example for motor overload protection:
Overload is reported after the motor runs for 2 minutes at 150% of rated current. As shown by the overload curve, 150% (I) of rated current is between 145% (I1) and 155% (I2) of rated current. The overload fault is reported after 6 min for 145% of rated current (T1), and that for 155% of rated current is 4 min (T2). Therefore, the overload fault is reported 5 min for 150% of rated current by default, as calculated below:

$$T = T1 + (T2 - T1) \times (I - I1)/(I2 - I1) = 6 + (4 - 6) \times (150\% - 145\%)/(155\% - 145\%) = 5 \text{ (min)}$$

Then, the motor overload protection gain can be calculated based on the following formula:

$$F9\text{-}01 = 2/5 = 0.4$$

Note: Set F9-01 properly based on the actual overload capacity. An excessively high setpoint may result in motor damage when the motor is overheated but the drive does not report the alarm timely.

3) When the motor overload detection level reaches the value of F9-02 (Motor overload pre-warning coefficient), the DO or fault relay outputs the motor overload pre-warning signal. The value of F9-02 (Motor overload pre-warning coefficient) is the percentage of the time duration during which the motor runs continuously without reporting the overload fault.

Example:
When the motor overload protection gain is set to 1.00 and motor overload alarm coefficient is set to 80%, if the motor operating current reaches 145% of the rated motor current and the motor runs at this current for 4.8 min (80% x 6), the DO or fault relay outputs the motor overload alarm signal.

<table>
<tr><td rowspan="3">F9-07</td><td colspan="2">Short circuit-to-ground protection at power-on</td><td>Default</td><td>1</td></tr>
<tr><td rowspan="2">Setting range</td><td>0</td><td colspan="2">Inactive</td></tr>
<tr><td>1</td><td colspan="2">Active</td></tr>
</table>

This function is used by the drive to check whether the motor is short-circuited to ground at power-on.

If this function is enabled, voltage output is generated in the UVW terminals of the drive within a limited duration after power-on.

F9-08	Starting voltage of braking unit action	Default	700.0 V
	Setting range	310.0 V to 810.0 V	

See the following for setting the starting voltage Vbreak of the built-in braking unit:

$$800 \geqslant Vbreak \geqslant (1.414Vs + 30)$$

Vs - AC voltage input of the drive

Note: Improper setting may lead to improper operation of the built-in braking unit.

F9-09	Number of automatic fault resets upon fault	Default	0
	Setting range	0 to 20	

It can be used to set the number of automatic resets when automatic fault reset is enabled. If the number of fault resets exceed the value of this parameter, the AC drive remains in the fault state.

F9-10	DO action during automatic reset upon fault	Default	0
	Setting range	0: Not act 1: Act	

If the automatic fault reset is set in the drive, you can set whether the fault DO acts during automatic fault reset through F9-10.

F9-11	Interval time of automatic fault reset	Default	1.0s
	Setting range	0.1s to 100.0s	

It defines the waiting time between fault occurrence to automatic fault reset.

F9-12	Input phase loss protection	Default	1
	Setting range	0: Disable 1: Enable	

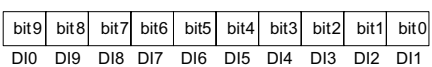
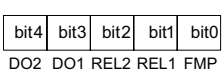
It is used to determine whether to perform power input phase loss protection.

F9-13	Output phase loss protection	Default	1
	Setting range	0: Inactive 1: Active	

It determines whether to enable output phase loss protection. If it is set to 0, the output phase loss is not reported. In this case, the actual current is higher than the current displayed on the operating panel. Use this function with caution.

F9-14	Type of the 1st fault	-
F9-15	Type of the 2nd fault	
F9-16	Type of the 3rd (latest) fault	

These parameters are used to record the latest three faults of the drive. The value 0 indicates that no fault occurs. For possible causes and solutions of each fault code, see "8 Troubleshooting".

F9-17	Frequency upon the 3rd fault	Indicates the frequency upon occurrence of the latest fault.
F9-18	Current upon the 3rd fault	Indicates the current upon occurrence of the latest fault.
F9-19	Bus voltage upon the 3rd fault	Indicates the bus voltage upon occurrence of the latest fault.
F9-20	Input terminal state upon the 3rd fault	Indicates the DI terminal state upon the latest fault in the following sequence.  When the output terminal is ON, its binary bit is 1 (0 when OFF). The state of all DOs is displayed in decimal.
F9-21	Output terminal state upon the 3rd fault	Indicates the state of all the output terminals upon occurrence of the latest fault in the following sequence.  When the output terminal is ON, its binary bit is 1 (0 when OFF). The state of all DOs is displayed in decimal.
F9-22	AC drive state upon the 3rd fault	Reserved
F9-23	Power-on time upon the 3rd fault	Indicates current power-on time upon occurrence of the latest fault.
F9-24	Operating time upon the 3rd fault	Indicates current operating time upon occurrence of the latest fault.

F9-27	Frequency upon the 2nd fault	Same as F9-17 to F9-24
F9-28	Current upon the 2nd fault	
F9-29	Bus voltage upon the 2nd fault	
F9-30	Input terminal state upon the 2nd fault	
F9-31	Output terminal state upon the 2nd fault	
F9-32	AC drive state upon the 2nd fault	
F9-33	Power-on time upon the 2nd fault	
F9-34	Operating time upon the 2nd fault	
F9-37	Frequency upon the 1st fault	Same as F9-17 to F9-24
F9-38	Current upon the 1st fault	
F9-39	Bus voltage upon the 1st fault	
F9-40	Input terminal state upon the 1st fault	
F9-41	Output terminal state upon 1st fault	
F9-42	AC drive state upon the 1st fault	
F9-43	Power-on time upon the 1st fault	
F9-44	Operating time upon the 1st fault	

F9-47	Fault protection action selection 1		Corresponding fault type	Default: 00000	
	Setting range	Ones	Motor overload (Err11)	0	Coast to stop
				1	Stop based on the stop mode
				2	Continue operating
		Tens	Input phase loss (Err12)	Same as that for the ones	
		Hundreds	Output phase loss (Err13)	Same as that for the ones	
		Thousands	External fault (Err15)	Same as that for the ones	
		Ten thousands	Communication error (Err16)	Same as that for the ones	

F9-48	Fault protection action 2		Corresponding fault type	Default: 00000	
	Setting range	Ones	Reserved		
		Tens	Parameter read/write error (Err21)	0	Coast to stop
				1	Stop based on the stop mode
		Hundreds	Reserved		
		Thousands	Reserved		
		Ten thousands	Operating time reached (Err26)	0	Coast to stop
				1	Stop based on the stop mode
				2	Continue operating
F9-49	Fault protection action 3		Corresponding fault type	Default: 00000	
	Setting range	Ones	User-defined fault 1 (Err27)	0	Coast to stop
				1	Stop based on the stop mode
				2	Continue operating
		Tens	User-defined fault 2 (Err28)	Same as that for the ones	
		Hundreds	Power-on time reached (Err29)	Same as that for the ones	
		Thousands	Load loss (Err30)	0	Coast to stop
				1	Stop based on the stop mode
				2	Continue to operate at 7% of rated motor frequency and resume to the set frequency if the load recovers
		Ten thousands	PID feedback loss during operation (Err31)	Same as that for the ones	
F9-50	Fault protection action 4		Corresponding fault type	Default: 000	
	Setting range	Ones	The speed deviation is excessive.	0	Coast to stop
				1	Stop based on the stop mode
				2	Continue operating
		Tens	Reserved		
		Hundreds	Reserved		

If "Coast to stop" is selected, the drive displays Err** and stops directly.

If "Stop as defined by the stop mode" is selected, the drive displays A** and stops based on the stop mode. After stop, th drive displays Err**.

If "Continue operating" is selected, the drive continues to run and displays A**. The operating frequency is set in F9-54.

F9-54	Frequency for continuing operating upon fault		Default	0
	Setting range	0	Operating at current frequency	
		1	Operating at the set frequency	
		2	Operating at frequency upper limit	
		3	Operating at frequency lower limit	
		4	Operating at backup frequency upon fault	
F9-55	Backup frequency upon fault		Default	100.0%
	Setting range		0.0% to 100.0%	

If a fault occurs during the operation of the drive and the fault protection action is set to "Continue operating", the drive displays A** and continues to run at the frequency set in F9-54.

When "Operating at backup frequency" is selected, the setpoint of F9-55 is a percentage to the maximum frequency.

- Power dip ride-through

As shown in the following figure, when the bus voltage drops below the value of F9-62, the power dip ride-through function is activated. In this case, the drive output frequency decreases automatically to keep the motor in the generating state and the bus voltage around the value of F9-62, so that the system can decelerate to 0 Hz normally.

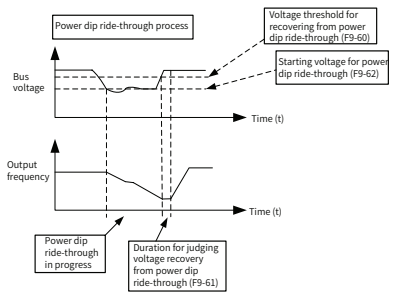


Figure 6-31 Power dip ride-through

Param.	Name	Setting range	Default	Attribute
F9-59	Action selection at instantaneous power failure	0: Inactive 1: Decelerate 2: Decelerate to stop	0	At stop

F9-60	Voltage threshold for recovery from power dip ride-through	80% to 100% (standard bus voltage)	85%	At stop
F9-61	Time threshold for recovering from power dip ride-through	0.0s to 100.0s	0.5s	At stop
F9-62	Threshold for enabling power dip ride-through	60% to F9-60 (Standard bus voltage)	80%	At stop
F9-71	Power dip ride-through gain Kp	0 to 100	40	Real time
F9-72	Power dip ride-through integral coefficient Ki	0 to 100	30	Real time
F9-73	Deceleration time of power dip ride-through	0.0s to 300.0s	20.0s	At stop

Note:

Note: (1) In the bus voltage constant control mode, when the power supply recovers, the drive output frequency increases gradually to the target frequency. In the decelerate-to-stop mode, when the power supply recovers, the drive gradually decelerates to 0 Hz and stops until receiving a start command again.

(2) The power dip ride through function is to ensure that the motor can decelerate to stop normally when the power supply is abnormal rather than coasting to stop due to undervoltage and then the motor can start immediately after the power supply recovers. In the large-inertia system, it takes a long time for the motor to coast to stop. After the power supply recovers, if the motor is started when it is still operating at high speed, the drive is may report an overload or overcurrent fault.

F9-63	Protection upon load loss		Default	0
	Setting range	0	Inactive	
		1	Active	

F9-64	Load loss detection level		Default	10.0%
	Setting range	0.0% to 100.0%		

F9-65	Load loss detection time		Default	1.0s
	Setting range	0.0s to 60.0s		

If the load loss protection is enabled, when the output current of the drive falls below detection level (F9-64) for a period longer than the time set in F9-65, the output frequency of the drive is reduced to 7% of the rated frequency automatically. Once the load recovers during protection, the drive restores to operate at the set frequency.

Note that the output current fluctuates during actual application, if the setpoint of F9-64 is close to the output current upon load loss, load loss protection may not be triggered properly. It is

recommended to set F9-64 to at least 10% of the output current upon load loss.

F9-66	Minimum PID deviation 2	Default	0.0%
	Setting range	0.0% to 100.0%	

F9-69	Detection value for excessive speed deviation	Default	20.0%
	Setting range	0.0% to 50.0% (maximum frequency)	

F9-70	Detection time for excessive speed deviation	Default	0.0s
	Setting range	0.0s: No detected 0.1s to 60.0s	

This function is active only in vector control.

When the detected motor speed is different from the frequency reference and the difference is higher than the value set in F9-69 for a period longer than the time set in F9-70, the drive reports Err42.

If the excessive speed deviation detection time is set to 0.0s, the excessive speed deviation detection is disabled.

Group FA: Process Control PID Function

PID control is a general process control method. By performing proportional, integral, and derivative operations on the difference between the feedback signal and the target signal, it adjusts the AC drive output frequency and constitutes a feedback system to stabilize the controlled counter around the target value.

It is applied to process control such as flow control, pressure control, and temperature control. The following figure shows the PID control principle.

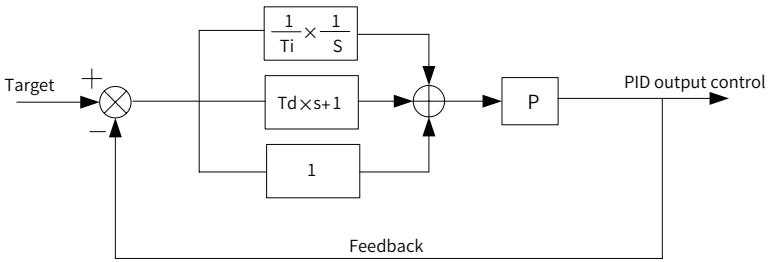


Figure 6-32 Schematic diagram of PID control

FA-00	PID setting source		Default	0
	Setting range	0	FA-01	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference (DI5)	
		5	Communication, communication address: 1000H	
		6	Multi-reference	
FA-01	PID setting		Default	50.0%
	Setting range		0.0% to 100.0%	

This parameter is used to select the target process PID setting source.

The target setpoint of PID is a relative value ranging from 0.0% to 100.0%. The PID feedback is also a relative value. The purpose of PID control is to make the PID setting and PID feedback equal.

FA-02	PID feedback source		Default	0
	Setting range	0	AI1	
		1	AI2	
		2	AI3	
		3	AI1 − AI2	
		4	Pulse reference (DI5)	
		5	Communication, communication address:1000H	
		6	AI1+AI2	
		7	Max (|AI1|, |AI2|)	
		8	Min (|AI1|, |AI2|)	

This parameter is used to select the feedback signal channel of process PID.

The PID feedback is also a relative value ranging from 0.0% to 100.0%.

FA-03	PID action direction		Default	0
	Setting range	0	Positive	
		1	Negative	

Positive action: When the PID feedback is lower than the PID setting, the output frequency of the AC drive increases. Example: Tension control in winding

Negative action: When the PID feedback is lower than the PID setting, the output frequency of the AC drive decreases. Example: Tension control in unwinding

Note that this function is affected by the DI function 35 "Inverted PID action".

FA-04	PID reference feedback range	Default	1000
	Setting range	0 to 65535	

This parameter is a non-dimensional unit. It is used for PID setting display (U0-15) and PID feedback display (U0-16).

The relative value 100% of PID setting/feedback corresponds to the value of FA-04. For example, if FA-04 is set to 2000 and PID setting is 100.0%, the PID setting display (U0-15) is 2000.

FA-05	Proportional gain Kp1	Default	20.0
	Setting range	0.0 to 1000.0	
FA-06	Integral time Ti1	Default	2.00s
	Setting range	0.01s to 10.00s	
FA-07	Derivative time Td1	Default	0.000s
	Setting range	0.000 to 10.000	

Proportional gain Kp1

It decides the regulating intensity of the PID regulator. The higher the Kp1 value is, the greater the regulating intensity is.

Integral time Ti1

It decides the integral regulating intensity. The shorter the integral time, the greater the adjustment intensity is. When the deviation between PID feedback and PID setting is 100.0%, the integral regulator performs continuous regulation within the set time, and the regulation value reaches the maximum frequency.

Derivative time Td1

It decides the regulating intensity of the PID regulator on the deviation change. The longer the derivative time, the greater the adjustment intensity is. Derivative time indicates the time within which the feedback change reaches 100.0%. In this case, the regulation value reaches the maximum frequency.

FA-08	PID reverse cut-off frequency	Default	2.00 Hz
	Setting range	0.00 Hz to maximum frequency	

In some applications, only when the PID output frequency is a negative value (reverse run), PID setting and PID feedback can be equal. However,an excessively high reverse operating frequency is prohibited in some applications. FA-08 is used to determine the reverse operating frequency upper limit.

FA-09	PID deviation limit	Default	0.00%
	Setting range	0. 00% to 100.00%	

If the deviation between PID feedback and PID setting is lower than the value of this parameter,

PID control stops. When the deviation between PID feedback and PID setting is small, the output frequency is stable.

FA-10	PID derivative limit	Default	0.10%
	Setting range	0.00% to 100.00%	

It is used to set the PID derivative output range. In PID control, the derivative operation may easily cause system oscillation. Therefore, the PID derivative regulation is restricted to a small range.

FA-11	PID setting change time	Default	0.00s
	Setting range	0.00s to 650.00s	

The PID setting change time indicates the time required for the PID setting to change from 0.0% to 100.0%.

The PID setting changes linearly according to the change time, reducing the impact caused by sudden setting change on the system.

FA-12	PID feedback filter time	Default	0.00s
	Setting range	0.00s to 60.00s	
FA-13	PID output filter time	Default	0.00s
	Setting range	0.00s to 60.00s	

FA-12 is used to filter the PID feedback, helping reduce the interference on the feedback. However, this slows the responsiveness of the process closed-loop system.

FA-13 is used to filter the PID output frequency, helping weaken sudden change of the AC drive output frequency. However, this slows the responsiveness of the process closed-loop system.

FA-15	Proportional gain Kp2	Default	20.0
	Setting range	0.0 to 1000.0	
FA-16	Integral time Ti2	Default	2.00s
	Setting range	0.01s to 10.00s	
FA-17	Derivative time Td2	Default	0.000s
	Setting range	0.000 to 10.000	
FA-18	PID parameter switchover condition	Default	0
	Setting range: 0	Not switched	
	Setting range: 1	Switchover by DI	
	Setting range: 2	Switched automatically based on deviation	
	Setting range: 3	3: Automatic switchover based on operating frequency	
FA-19	PID parameter switchover deviation 1	Default	20.0%
	Setting range	0.0% to FA-20	

FA-20	PID parameter switchover deviation 2	Default	80.0%
	Setting range	FA-19 to 100.0%	

In some applications, PID parameter switchover is required when one group of PID parameters cannot satisfy the requirements of the whole operating process.

These parameters are used for switchover between two groups of PID parameters. Regulator parameters FA-15 to FA-17 are set in the same way as FA-05 to FA-07.

The switchover can be implemented either through a DI or based on the PID deviation.

To enable switchover through a DI, assign the DI with function 43 (PID parameter switchover). If the DI is invalid, group 1 (FA-05 to FA-07) is selected. If the DI is valid, group 2 (FA-15 to FA-17) is selected.

If you select automatic switchover, when the absolute value of the deviation between the reference value and feedback is lower than the value of FA-19, group 1 is selected. When the absolute value of the deviation between the reference value and PID setting is higher than the value of FA-20, group 2 is selected. When the deviation is between FA-19 (PID parameter switchover deviation 1) and FA-20 (PID parameter switchover deviation 2), the PID parameters are the linearly interpolated value of the two groups of PID parameter values, as shown in the following figure.

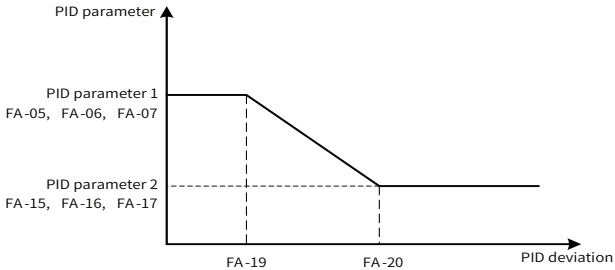


Figure 6-33 PID parameter switchover

FA-21	PID initial value	Default	0.0%
	Setting range	0.0% to 100.0%	
FA-22	Active time of PID initial value	Default	0.00s
	Setting range	0.00s to 650.00s	

When the AC drive starts, the PID starts closed-loop regulation algorithm only after the PID output is fixed to the PID initial value (FA-21) and such status lasts for the time defined by FA-22. The following figure shows the PID initial value function.

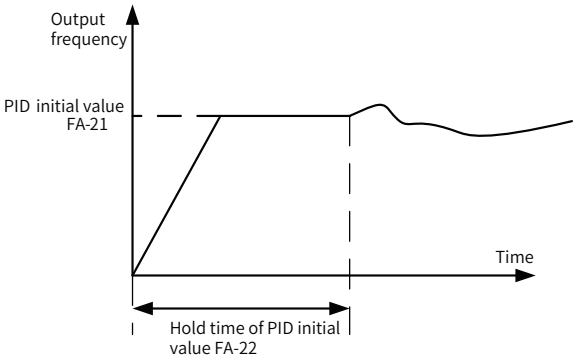


Figure 6-34 PID initial value function

This function is used to limit the difference between two cycles outputted by PID (2 ms/cycle) to suppress excessively fast PID output change and stabilize the operation of the AC drive.

FA-23	Maximum deviation between two outputs in forward direction	Default	1.00%
	Setting range	0.00% to 100.00%	
FA-24	Maximum deviation between two outputs in reverse direction	Default	1.00%
	Setting range	0.00% to 100.00%	

FA-23 and FA-24 respectively correspond to the maximum absolute value of the output deviation between forward run and reverse run.

FA-25	PID integral	Default	00
	Setting range: Ones	Integral separation	
	0	Inactive	
	1	Active	
	Tens	Whether to stop integral operation when the output reaches the limit	
	0	Continue integral operation	
	1	Stop integral operation	

Integral separation:

If the integral separation is active, the PID integral operation stops when the DI assigned with function 38 is active. In this case, only proportional and derivative actions take effect.

If the integral separation is invalid, the integral separation remains invalid no matter whether the DI is valid.

Whether to stop integral operation when the output reaches the limit:

Determines whether to stop the integral operation when the PID operation output reaches the maximum or minimum value. If you select "Stop the integral operation", the PID integral operation stops, which may help reduce the PID overshoot.

FA-26	Detection value of PID feedback loss	Default	0.0%
	Setting range	0.0%: No detection on feedback loss 0.1% to 100.0%	
FA-27	Detection time of PID feedback loss	Default	0.0s
	Setting range	0.0s to 20.0s	

These parameters are used to judge whether PID feedback is lost.

If the PID feedback remains smaller than the value of FA-26 and such status lasts for the time set in FA-27, the AC drive reports Err31.

FA-28	PID operation at stop		Default	0
	Setting range	0	Disable	
		1	Enable	

It is used to determine whether to continue the PID operation when the AC drive stops. Generally, the PID operation needs to be stopped when the AC drive stops.

Group FB: Wobble frequency, fixed length and counting

The wobble frequency function is applicable to industries such as textile and chemical fibers, as well as applications requiring reciprocating motion and winding/unwinding.

The wobble frequency function indicates that the output frequency of the drive increases/decreases based on the set frequency. The track of the operating frequency at the time axis is shown in the following figure. The wobble amplitude is set in FB-00 and FB-01. When FB-01 is set to 0, the wobble frequency function is inactive.

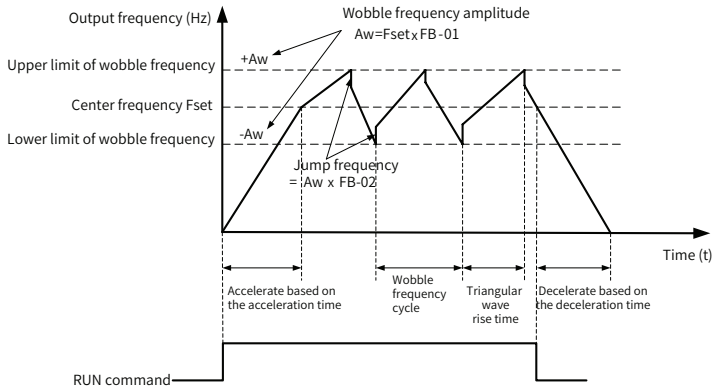


Figure 6-35 Operating diagram of wobble frequency

FB-00	Wobble amplitude setting mode		Default	0
	Setting range	0	Relative to the center frequency	
		1	Relative to the maximum frequency	

This parameter is used to select the base value of the wobble amplitude.

0: Relative to the center frequency (F0-07)
The setpoint 0 indicates a variable wobble amplitude system where the wobble amplitude changes with the center frequency (set frequency).

1: Relative to the maximum frequency (F0-10)
The setpoint 1 indicates a fixed wobble frequency system where the wobble amplitude is fixed.

FB-01	Wobble frequency amplitude	Default	0.0%
	Setting range	0.0% to 100.0%	
FB-02	Jump frequency amplitude	Default	0.0%
	Setting range	0.0% to 50.0%	

These parameters are used to determine the wobble amplitude and jump frequency.

When the set wobble amplitude is relative to the center frequency (FB-00 = 0), AW (Actual wobble amplitude) = F0-07 x FB-01. When the set wobble amplitude is relative to the maximum frequency (FB-00 = 1), AW (Actual wobble amplitude) = F0-10 x FB-01.

Jump frequency = AW (Actual wobble amplitude) x FB-02 (Jump frequency amplitude). If the wobble frequency is relative to the center frequency (FB-00=0), the jump frequency is a variable value. If the wobble frequency is relative to the maximum frequency (FB-00 = 1), the jump frequency is a fixed value.

The operating frequency of wobble frequency is limited by the frequency upper limit and lower limit.

FB-03	Wobble frequency cycle	Default	10.0s
	Setting range	0.1s to 3000.0s	
FB-04	Triangular wave rise time coefficient	Default	50.0%
	Setting range	0.1% to 100.0%	

Wobble frequency cycle: Specifies the time of a complete wobble frequency cycle.

FB-04 specifies the time percentage of triangular wave rise time to FB-03.

Triangular wave rise time (unit: s) = FB-03 x FB-04

Triangular wave fall time (unit: s) = FB-03 x (1 – FB-04)

FB-05	Length reference	Default	1000 m
	Setting range	0 m to 65535 m	
FB-06	Actual length	Default	-
	Setting range	0 m to 65535 m	
FB-07	Number of pulses per meter	Default	100.0
	Setting range	0.1 to 6553.5	

The preceding parameters are used for fixed length control.

The length information is collected by DIs. FB-06 = Number of pulses collected by the DI/FB-07. When the actual length FB-06 exceeds the set length in FB-05, the DO assigned with function 10 (Length reached) outputs the "ON" signal.

During fixed length control, the length reset operation can be performed through the DI assigned with function 28. For details, see the descriptions of F4-00 to F4-04

Assign corresponding DI with function 27 (Length counting input). If the pulse frequency is high, DI5 must be used.

FB-08	Set counting value	Default	1000
	Setting range	1 to 65535	
FB-09	Designated counting value	Default	1000
	Setting range	1 to 65535	

The counting value needs to be collected by DIs. Assign the corresponding DI with function 25 (Counter input). If the pulse frequency is high, DI5 must be used.

When the counting value reaches the set counting value (FB-08), the DO assigned with function 8 (Set counting value reached) outputs the "ON" signal.

When the counting value reaches the designated counting value (FB-09), the DO assigned with function 9 (Designated counting value reached) outputs the "ON" signal.

The specified counting value FB-09 cannot exceed the set counting value FB-08. The following figure shows the function of reaching the set counting value and reaching the specified counting value.

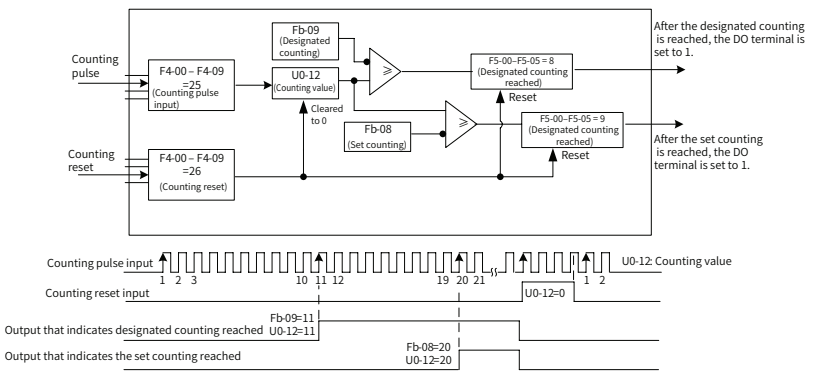


Figure 6-36 The set counting value and designated counting value

Group FC: Multi-Reference and Simple PLC Function

The multi-reference function, besides multi-speed, can also be used as the separated V/f voltage source and process PID setting source. Therefore, the multi-reference is a relative value.

The simple PLC function is different from the user programmable function. Simple PLC can only complete simple combination of multi-reference.

FC-00	Multi-reference 0	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-01	Multi-reference 1	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-02	Multi-reference 2	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-03	Multi-reference 3	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-04	Multi-reference 4	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-05	Multi-reference 5	Default	0.0%
	Setting range	-100.0% to +100.0%	

FC-06	Multi-reference 6	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-07	Multi-reference 7	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-08	Multi-reference 8	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-09	Multi-reference 9	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-10	Multi-reference 10	Default	0.0 Hz
	Setting range	-100.0% to +100.0%	
FC-11	Multi-reference 11	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-12	Multi-reference 12	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-13	Multi-reference 13	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-14	Multi-reference 14	Default	0.0%
	Setting range	-100.0% to +100.0%	
FC-15	Multi-reference 15	Default	0.0%
	Setting range	-100.0% to +100.0%	

Multi-reference can be the setting source of frequency, separated V/f voltage and process PID.

The multi-reference is a relative value that ranges from -100.0% to +100.0%. When used as the frequency source, it is a percentage to the maximum frequency. When used as the separated V/f voltage source, it is a percentage to the rated motor voltage. When used as the process PID setting source, it does not require value conversion.

Multi-reference can be switched based on different states of DIs. For details, see "Group F4 Input Terminals".

FC-16	Simple PLC operation mode	Default	0
	Setting range	0	Stop after operating for one cycle
		1	Keep the final value after operating for one cycle
		2	Repeat after operating for one cycle

Simple PLC can be the frequency source or separated V/f voltage source.

The following figure describes the simple PLC used as the frequency source. When the simple PLC is used as the frequency source, the positive or negative values of FC-00 to FC-15 determines the operating direction. If the parameter values are negative, the AC drive runs in the reverse direction.

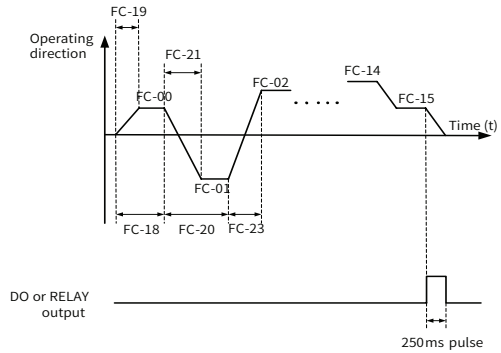


Figure 6-37 Simple PLC diagram

When used as the frequency source, the PLC supports the following three operation modes. When used as the separated V/f voltage source, these three modes are not supported. Where:

0: Stop after operating for one cycle

The drive stops after operating for one cycle and will not start until receiving a run command.

1: Keep final values after operating for one cycle

The AC drive keeps the final operating frequency and direction after operating for one cycle.

2: Repeat after operating for one cycle

The AC drive automatically starts another cycle after operating for one cycle and will not stop until receiving the stop command.

FC-17	Simple PLC retention selection upon power failure		Default	00
	Setting range	Ones	Retention selection upon power failure	
		0	Non-retentive upon power failure	
		1	Retentive upon power failure	
		Tens	Retention selection upon stop	
		0	Non-retentive upon stop	
		1	Retentive upon stop	

PLC retention upon power failure indicates that the AC drive records the PLC operating phase and operating frequency before power failure and will continue to run from the recorded values after it is powered on again. If "Non-retentive upon power failure" is selected, the AC drive restarts the PLC process after it is powered on again.

PLC retention upon stop indicates that the AC drive memorizes the PLC operating phase and operating frequency upon stop and will continue to run from the memorized values after it operates again. If "Non-retentive upon stop" is selected, the drive restarts the PLC process every time it starts.

FC-18	Operating time of multi-reference 0 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-19	Acceleration/Deceleration time of simple PLC reference 0	Default	0
	Setting range	0 to 3	
FC-20	Operating time of multi-reference 1 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-21	Acceleration/Deceleration time of simple PLC reference 1	Default	0
	Setting range	0 to 3	
FC-22	Operating time of multi-reference 2 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-23	Acceleration/Deceleration time of simple PLC reference 2	Default	0
	Setting range	0 to 3	
FC-24	Operating time of multi-reference 3 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-25	Acceleration/Deceleration time of simple PLC reference 3	Default	0
	Setting range	0 to 3	
FC-26	Operating time of multi-reference 4 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-27	Acceleration/Deceleration time of simple PLC reference 4	Default	0
	Setting range	0 to 3	
FC-28	Operating time of multi-reference 5 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-29	Acceleration/Deceleration time of simple PLC reference 5	Default	0
	Setting range	0 to 3	
FC-30	Operating time of multi-reference 6 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	

FC-31	Acceleration/Deceleration time of simple PLC reference 6	Default	0
	Setting range	0 to 3	
FC-32	Operating time of multi-reference 7 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-33	Acceleration/Deceleration time of simple PLC reference 7	Default	0
	Setting range	0 to 3	
FC-34	Operating time of multi-reference 8 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-35	Acceleration/Deceleration time of simple PLC reference 8	Default	0
	Setting range	0 to 3	
FC-36	Operating time of multi-reference 9 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-37	Acceleration/Deceleration time of simple PLC reference 9	Default	0
	Setting range	0 to 3	
FC-38	Operating time of multi-reference 10 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-39	Acceleration/Deceleration time of simple PLC reference 10	Default	0
	Setting range	0 to 3	
FC-40	Operating time of multi-reference 11 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-41	Acceleration/Deceleration time of simple PLC reference 11	Default	0
	Setting range	0 to 3	
FC-42	Operating time of multi-reference 12 set by simple PLC	Default	0.0s (h)
	Setting range	0.0s (h) to 6500.0s (h)	
FC-43	Acceleration/Deceleration time of simple PLC reference 12	Default	0
	Setting range	0 to 3	

FC-44	Operating time of multi-reference 13 set by simple PLC		Default	0.0s (h)
	Setting range		0.0s (h) to 6500.0s (h)	
FC-45	Acceleration/Deceleration time of simple PLC reference 13		Default	0
	Setting range		0 to 3	
FC-46	Operating time of multi-reference 14 set by simple PLC		Default	0.0s (h)
	Setting range		0.0s (h) to 6500.0s (h)	
FC-47	Acceleration/Deceleration time of simple PLC reference 14		Default	0
	Setting range		0 to 3	
FC-48	Operating time of multi-reference 15 set by simple PLC		Default	0.0s (h)
	Setting range		0.0s (h) to 6500.0s (h)	
FC-49	Acceleration/Deceleration time of simple PLC reference 15		Default	0
	Setting range		0 to 3	
FC-50	Time unit of simple PLC operation		Default	0
	Setting range	0	s (seconds)	
		1	h (hour)	
FC-51	Multi-reference 0 setting mode		Default	0
	Setting range	0	FC-00	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference	
		5	PID	
		6	F0-08 (Preset frequency), which can be modified by UP/DOWN keys	

This parameter determines the source of reference 0.

You can perform convenient switchover between the reference sources. When multi-reference or simple PLC is used as the frequency source, the switchover between two frequency sources can be achieved easily.

Group FD: Communication parameters

See "Appendix A: MD310 Modbus Communication Protocol".

Group FE: User-defined parameters

FE-00	User-defined parameter 0	Default	F0.01
	Setting range	F0.00 to FP.xx A0.00 to Ax.xx U0.00 to U3.xx	
FE-01	User-defined parameter 1	Default	F0.02
	Setting range	Same as FE-00	
FE-02	User-defined parameter 2	Default	F0.03
	Setting range	Same as FE-00	
FE-03	User-defined parameter 3	Default	F0.07
	Setting range	Same as FE-00	
FE-04	User-defined parameter 4	Default	F0.08
	Setting range	Same as FE-00	
FE-05	User-defined parameter 5	Default	F0.17
	Setting range	Same as FE-00	
FE-06	User-defined parameter 6	Default	F0.18
	Setting range	Same as FE-00	
FE-07	User-defined parameter 7	Default	F3.00
	Setting range	Same as FE-00	
FE-08	User-defined parameter 8	Default	F3.01
	Setting range	Same as FE-00	
FE-09	User-defined parameter 9	Default	F4.00
	Setting range	Same as FE-00	
FE-10	User-defined parameter 10	Default	F4.01
	Setting range	Same as FE-00	
FE-11	User-defined parameter 11	Default	F4.02
	Setting range	Same as FE-00	
FE-12	User-defined parameter 12	Default	F5.02
	Setting range	Same as FE-00	
FE-13	User-defined parameter 13	Default	F5.07
	Setting range	Same as FE-00	
FE-14	User-defined parameter 14	Default	F6.00
	Setting range	Same as FE-00	
FE-15	User-defined parameter 15	Default	F6.10
	Setting range	Same as FE-00	
FE-16	User-defined parameter 16	Default	F0.00
	Setting range	Same as FE-00	

FE-17	User-defined parameter 17	Default	F0.00
	Setting range	Same as FE-00	
FE-18	User-defined parameter 18	Default	F0.00
	Setting range	Same as FE-00	
FE-19	User-defined parameter 19	Default	F0.00
	Setting range	Same as FE-00	
FE-20	User-defined parameter 20	Default	F0.00
	Setting range	Same as FE-00	
FE-21	User-defined parameter 21	Default	F0.00
	Setting range	Same as FE-00	
FE-22	User-defined parameter 22	Default	F0.00
	Setting range	Same as FE-00	
FE-23	User-defined parameter 23	Default	F0.00
	Setting range	Same as FE-00	
FE-24	User-defined parameter 24	Default	F0.00
	Setting range	Same as FE-00	
FE-25	User-defined parameter 25	Default	F0.00
	Setting range	Same as FE-00	
FE-26	User-defined parameter 26	Default	F0.00
	Setting range	Same as FE-00	
FE-27	User-defined parameter 27	Default	F0.00
	Setting range	Same as FE-00	
FE-28	User-defined parameter 28	Default	F0.00
	Setting range	Same as FE-00	
FE-29	User-defined parameter 29	Default	F0.00
	Setting range	Same as FE-00	
FE-30	User-defined parameter 30	Default	F0.00
	Setting range	Same as FE-00	
FE-31	User-defined function code 31	Default	F0.00
	Setting range	Same as FE-00	

Group FE is user-defined parameter group.

You can select the parameters needed and add them into this group.

Group FE provides a maximum of 30 user-defined parameters. If "F0.00" is displayed, it indicates group FE is empty.

After you enter user-defined parameter mode, the displayed parameters are defined by FE-00 to FE-31 and the sequence is consistent with that of group FE.

Group FP: User Password

FP-00	User password	Default	0
	Setting range	0 to 65535	

If FP-00 is set to a non-zero value, the password protection function is enabled. You must input the password correctly to enter the function parameter editing mode. Otherwise, you cannot view or modify the parameters. Make sure to remember the password you set.

If FP-00 is set to 00000, the previous user password will be cleared, and the password protection function is disabled.

FP-01	Parameter initialization		Default	0
	Setting range	0	No operation	
		1	Restore factory parameters except motor parameters	
		2	Clear records	
		4	Back up current user parameters	
		501	Restore user backup parameters	
		10	Initializing parameters for pay-off machines	
		20	Initializing parameters for mechanical motion (vertical, horizontal, swing arm)	
		21	Initializing parameters for the inertia industry (wind turbine)	
		22	Initializing parameters for the lathe industry	
		23	Initializing parameters for the quick start/stop industry (printing machines)	

1: Restore parameters excluding motor parameters to default

If FP-01 is set to 1, most parameters are restored to default except motor parameters, fault record information, accumulative operating time (F7-09), accumulative power-on time (F7-13), and accumulative power consumption (F7-14).

2: Clear records

The fault records, accumulative operating time (F7-09), accumulative power-on time (F7-13), and accumulative power consumption (F7-14) are cleared.

4: Back up current user parameters

The current parameters are backed up. Values of all the current parameters are backed up for restoration after an error caused by parameter adjustment occurs.

501: Restore user backup parameters

The user parameter setting that is backed up previously (FP-01 =4) can be restored.

The AC drive is built-in with recommended parameters for industry applications. The commonly used parameters in the following industries can be set to the recommended values through FP-01, help shortening the parameter setting process.

Note: Before initializing industry parameters through FP-01, set FP-01 to 1 to restore default settings.

10: Initializing parameters for pay-off machines

No.	Name	Optimal value
F0-02	Command source	1: Terminal I/O control
F0-03	Main frequency source X	8: PID
F0-17	Acceleration time 1	1.0s
F0-18	Deceleration time 1	1.0s
F2-03	Speed loop proportional gain 2	50
F4-01	DI2 function selection	8: Coast to stop
FA-05	Proportional gain Kp1	15.0
FA-06	Integral time Ti1	1.30s
FA-07	Derivative time Td1	0.000s
FA-11	PID setting change time	0.00s
A5-03	Random PWM depth	3

20: Initializing parameters for mechanical motion (vertical, horizontal, swing arm) industry

No.	Name	Optimal value
F6-07	Acceleration/Deceleration mode	2: Dynamic S-curve acceleration/deceleration
F6-11	Starting frequency for DC braking at stop	0.50 Hz
F6-13	DC braking current at stop	50%
F6-14	DC braking time at stop	1.0s

21: Initializing parameters for inertia industry (wind turbines)

No.	Name	Optimal value
F6-00	Start mode	1: Flying start
F9-09	Number of automatic fault resets upon fault	3
F9-11	Interval time of automatic fault reset	Model dependent: Power ⩽ 5.5 kW: 1.0s Power > 5.5 kW: 2.0s
F9-59	Action selection at instantaneous power failure	1: Decelerate

22: Initializing parameters for lathe industry

No.	Name	Optimal value
F2-17	Speed loop property	Ones: 1 (Integral separation active) Tens: 1 (Torque feedforward active)
F6-07	Acceleration/Deceleration mode	2: Dynamic S-curve acceleration/deceleration
F6-11	Starting frequency for DC braking at stop	0.50 Hz
F6-13	DC braking current at stop	50%
F6-14	DC braking time at stop	1.0s
A5-03	Random PWM depth	3
A5-05	Maximum output voltage coefficient	107%

23: Initializing parameters for quick start/stop (printing machines) industry

No.	Name	Optimal value
F3-10	V/f over-excitation gain	150
F3-23	Overvoltage stall enable	0 (invalid)
F4-10	DI filter time	0.002s
F6-11	Starting frequency for DC braking at stop	0.50 Hz
F6-13	DC braking current at stop	70%
F6-14	DC braking time at stop	1.0s

FP-02	Attribute of function parameter mode display		Default	11
	Setting range	Ones	Selection of group U display	
		0	Not displayed	
		1	Displayed	
		Tens	Selection of group A display	
		0	Not displayed	
		1	Displayed	
FP-03	Display of individualized parameters		Default	00
	Setting range	Ones	User-defined parameter display	
		0	Not displayed	
		1	Displayed	
		Tens	User-changed parameter display	
		0	Not displayed	
		1	Displayed	

The setting of parameter display mode can assist users in viewing different types of parameters as needed. The MD310 provides the following three parameter display modes.

Name	Description
Function parameter mode	Displays function parameters (F0 to FF, A1 to AF, and U0 to UF) in sequence.
User-defined parameter mode	Display a maximum of 32 user-defined parameters defined in group FE.
User-modified parameter mode	Display the parameters whose default values are modified.

If the ones of FP-03 is set to 1, you can switch to different parameter display modes by pressing the MF.K key (F7-01 needs to be set to 5 first). By default, the function parameter display mode is used.

The following table lists the display codes of different parameter types.

Parameter display mode	Display
Function parameter mode	-bASE
User-defined parameter mode	-USEr
User-modified parameter mode	--C--

The MD310 provides display of two groups of individualized parameters: user-defined parameters and user-modified parameters.

User-defined parameters are set in group FE. You can select up to 32 parameters to group FE.

In user-defined parameter mode, symbol "u" is added before the parameter. For example, F1-00 is displayed as uF1-00.

User-modified parameters indicate the parameters that are modified by you and differ from the default values. User-modified parameters are grouped together, convenient for on-site troubleshooting.

In user-modified parameter mode, symbol "c" is added before the parameter. For example, F1-00 is displayed as cF1-00.

FP-04	Parameter modification property		Default	0
	Setting range	0	Modifiable	
		1	Non-modifiable	

It is used to set whether the parameters are modifiable to avoid mal-function.

If it is set to 0, all parameters are modifiable. If it is set to 1, all parameters can only be viewed.

Group A0: Torque Control and Limit Parameters

A0-00	Speed/Torque control mode selection		Default	0
	Setting range	0	Speed control	
		1	Torque control	

It is used to select the AC drive control mode: speed control or torque control.

The DI of MD310 supports two functions related to torque control: function 29 (Torque control prohibited) and function 46 (Speed control/Torque control switchover). The two DI functions need to be used together with A0-00 to switch between speed control and torque control.

If the DI assigned with function 46 (Speed control/Torque control switchover) is inactive, the control mode is determined by A0-00. If the DI assigned with function 46 is active, the control mode is the inverted value of A0-00.

When the torque control inhibition terminal is enabled, the drive always run in speed control no matter whether function 46 is enabled or disabled.

A0-01	Torque reference source selection in torque control		Default	0
	Setting range	0	Digital setting (A0-03)	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference (DI5)	
		5	Communication, communication address: 1000H	
		6	Min. (AI1, AI2)	
		7	Max. (AI1, AI2)	
A0-03	Torque digital setting in torque control		Default	150.0%
	Setting range		-200.0% to +200.0%	

A0-01 is used to select the torque setting source. There are a total of eight torque setting sources.

The torque reference uses relative value. The value 100.0% corresponds to the rated motor torque. The setpoint ranges from -200.0% to +200.0%, indicating that the maximum torque of the drive is two x rated torque of the motor.

If the torque reference is positive, the drive rotates in the forward direction.

If the torque setting is negative, the AC drive rotates in the reverse direction.

The torque reference sources are shown below.

0: A0-03: The target torque uses the setpoint of A0-03 directly.

1: AI1
2: AI2

3: AI3

The target torque is set by analog input terminal. The MD310 control board provides two analog input (AI) terminals (AI1, AI2). Another AI terminal (AI3) is provided by the I/O expansion card.

Where:

AI1: 0–10 V voltage input or 4–20 mA current input, determined by jumper J14

AI2: 0–10 V voltage input or 4–20 mA current input, determined by jumper J4

AI3: -10 V to +10 V voltage input

You can select the relationship curve between the input voltage values of AI1, AI2, and AI3 through F4-33.

The MD310 provides five relationship curves, three of which are linear (point-point) curves and two of which are four-point curves, which can be set through F4-13...F4-27 and parameters in group A6.

F4-33 can be used to set the analog inputs of AI1 to AI3.

When AI is used as the frequency source, the value 100% of the voltage/current input corresponds to the value of A0-03.

4: Pulse (DI5)

The target torque is set by DI5 (high-speed pulse).

Specifications of pulse reference signals: 9 V to 30 V (voltage) and 0 kHz to 20 kHz (frequency) Pulse reference can be inputted only through DI5.

You can set the mapping relationship between DI5 pulse input and the corresponding setting in F4-28 to F4-31, and the relationship is a linear curve. 100% of the corresponding setting of pulse input corresponds to the value of A0-03.

5: Communication

The target torque is set through communication. The host controller writes data -100.00% to +100.00% through the communication address 0x1000, where 100.00% is the percentage to the value of A0-03.

A0-05	Maximum frequency of torque control in forward direction	Default	50.00 Hz
	Setting range	0.00 Hz to F0-10 (maximum frequency)	
A0-06	Maximum frequency of torque control mode in reverse direction	Default	50.00 Hz
	Setting range	0.00 Hz to F0-10 (maximum frequency)	

These function parameters set maximum frequency of the AC drive in forward and reverse directions in torque control.

In torque control, if the load torque is smaller than the motor output torque, the motor rotational

speed will rise continuously. To avoid runaway of the mechanical system, the motor maximum rotating speed must be limited in torque control.

You can implement continuous change of the maximum frequency in torque control dynamically by controlling the frequency upper limit.

A0-07	Acceleration time in torque control	Default	0.00s
	Setting range	0.00s to 650.00s	
A0-08	Torque deceleration time	Default	0.00s
	Setting range	0.00s to 650.00s	

In torque control mode, the difference between the motor output torque and the load torque determines the speed change rate of the motor and load. The motor speed may change quickly, resulting in loud noise or high mechanical stress. Setting the acceleration/deceleration time in the torque control mode helps smooth the motor speed.

If the motor needs to respond to torque changes quickly, set this parameter to 0.00s.

For example, two AC drives are connected to drive the same load. To balance the load distribution, set one AC drive as the master and select the speed control mode. Set the other one as the slave and select the torque control mode. The slave receives the output torque of the master as the torque command and follows the master rapidly. In this case, the acceleration/deceleration time of the slave in the torque control mode is set to 0.00s.

A1 VDI/VDO Parameters

A1-00	VDI1 function selection	Default	0
	Setting range	0 to 59	
A1-01	VDI2 function selection	Default	0
	Setting range	0 to 59	
A1-02	VDI3 function selection	Default	0
	Setting range	0 to 59	
A1-03	VDI4 function selection	Default	0
	Setting range	0 to 59	
A1-04	VDI5 function selection	Default	0
	Setting range	0 to 59	

VDI1 to VDI5 have the same functions as DIs on the control board and can be used as digital input. For details, see descriptions of F4-00 to F4-09.

A1-05	VDI active state setting mode		Default	00000
	Setting range	Ones	VDI1	
		0	Decided by state of VDOx	
		1	A1-06	
		Tens	VDI2 (0 to 1, same as above)	
		Hundreds	VDI3 (0 to 1, same as above)	
		Thousands	VDI4 (0 to 1, same as above)	
		Ten thousands	VDI5 (0 to 1, same as above)	
A1-06	VDI state setting		Default	00000
	Setting range	Ones	VDI1	
		0	Inactive	
		1	Active	
		Tens	VDI2 (0 to 1, same as above)	
		Hundreds	VDI3 (0 to 1, same as above)	
		Thousands	VDI4 (0 to 1, same as above)	
		Ten thousands	VDI5 (0 to 1, same as above)	

Different from regular DIs, VDI state can be set in two modes, which is determined in A1-05.

When the VDI state is determined by the corresponding VDO, the VDI state depends on the VDO state. VDIx is bound to a unique VDOx (x: 1–5).

When the VDI state is set by parameters, the binary bitof A1-06 determines the VDI state.

The following shows how to use VDIs.

Example 1: To implement the function that the drive reports an alarm and stops when the AI1 input exceeds the limit, perform the following setting:

Set the VDI1 function to "User-defined fault 1" (A1-00 = 44).

Set A1-05 to xxx0 to make VDI1 state to be determined by VDO1.

Assign VDO1 with function 31 "AI1 input limit exceeded" (A1-11 = 31).

When the AI1 input exceeds the limit, VDO1 outputs the "ON" signal. In this case, the VDI1 state is active and receives user-defined fault 1. Then the AC drive reports Err27 and stops.

Example 2: To implement the function that the AC drive automatically enters the operating state after power-on, perform the following setting:

1. Assign VDI1 with function 1 "Forward run (FWD)" (A1-00 = 1).

2. Set A1-05 to xxx1: The state of VDI1 is decided by A1-06.

3. Set A1-06 to xxx1: VDI1 is valid.

4. Set F0-02 to 1: The command source is set to "Terminal control".

5. Set F8-18 to 0: Startup protection is not enabled.

When initialization is done after power-on, VDI1 is detected to be active and this terminal represents forward run, which means that the drive receives the forward run command from the terminal. Therefore, The drive starts to run in the forward direction.

A1-07	Function selection for AI1 used as DI		Default	0
	Setting range		0 to 59	
A1-08	Function selection for AI2 used as DI		Default	0
	Setting range		0 to 59	
A1-09	Function selection for AI3 used as DI		Default	0
	Setting range		0 to 59	
A1-10	Active mode selection for AI used as DI		Default	000
	Setting range	Ones	AI1	
		0	Active high	
		1	Active low	
		Tens	AI2 (0 or 1, same as the ones)	
		Hundreds	AI3 (0 or 1, same as the ones)	

The functions of these parameters are to use AI as DI. When AI is used as DI and the AI input voltage is higher than 7 V, the AI state is high level. When the AI input voltage is lower than 3 V, the AI state is low level. The AI state is hysteresis if the AI input voltage is between 3 V and 7 V.

A1-10 is used to determine whether AI is active high or active low when the AI is used as DI.

The setting of AIs (used as DI) function is the same as that of DIs. For details, see the descriptions of group F4.

The following figure takes AI input voltage as an example to describe the relationship between AI input voltage and corresponding DI state.

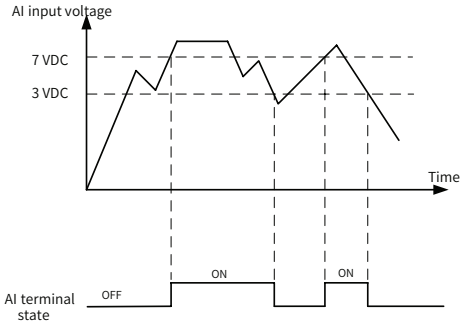


Figure 6-38 Judgment on the AI terminal active state

A1-04	VDI5 function selection	Default	0
	Setting range	0 to 59	

A1-11	VDO1 function selection	Default	0
	Setting range	0: Shorted with physical DIx internally 1 to 41: See physical DO selection in group F5	
A1-12	VDO2 function selection	Default	0
	Setting range	0: Shorted with physical DIx internally 1 to 41: See physical DO selection in group F5	
A1-13	VDO3 function selection	Default	0
	Setting range	0: Shorted with physical DIx internally 1 to 41: See physical DO selection in group F5	
A1-14	VDO4 function selection	Default	0
	Setting range	0: Shorted with physical DIx internally 1 to 41: See physical DO selection in group F5	
A1-15	VDO5 function selection	Default	0
	Setting range	0: Shorted with physical DIx internally 1 to 41: See physical DO selection in group F5	
A1-16	VDO1 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	
A1-17	VDO2 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	
A1-18	VDO3 output delay	Default	0.0s
	Setting range	0.0s to 3600.0s	

A1-19	VDO4 output delay		Default	0.0s
	Setting range		0.0s to 3600.0s	
A1-20	VDO5 output delay		Default	0.0s
	Setting range		0.0s to 3600.0s	
A1-21	Active state of VDO		Default	00000
	Setting range	Ones	VDO1	
		0	Positive logic	
		1	Negative logic	
		Tens	VDO2 (0 or 1, same as the ones)	
		Hundreds	VDO3 (0 or 1, same as the ones)	
		Thousands	VDO4 (0 or 1, same as the ones)	
		Ten thousands	VDO5 (0 or 1, same as the ones)	

The virtual digital output (VDO) functions are similar to the DO functions on the control board. The VDO can be used together with the virtual digital input (VDIx) to implement some simple logic control.

If VDOx function is set to 0, the states of VDO1 to VDO5 are determined by the states of DI1 to DI5 on the control board. In this case, VDOx corresponds to DIx one by one.

If VDOx function is set to a non-zero value, the function setting and use of VDOx are the same as the DOs in group F5.

The active state of VDOx is set in A1-21.

The application examples of VDIx involve the use of VDOx.

A2 Motor 2 parameters

The MD310 can switch between two groups of motor parameters, you can:
set motor nameplate parameters respectively.
perform motor parameter auto-tuning respectively.
select V/f control or vector control respectively.
set parameters related to V/f control or vector control independently.

All parameters in group A2 have the same definition and usage as parameters of motor 1. For more details, see the descriptions of motor 1 parameters.

A2-00	Motor type		Default	0
	Setting range	0	Common asynchronous motor	
		1	Variable-frequency asynchronous motor	
A2-01	Rated power		Default	Model dependent
	Setting range		0.1 kW to 30.0 kW	

A2-02	Rated voltage		Default	Model dependent
	Setting range		1 V to 1000 V	
A2-03	Rated current		Default	Model dependent
	Setting range		0.01 A to 655.35 A	
A2-04	Rated frequency		Default	Model dependent
	Setting range		0.01 Hz to maximum frequency	
A2-05	Rated speed		Default	Model dependent
	Setting range		1 rpm to 65535 rpm	
A2-06	Asynchronous motor stator resistance		Default	Model dependent
	Setting range		0.001 Ω to 65.535 Ω	
A2-07	Asynchronous motor rotor resistance		Default	Model dependent
	Setting range		0.001 Ω to 65.535 Ω	
A2-08	Leakage inductance of asynchronous motor		Default	Model dependent
	Setting range		0.01 mH to 655.35 mH	
A2-09	Mutual inductance of asynchronous motor		Default	Model dependent
	Setting range		0.1 mH to 6553.5 mH	
A2-10	No-load current of asynchronous motor		Default	Model dependent
	Setting range		0.01 A to A2-03	
A2-37	Parameter auto-tuning selection		Default	0
	Setting range	0	No operation	
		1	Asynchronous motor static parameter auto-tuning 1	
		2	Asynchronous motor complete parameter auto-tuning	
		3	Asynchronous motor static parameter auto-tuning 2	
A2-38	Speed loop proportional gain 1		Default	30
	Setting range		1 to 100	
A2-39	Speed loop integral time 1		Default	0.50s
	Setting range		0.01s to 10.00s	
A2-40	Switchover frequency 1		Default	5.00 Hz
	Setting range		0.00 to A2-43	
A2-41	Speed loop proportional gain 2		Default	20
	Setting range		0 to 100	
A2-42	Speed loop integral time 2		Default	1.00s
	Setting range		0.01s to 10.00s	

A2-43	Switchover frequency 2		Default	10.00 Hz
	Setting range		Switchover frequency 1 (A2-40) to max. output frequency	
A2-44	Vector control slip gain		Default	100%
	Setting range		50% to 200%	
A2-45	Filter time constant of speed loop		Default	0.015s
	Setting range		0.000s to 0.100s	
A2-46	Overexcitation gain in vector control		Default	0
	Setting range		0 to 200	
A2-47	Torque limit source in speed control		Default	0
	Setting range	0	A2-48	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference	
		5	Communication	
		6	Min. (AI1, AI2)	
		7	Max. (AI1, AI2)	
A2-48	Digital setting of torque upper limit in speed control		Default	150.0%
	Setting range		0.0% to 200.0%	
A2-49	Torque upper limit reference in speed control (generating)		Default	0
	Setting range The full range of options 1 to 7 corresponds to the value of A2-50.	0	A2-47 and A2-48	
		1	AI1	
		2	AI2	
		3	AI3	
		4	Pulse reference	
		5	Communication	
		6	Min. (AI1, AI2)	
		7	Max. (AI1, AI2)	
		8	A2-50	
A2-50	Digital setting of torque upper limit in speed control (generating)		Default	150.0%
	Setting range		0.0% to 200.0%	
A2-51	Excitation tuning proportional gain		Default	10
	Setting range		0 to 60000	

A2-52	Excitation tuning integral gain		Default	10
	Setting range		0 to 60000	
A2-53	Torque tuning proportional gain		Default	10
	Setting range		0 to 60000	
A2-54	Torque tuning integral gain		Default	10
	Setting range		0 to 60000	
A2-55	Speed loop property		Default	00
	Setting range		Ones: Integral separation 0: Inactive 1: Active Tens: Torque feedforward 0: Inactive 1: Active	
A2-56	Torque feedforward gain		Default	80
	Setting range		20 to 100	
A2-59	Maximum torque coefficient in field weakening area		Default	80%
	Setting range		50% to 200%	
A2-60	Generating power limit mode		Default	0
	Setting range		0 to 3	
A2-61	Generating power upper limit		0.0%	
	Setting range		0.0%: No limit 0.1% to 200.0%	
A2-62	Motor 2 control mode		Default	0
	Setting range	0	Sensorless vector control (SVC)	
		1	V/f control	
A2-63	Motor 2 acceleration/deceleration time selection		Default	0
	Setting range	0	Same as motor 1	
		1	Acceleration/Deceleration time 1	
		2	Acceleration/Deceleration time 2	
		3	Acceleration/Deceleration time 3	
		4	Acceleration/Deceleration time 4	
A2-64	Torque boost of motor 2		Default	Model dependent
	Setting range		0.0%: Automatic torque boost 0.1% to 30.0%	
A2-66	Oscillation suppression gain of motor 2		Default	Model dependent
	Setting range		0 to 100	

Group A5: Control Optimization Parameters

A5-00	Frequency upper limit for DPWM switchover	Default	Model dependent
	Setting range	0.00 Hz to maximum frequency	

It is only active in V/f control.

It determines the digital pulse width modulation (DPWM) pattern in V/f control.
When the output frequency is below the value of this parameter, the 7-segment continuous modulation pattern is used. When above the value of this parameter, the 5-segment intermittent modulation pattern is used.

The 7-segment continuous modulation causes more loss to switches of the AC drive but smaller current ripple. The 5-segment intermittent modulation causes less loss to switches of the AC drive but larger current ripple. This may lead to motor operating instability at high frequency. Do not modify this parameter generally.

If the V/f operation is unstable, see the description of F3-11. For consumption and temperature loss of the drive, see F0-15.

A5-01	PWM modulation mode		Default	0
	Setting range	0	Asynchronous modulation	
		1	Synchronous modulation	

It is only active in V/f control.

Synchronous modulation indicates that the carrier frequency varies linearly with the change of the output frequency, ensuring that the ratio of carrier frequency to output frequency remains unchanged. Synchronous modulation is generally used at high output frequency, which helps improve the output voltage quality.

Synchronous modulation is not required at low output frequency (100 Hz or lower). This is because asynchronous modulation is preferred when the ratio of carrier frequency to output frequency is high.

Synchronous modulation takes effect when the frequency reference is higher than 85 Hz. If below 85 Hz, asynchronous modulation is used.

A5-02	Dead-zone compensation mode		Default	1
	Setting range	0	Disable	
		1	Compensated	

Generally, you need not modify this parameter. Try to use a different compensation mode only when there is special requirement on the waveform quality of the output voltage or oscillation occurs on the motor.

A5-03	Random PWM depth		Default	0
	Setting range	0	Random PWM inactive	
		1 to 10	Random PWM carrier frequency depth	

This parameter is used to lower the unpleasant motor noise and reduce the electromagnetic interference.

If this parameter is set to 0, random PWM is invalid. Different random PWM depth brings different results.

A5-04	Fast current limit		Default	1
	Setting range	0	Disable	
		1	Enable	

The quick current limit function can be enabled to minimize the occurrence of overcurrent faults, guaranteeing uninterrupted operation of the AC drive.

However, long-time quick current limit may result in overtemperature. In this case, the drive reports Err40, indicating the AC drive is overloaded and needs to stop.

A5-05	Maximum output voltage coefficient	Default	105%
	Setting range	100% to 110%	

Increasing the value of this parameter improves the maximum loading capacity in the motor flux weakening area. Be aware that this may lead to an increase in motor current ripple and an increase in motor heating. Decreasing the value of this parameter reduces the motor current ripple and heat generated by the motor. Be aware that this can lower the maximum loading capacity in the motor flux weakening area. The default value applies to most of application.

A5-06	Undervoltage threshold	Default	Model dependent
	Setting range	300.0 V to 600.0 V	

It is used to set the threshold for undervoltage fault (Err09 or A09 in the stop state) of the drive.

Voltage class	Undervoltage base value
Three-phase 380 V	350 V

A5-07	SVC optimization mode	Default	1
	Setting range	0: No optimization 1: Optimization mode 1 2: Optimization mode 2	

The SVC optimization mode of asynchronous motors generally requires no adjustment.

A5-08	Low-speed carrier frequency upper limit	Default	0.0%
	Setting range	0.0% to 6.0%	

A5-09	Overvoltage threshold	Default	Model dependent
	Setting range	200.0 V to 900.0 V	

This parameter is used to set the voltage upon which the AC drive overvoltage fault is reported.

Note: The default value is also the upper limit for overvoltage protection of the drive. This parameter setting is active only when the setpoint of A5-09 is lower than the default value. When the setpoint of A05-09 is higher than the default value, the default value applies.

A5-10	Energy-saving mode	Default	0
	Setting range	0 to 1	

Group A6: AI curve setting

A6-00	Minimum input of AI curve 4	Default	0.00 V
	Setting range	-10.00 V to A6-02	
A6-01	Percentage corresponding to minimum input of AI curve 4	Default	0.0%
	Setting range	-100.0% to +100.0%	
A6-02	Inflection point 1 input of AI curve 4	Default	3.00 V
	Setting range	A6-00 to A6-04	
A6-03	Percentage corresponding to inflection point 1 input of AI curve 4	Default	30.0%
	Setting range	-100.0% to +100.0%	
A6-04	Inflection point 2 input of AI curve 4	Default	6.00 V
	Setting range	A6-02 to A6-06	
A6-05	Percentage corresponding to inflection 2 input of AI curve 4	Default	60.0%
	Setting range	-100.0% to +100.0%	
A6-06	Maximum input of AI curve 4	Default	10.00 V
	Setting range	A6-06 to 10.00 V	
A6-07	Percentage corresponding to maximum input of AI curve 4	Default	100.0%
	Setting range	-100.0% to +100.0%	

A6-08	Minimum input of AI curve 4	Default	0.00 V
	Setting range	-10.00 V to A6-10	
A6-09	Percentage corresponding to minimum input of AI curve 5	Default	0.0%
	Setting range	-100.0% to +100.0%	
A6-10	Inflection point 1 input of AI curve 5	Default	3.00 V
	Setting range	A6-08 to A6-12	
A6-11	Percentage corresponding to inflection point 1 input of AI curve 5	Default	30.0%
	Setting range	-100.0% to +100.0%	
A6-12	Inflection point 2 input of AI curve 5	Default	6.00 V
	Setting range	A6-10 to A6-14	
A6-13	Percentage corresponding to inflection point 2 input of AI curve 5	Default	60.0%
	Setting range	-100.0% to +100.0%	
A6-14	Maximum input of AI curve 5	Default	10.00 V
	Setting range	A6-14 to 10.00 V	
A6-15	Percentage corresponding to maximum input of AI curve 5	Default	100.0%
	Setting range	-100.0% to +100.0%	

The function of curve 4 and curve 5 is similar to that of curve 1 to curve 3, but curve 1 to curve 3 are straight lines, and curve 4 and curve 5 are 4-point curves, allowing more flexible mapping relationship.

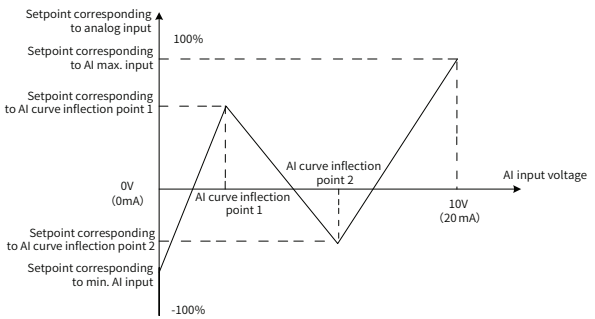


Figure 6-39 Curve 4 and curve 5

When setting curve 4 and curve 5, note that the curve' s minimum input voltage, inflexion point 1 voltage, inflexion point 2 voltage, and maximum voltage must be in increment order.

The curves for AI1 to AI3 are selected in F4-33.

A6-24	AI1 jump point	Default	0.0%
	Setting range	-100.0% to +100.0%	
A6-25	AI1 jump amplitude	Default	0.5%
	Setting range	0.0% to 100.0%	
A6-26	AI2 jump point	Default	0.0%
	Setting range	-100.0% to +100.0%	
A6-27	AI2 jump amplitude	Default	0.5%
	Setting range	0.0% to 100.0%	
A6-28	AI3 jump point	Default	0.0%
	Setting range	-100.0% to +100.0%	
A6-29	AI3 jump amplitude	Default	0.5%
	Setting range	0.0% to 100.0%	

The AIs (AI1 to AI3) all support the setpoint jump function.

The jump function fixes the percentage corresponding to the AI to the jump point when this percentage jumps around the jump range.

Example:

For example, AI1 input voltage jumps around 5.00 V with a range of 4.90 V to 5.10 V. The AI1 minimum input 0.00 V corresponds to 0.0% and maximum input 10.00 V corresponds to 100.0%. The detected percentage corresponding to AI1 varies between 49.0% and 51.0%.

If you set A6-24 to 50.0% and A6-25 to 1.0%, then the percentage corresponding to AI1 input is fixed to 50.0%, eliminating the fluctuation.

Group AC AI/AO correction

AC-00	AI1 measured voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-01	AI1 displayed voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-02	AI1 measured voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	

AC-03	AI1 displayed voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-04	AI2 measured voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-05	AI2 displayed voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-06	AI2 measured voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-07	AI2 displayed voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-08	AI3 measured voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-09	AI3 displayed voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-10	AI3 measured voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-11	AI3 displayed voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	

These parameters are used to correct the AI to eliminate the impact of AI zero offset and gain.

This group of parameters have been corrected by default. If restored to default, these setpoints are restored to the values calibrated by default. Generally, no calibration is needed on site.

The measured voltage indicates the actual output voltage measured by instruments such as the multimeter. The displayed voltage indicates the voltage sampled and displayed by the drive. For details, see U0-21, U0-22, and U0-23.

During correction, send two voltage values to each AI terminal, and save the measured values and displayed values in group U0 to AC-00...AC-03. Then the drive automatically performs AI zero offset and gain correction.

AC-12	A01 target voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-13	A01 measured voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-14	A01 target voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-15	A01 measured voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-16	A02 target voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-17	A02 measured voltage 1	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-18	A02 target voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	
AC-19	A02 measured voltage 2	Default	Factory-calibrated
	Setting range	-10.000 V to +10.000 V	

These parameters are used to correct the AO.

This group of parameters have been corrected by default. If restored to default, these setpoints are restored to the values calibrated by default. Generally, no calibration is needed on site.

The target voltage indicates the theoretical output voltage of the drive. The measured voltage indicates the actual output voltage value measured by instruments such as the multimeter.

Group U0: Monitoring Parameters

Group U0 is used to monitor the AC drive operating state. You can view the parameter values through the operating panel or through the host controller via communication (address: 0x7000 to 0x7044).

U0-00 to U0-31 are the operation and monitoring parameters defined by F7-03 and F7-04.

For details, see Table 6-1.

U0-00	Operating frequency	Display range	0.00 Hz to 500.00 Hz
U0-01	Frequency reference		

These two parameters display the absolute value of theoretical operating frequency and frequency reference. When the displayed value is between 0.00 Hz and 300.00 Hz, two decimal places are displayed. If the value is not within this range, it is automatically adjusted to one decimal place.

For the actual output frequency of the drive, see U0-19.

U0-02	Bus voltage	Display range	0.0 V to 3000.0 V

It displays the bus voltage of the AC drive.

U0-03	Output voltage	Display range	0 V to 1140 V

It displays the output current of the AC drive in the operating state.

U0-04	Output current	Display range	0.00 A to 655.35 A

It displays the output current of the AC drive in the operating state.

U0-05	Output power	Display range	0.00 kW to 327.67 kW

It displays the output power of the drive during operation.

U0-06	Output torque	Display range	-200.0% to +200.0%

It displays the output torque of the AC drive in the operating state.

U0-07	DI input state	Display range	0 to 32767

It displays the state value of the DI. After the value is converted into a binary value, each bitcorresponds to a DI. "1" indicates high level signal, and "0" indicates low level signal. The mapping relationship between bits and DIs is described in the following table.

bit0	bit1	bit2	bit3
DI1	DI2	DI3	DI4
bit4	bit5	bit6	bit7
DI5	DI6	DI7	DI8
bit8	bit9	bit10	bit11
DI9	DI10	VDI1	VDI2
bit12	bit13	bit14	bit15
VDI3	VDI4	VDI5	

U0-08	DO output state	Display range	0 to 1023

It displays the state value of the DO. After the value is converted into a binary value, each bitcorresponds to a DO. "1" indicates high level signal, and "0" indicates low level signal. The mapping relationship between bits and DOs is described in the following table.

bit0	bit1	bit2	bit3
DO3	Relay 1	Relay 2	DO1
bit4	bit5	bit6	bit7
DO2	VDO1	VDO2	VDO3
bit8	bit9	bit10	bit11
VDO4	VDO5		

U0-14	Load speed display	Display range	0 to 65535

For details, see the description of F7-12.

U0-15	PID setting	Display range	0 to 65535
U0-16	PID feedback	Display range	0 to 65535

They display the PID setting value and PID feedback value.

PID setting = PID setting (percentage) x FA-04

PID feedback = PID feedback (percentage) x FA-04

U0-18	Pulse input frequency	Display range	0.00 kHz to 20.00 kHz

It displays the high-speed pulse sampling frequency of DI5, in minimum unit of 0.01 kHz.

U0-19	Feedback speed	Display range	-500.0 Hz to +500.0 Hz

It displays the actual output frequency of the drive.

When the value of U0-19 is between -99.99 Hz and +300.00 Hz, two decimal places are displayed. If the value is not within this range, it is automatically adjusted to one decimal place.

U0-20	Remaining operating time	Display range	0.0 to 6500.0 min

It displays the remaining operating time during timed operation.

For details on timed operation, see F8-42 to F8-44.

U0-21	AI1 voltage before calibration	Display range	0.00 V to 10.57 V
U0-22	AI2 voltage before calibration	Display range	0.00 V to 10.57 V

U0-23	AI3 voltage before calibration	Display range	-10.57 V to +10.57 V

They display the AI sampling voltage.

The voltage in use has been linearly calibrated to reduce the deviation between the sampled voltage and the actual input voltage. For calibrated voltage in use, see U0-09, U0-10 and U0-11. See parameters in group AC for the calibration mode.

Note: U0-21 to U0-23 are displayed with three decimal places, but when the displayed value is negative, the five LEDs may not insufficient because the negative sign (-) is displayed. In this case, only two decimal places are displayed, and the last decimal place is not displayed.

U0-24	Motor speed	Display range	0 m/min to 65535 m/min

It displays the motor speed in m/min.

U0-27	Pulse input frequency	Display range	0 Hz to 65535 Hz

It displays the high-speed pulse sampling frequency of DI5, in unit of 1 Hz. It is the same as U0-18, except for the difference in unit.

U0-28	Communication setpoint	Display range	-100.00% to +100.00%

It displays data written through communication address 0x1000.

U0-30	Display of main frequency X	Display range	0.00 Hz to 500.00 Hz

It displays the setting of main frequency source X.

When the displayed value is between 0.00 Hz and 300.00 Hz, two decimal places are displayed. If the value is not within this range, it is automatically adjusted to one decimal place.

U0-31	Auxiliary frequency reference Y	Display range	0.00 Hz to 500.00 Hz

It displays the setting of auxiliary frequency source Y.

When the displayed value is between 0.00 Hz and 300.00 Hz, two decimal places are displayed. If the value is not within this range, it is automatically adjusted to one decimal place.

U0-35	Target torque	Display range	-200.0% to +200.0%

It displays the current torque upper limit.

U0-37	Power factor angle	Display range	-180° to +180°

It indicates the current power factor angle.

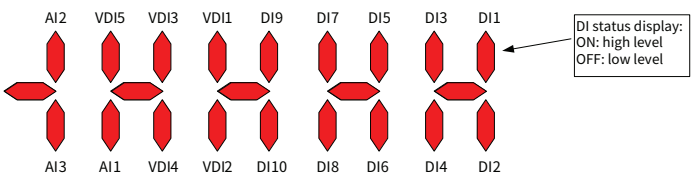
U0-39	Target voltage upon separated V/f	Display range	0 V to Rated motor voltage
U0-40	Output voltage upon separated V/f	Display range	0 V to Rated motor voltage

These parameters display the target output voltage and actual output voltage in the separated V/f state.

For separated V/f, see the descriptions of parameters in group F3.

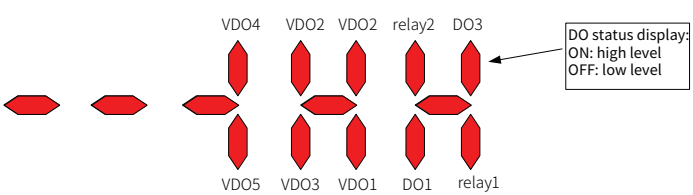
U0-41	DI input state display	Display range	-

It displays the DI state, as shown in the following figure.



U0-42	DO output state display	Display range	-

It displays the DO state, as shown in the following figure.

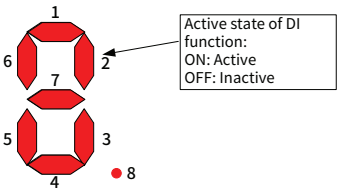


U0-43	DI function state display 1	Display range	-

It displays whether the DI functions 1-40 are active.

The operating panel has five 7-segment LEDs and each 7-segment LED displays eight functions.

The 7-segment LED is defined in the following figure.



The 7-segment LEDs display functions 1–8, 9–16, 17–24, 25–32 and 33–40 respectively from right to left.

U0-44	Reserved	Display range	-

It displays whether the DI functions 41-59 are active.

Similar to U0-43,

the 7-segment LEDs display functions 41–48, 49–56 and 57–59 respectively from right to left.

U0-61	AC drive operating status	Display range	0 to 65535

It displays the operating state of the AC drive.

The data format is listed in the following table.

U0-61	bit0	0: Stopped; 1: Operating
	bit1	
	bit2	0: Constant speed; 1: Acceleration; 2: Deceleration
	bit3	
	bit4	0: Bus voltage OK; 1: Undervoltage

U0-66	Model of communication expansion card	Display range	200: PROFIBUS DP 300: CANlink
U0-67	Communication expansion card version	Display range	-

U0-76	Low bits of accumulative power consumption	Display range	0 kWh to 999.9 kWh
U0-77	High bits of accumulative power consumption	Display range	0 kWh to 65535 x 1000 kWh

7 Electromagnetic Compatibility (EMC)

7.1 Definition of Terms

Electromagnetic compatibility (EMC) describes the ability of electronic and electrical devices or systems to work properly in the electromagnetic environment and not to generate electromagnetic interference that influences other local devices or systems. EMC includes two aspects: The electromagnetic interference generated by a device or system must be restricted within a certain limit; the device or system must have sufficient immunity to the electromagnetic interference in the environment.

First environment: Environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes.

Second environment: Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

Category C1 drive: Power Drive System (PDS) of rated voltage less than 1,000 V, intended for use in the first environment.

Category C2 drive: PDS of rated voltage less than 1000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional.

Category C3 drive: PDS of rated voltage lower than 1000 V, intended for use in the second environment and not intended for use in the first environment.

Category C4 drive: PDS of rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

7.2 Introduction to EMC standards

7.2.1 EMC Standards

The drive satisfies EN 61800-3:2004/A1:2012:2004 C2. The drives are applied to both the first environment and the second environment.

7.2.2 EMC Requirements of Mounting Environment

The integrator of the system installed with the AC drive is responsible for compliance of the system with the European EMC directive and standard EN 61800-3:2004/A1:2012 C2 Category C2, C3 or C4 according to the system application environment.

Machines and devices used in combination with this drive must also be CE certified and marked. The
integrator who integrates the drive with the CE mark in into other devices has the responsibility of ensuring
compliance with European directives and verifying that conditions meet requirements of EN 61800-

3:2004/A1:2012 C2 Category C2.

CAUTION

◆ If applied in the first environment, the controller may generate radio interference. Besides the CE compliance described in this chapter, users must take measures to avoid such interference, if necessary.

7.3 Selection of Peripheral EMC Devices

7.3.1 Installation of EMC Input Filter on Power Input Side

The MD310 series AC drive has a built-in filter to reduce external electromagnetic noise.

An EMC filter installed between the drive and the power supply can not only restrict the interference of electromagnetic noise in the surrounding environment on the controller, but also prevent the interference from the controller on the surrounding equipment. The drive satisfies the requirements of category C2 only with an EMC filter installed on the power input side. The installation precautions are as follows:

Strictly comply with the ratings when using the EMC filter. The EMC filter is category I electric apparatus, and therefore, the metal enclosure ground of the filter should be in good contact with the metal ground of the installation cabinet on a large area, and requires good conductive continuity. Otherwise, electric shock or poor EMC effect may occur.

The filter GND and the PE (GND) of the drive must be connected to the same common GND. Failure to comply can affect the EMC effect seriously.

Install the EMC filter as close as possible to the power input side of the drive.

The following table lists the recommended manufacturers and models of EMC filters for the drive. Select a proper one based on actual requirements.

Table 7-1 Recommended EMC filter manufacturers and models

Drive model	Power capacity (kVA)	Rated input current (A)	AC input reactor model (JIANLI)	AC input reactor model (SCHAFNER)
Three-phase power supply: 380 V, 50/60 Hz				
MD310T0.4B	1.2	1.9	DL-5EBK5	FN 3258-7-44
MD310T0.7B	1.5	3.4	DL-5EBK5	FN 3258-7-44
MD310T1.5B	3	5	DL-5EBK5	FN 3258-7-44
MD310T2.2B	4	5.8	DL-10EBK5	FN 3258-7-44
MD310T3.7B	5.9	10.5	DL-16EBK5	FN 3258-16-3:4
MD310T5.5B	8.9	14.6	DL-16EBK5	FN 3258-16-3:4
MD310T7.5B	11	20.5	DL-25EBK5	FN 3258-30-33
MD310T11B	17	26	DL-35EBK5	FN 3258-30-33
MD310T15B	21	35	DL-35EBK5	FN 3258-42-33
MD310T18.5B	24	38.5	DL-50EBK5	FN 3258-42-33

Descriptions of mounting dimensions:

Dimensions of Schaffner FN 3258 series filters (7 A to 55 A)

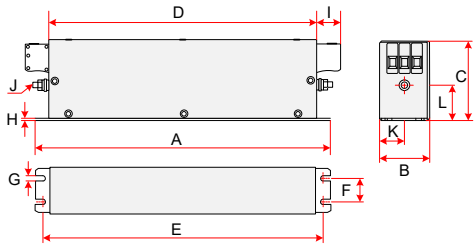


Figure 7-1 Dimensions of Schaffner FN 3258 series filter of 7 A to 55 A

Table 7-2 Dimensions of Schaffner FN 3258 series filter of 7 to 55 A

Rated current (A)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	I (mm)	J	K (mm)	L (mm)
7	190	40	70	160	180	20	4.5	1	22	M5	20	29.5
16	250	45	70	220	235	25	5.4	1	22	M5	22.5	29.5
30	270	50	85	240	255	30	5.4	1	25	M5	25	39.5
42	310	50	85	280	295	30	5.4	1	25	M6	25	37.5
55	250	85	90	220	235	60	5.4	1	39	M6	42.5	26.5

Dimensions of Jianli series filters

1) Dimensions of Jianli series filter DL-5EBK5

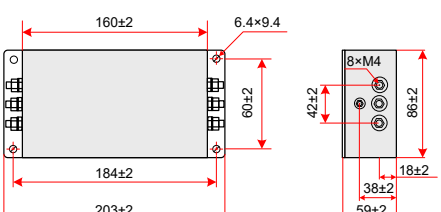


Figure 7-2 Dimensions of Jianli series filter DL-5EBK5 (unit: mm)

2) Dimensions of Jianli series filter DL-10EBK5/DL-16EBK5:

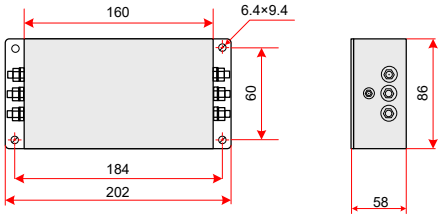


Figure 7-3 Dimensions of Jianli series filter DL-10EBK5/DL-16EBK5 (unit: mm)

3) Dimensions of Jianli series filter DL-25EBK5/DL-35EBK5/DL-50EBK5:

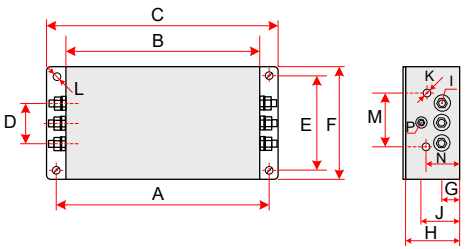


Figure 7-4 Dimensions of Jianli series filter DL-25EBK5/DL-35EBK5/ DL-50EBK5

Table 7-3 Dimensions (unit: mm) of Jianli series filters (25 A to 50 A)

Model	A	B	C	D	E	F	G	H	I	J	K	M	N	P	L
DL-25EBK5															
DL-35EBK5	243	224	265	58	70	102	25	92	M6	58	M4	74	49	M6	6.4 x 9.4
DL-50EBK5															

7.3.2 Installing the AC Input Reactor on Power Input Side

Installing the input reactor on the input side of the drive can improve the input power factor, suppress the high harmonics of the input current of the AC drive, and reduce external conduction and radiation interference. In applications where harmonics need to be suppressed, install an external reactor. The following table lists the recommended manufacturers and models of input reactors.

Table 7-4 Recommended manufacturers and models of AC input reactors

Drive model	Rated input current (A)	AC input reactor model (Inovance)
Three-phase power supply: 380 V, 50/60 Hz		
MD310T0.4B	1.9	MD-ACL-7-4T-222-2%
MD310T0.7B	3.4	MD-ACL-7-4T-222-2%

Drive model	Rated input current (A)	AC input reactor model (Inovance)
MD310T1.5B	5	MD-ACL-7-4T-222-2%
MD310T2.2B	5.8	MD-ACL-7-4T-222-2%
MD310T3.7B	10.5	MD-ACL-10-4T-372-2%
MD310T5.5B	14.6	MD-ACL-15-4T-552-2%
MD310T7.5B	20.5	MD-ACL-30-4T-113-2%
MD310T11B	26	MD-ACL-30-4T-113-2%
MD310T15B	35	MD-ACL-40-4T-153-2%
MD310T18.5B	38.5	MD-ACL-40-4T-153-2%

7.3.3 Installing AC Output Reactor on the Output Side of the Drive

Whether to install an AC output reactor on the output side of the AC drive depends on actual situation. The cables connecting the drive and motor cannot be excessively long. Excessively long cables can incur large distributed capacitance, which may result in high harmonic current.

When the output cable is excessively long, install an output reactor. When the cable length is greater than or equal to the recommended value in the following table, install an AC output reactor around the drive.

Table 7-5 Min. cable length for optional output reactor

AC drive power (kW)	Rated voltage (V)	Min. cable length for optional output reactor (m)
< 4	200 to 500	50
5.5	200 to 500	70
7.5	200 to 500	100
11	200 to 500	110
15	200 to 500	125
18.5	200 to 500	135

The recommended AC output reactor models are listed in the following table.

Table 7-6 Recommended manufacturers models of the AC output reactor

Drive model	Rated output current (A)	AC output reactor models (manufacturer EAGTOP recommended)
Three-phase power supply: 380 V, 50/60 Hz		
MD310T0.4B	1.5	OCL-0005-EISC-E1M4
MD310T0.7B	2.1	OCL-0005-EISC-E1M4
MD310T1.5B	3.8	OCL-0005-EISC-E1M4
MD310T2.2B	5.1	OCL-0007-EISC-E1M0

Drive model	Rated output current (A)	AC output reactor models (manufacturer EAGTOP recommended)
MD310T3.7B	9	OCL-0010-EISC-EM70
MD310T5.5B	13	OCL-0015-EISC-EM47
MD310T7.5B	17	OCL-0020-EISC-EM35
MD310T11B	25	OCL-0030-EISC-EM23
MD310T15B	32	OCL-0040-EISC-EM18
MD310T18.5B	37	OCL-0050-EISC-EM14

7.4 Shielded Cables

7.4.1 Requirements for Shielded Cables

Shielded cables must be used to satisfy the EMC requirements in CE certification. Shielded cables are classified into three-conductor cables and four-conductor cables. If the conductivity of the cable shield is insufficient, add an extra PE cable or use a four-conductor shielded cable, with one conductor of which being PE cable, as shown below.

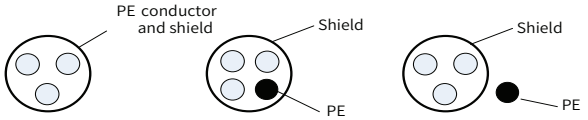


Figure 7-5 Cross sectional area of shielded cable

To suppress emission and conduction of the radio frequency interference effectively, the shield of the shielded cable is cooper braid. The braided density of the cooper braid should be greater than 90% to enhance the shielding efficiency and conductivity, as shown in the following figure.

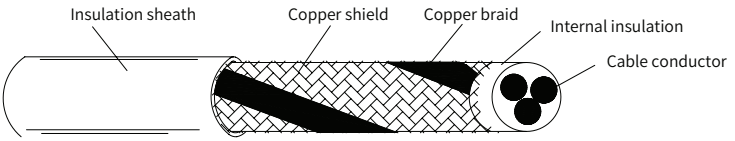


Figure 7-6 Braided density of shield

The following figure shows the grounding method of the shielded cable.

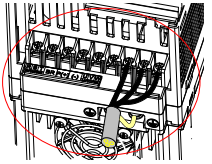


Figure 7-7 Grounding of the shielded cable

Safety precautions:

1) Symmetrical shielded cable is recommended. The four-conductor shielded cable can also be used as an input cable.
2) The motor cable and PE shielded conductor (twisted shielded) must be as short as possible to reduce electromagnetic radiation, external stray current, and capacitive current of the cable. For the motor cable longer than 100 m, install an output filter or reactor.
3) It is recommended that all control cables be shielded.
4) It is recommended to use shielded power cables or power cables with steel tube as the shield, with the shield grounded properly. For drain wires of disturbed devices, it is recommended to use shielded twisted pairs as the control cable, with the shield grounded properly.

7.4.2 Cable Routing Requirements

1) Route the motor cables away from other cables. Motor cables of several drives can be laid in parallel.
2) It is recommended that motor cables, power input cables and control cables be laid in different cable ducts. To avoid electromagnetic interference caused by rapid change of the output voltage of the drive, the motor cables and other cables cannot be laid side by side for a long distance.
3) If the control cable must be routed through the power cables, make sure that the angle between the control cable and power cable is close to 90° . Other cables cannot run through the drive.
4) Power input and output cables of the drive and weak-current signal cables (such as control cables) must be laid vertically (if possible) rather than in parallel.
5) The cable ducts must be in good connection between each other and well grounded. Aluminum duct can be used to improve equipotentiality.
6) Connect the filter, AC drive, and motor to the system (machines or devices) properly. Protect all connections with spray coating and ensure good contact of conductive metal.

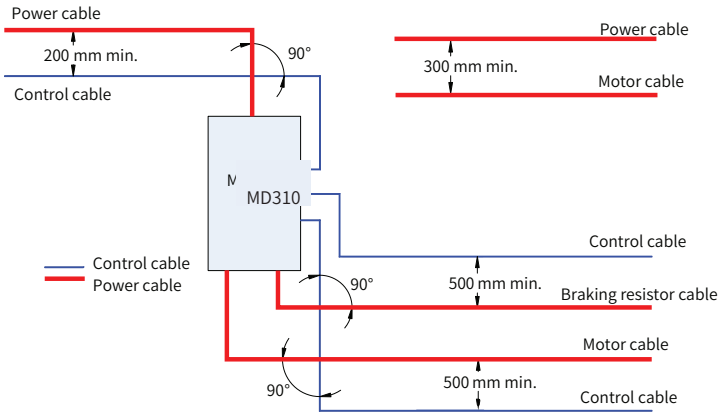


Figure 7-8 Wiring of cables

7.5 Solutions to Leakage Current

1) The drive outputs high-speed pulse voltage, generating high-frequency leakage current during operating of the drive. To prevent electric shock and even a fire, it is necessary to install a residual current protection device to the drive.
2) The leakage current generated by the drive can exceed 100 mA. Therefore, the induced current of the residual current protection device must be above 100 mA.
3) The high-frequency pulse interference may cause the protection device to malfunction, thus the residual current protection device must have the high-frequency filtering function.
4) If multiple AC drives are required, each AC drive must be installed with a residual current protection device.
5) The factors that affect the leakage current are as follows:
   - AC drive capacity
   - Carrier frequency
   - Type and length of the motor cable
   - EMI Filter
6) When the leakage current causes the residual current protection device to act, you should:
   - Increase induced current of the residual current protection device.
   - Replace the residual current protection device with a new one that carries high-frequency suppression function.
   - Reduce the carrier frequency.
   - Shorten the length of the output cable.
   - Install a leakage current suppression device.

7) Description of the safety capacitor jumper:

The drive is equipped with a safety capacitor. When the residual current protection device trips due to high leakage current upon power-on, you can reduce the leakage current to the ground during power-on by disconnecting the safety capacitor jumper. The following figure shows the position and disconnection of the safety capacitor jumper, which is connected by default.

- Note: The safety capacitor cannot be restored after the safety capacitor jumper is disconnected. The leakage current to the ground will increase during operating.

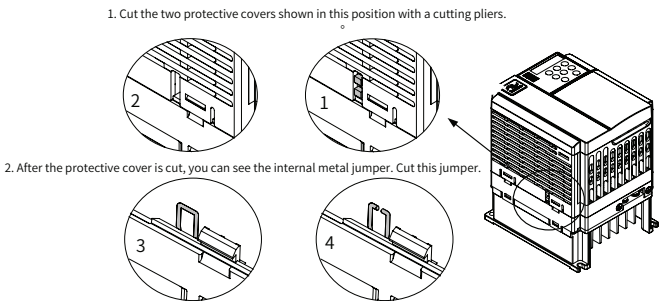


Figure 7-9 Position and disconnection of the safety capacitor jumper of MD310T0.4B, MD310T0.7B, MD310T1.5B, MD310T2.2B, MD310T3.7B, and MD310T5.5B.

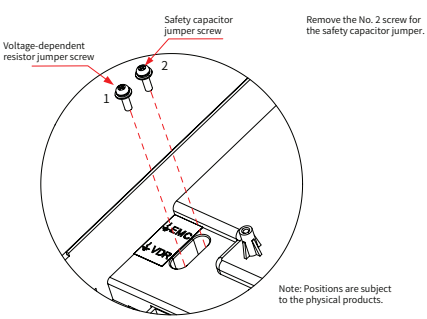


Figure 7-10 Position and disconnection of safety capacitor jumper of MD310T7.5B, MD310T11B, MD310T15B, and MD310T18.5B

7.6 Power Grid System Requirement

The drive is applicable to power grid systems with neutral points grounded. If the drive is used in an IT system (where the neutral point is not grounded), screws shown in Figure 7-11 and Figure 7-12 must be removed.

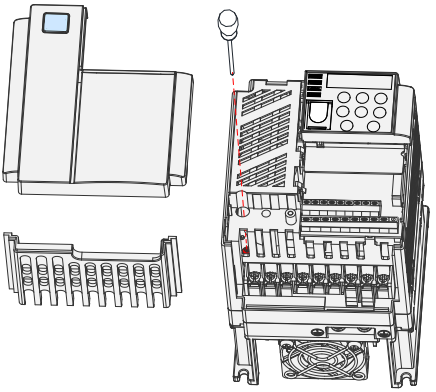


Figure 7-11 Position of the screws connected to the PE of the voltage-dependent resistor and safety capacitor of MD310T0.4B, MD310T0.7B, MD310T1.5B, and MD310T2.2B

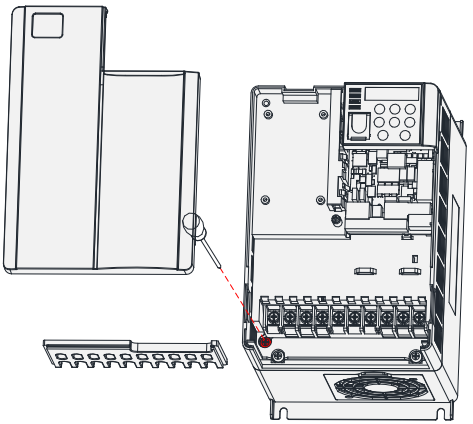


Figure 7-12 Position of the screws connected to PE of the voltage-dependent resistor and safety capacitor of MD310T3.7B and MD310T5.5B

For models MD310T7.5B, MD310T11B, MD310T15B, and MD310T18.5B, it is necessary to remove the jumpers to ground of the voltage-dependent resistor and safety capacitor, which is screw 1 and screw 2 in Figure 7-10. Do not install the filter, failure to comply can result in danger or damage the drive.

7.7 Solutions to Common EMC Interference

The AC drive generates strong interference during operation. Although EMC measures are taken, interference may still exist due to improper cabling or grounding. In this case, take the following

measures.

Table 7-7 Solutions to common EMC interference problems

Interference type	Solution
Tripping of residual current protection device	◆ Connect the motor enclosure to the PE of the drive. ◆ Connect the PE of the drive to the PE of the mains power supply. ◆ Install a safety capacitor box to the power input cable. ◆ Wind the power input cable around the magnetic ring by two or three turns.
Interference generated during operation of the drive	◆ Connect the motor enclosure to the PE of the drive. ◆ Connect the PE of the drive to the PE of the mains power supply. ◆ Install a safety capacitor to the power input cable and wind the cable around the magnetic ring. ◆ Install a capacitor to the disturbed signal terminal or wind the cable around the magnetic ring. ◆ Connect the equipment to the common ground.
Communication interference	◆ Connect the motor enclosure to the PE of the drive. ◆ Connect the PE of the drive to the PE of the mains power supply. ◆ Install a safety capacitor to the power input cable and wind the cable around the magnetic ring. ◆ Install termination resistors to the communication cable source and load end. ◆ Install a communication common grounding cable to the communication cable. ◆ Use a shielded cable as the communication cable, with the shield connected to the common GND of communication.
I/O interference	◆ Increase the filtering capacitance of the low-speed DI. The recommended maximum value is 0.1 uF. ◆ Increase the filtering capacitance of the AI. The recommended maximum value is 0.22 uF.

8 Troubleshooting

8.1 Fault List and Solutions

If a fault occurs during operation, the drive stops output and protects the motor immediately, with the fault relay contact acts accordingly. In this case, the operating panel displays the fault code. See the following table for details for how to rectify the fault. The following information is used for reference only. Do not repair or retrofit the drive by yourself. If the fault cannot be rectified, contact the agent or Inovance for technical support.

● Note: The drive may encounter faults and alarms. Faults have higher priority over alarms. When alarms occur, the drive continues operating.

1. Display upon faults (such as Err07)
2. Display upon alarms (such as A08)

Table 8-1 Fault list and solutions

Fault code	Name	Cause	Solution
Err02	Overcurrent during acceleration	The output circuit of the AC drive is grounded or short-circuited.	Rectify external faults.
		The control mode is SVC but motor auto-tuning is not performed.	Set the motor parameters according to the motor nameplate and perform motor parameter auto-tuning.
		The acceleration time is too short.	Increase the acceleration time.
		The manual torque boost or V/f curve is improper.	Adjust the customized torque boost or V/f curve.
		The voltage is excessively low.	Adjust the voltage to a value within the normal range.
		The motor is started while rotating.	Select the flying start mode or start the drive after the motor stops.
		A sudden load is applied during acceleration.	Remove the load added suddenly.
		The braking unit or braking resistor is not installed.	Install the braking unit and braking resistor.
		The resistance of the braking resistor is too low or the braking resistor is short-circuited.	Replace the braking resistor.
		The motor is short-circuited to ground.	Replace the cable or motor.

Fault code	Name	Cause	Solution
Err03	Overcurrent during deceleration	The output circuit of the AC drive is grounded or short-circuited.	Rectify external faults.
		The control mode is SVC but motor auto-tuning is not performed.	Set the motor parameters according to the motor nameplate and perform motor parameter auto-tuning.
		The deceleration time is too short.	Increase the deceleration time.
		The voltage is excessively low.	Adjust the voltage until it is within the normal range.
		A sudden load is added during deceleration.	Remove the load added suddenly.
		The braking unit or braking resistor is not installed.	Install the braking unit and braking resistor.
		The resistance of the braking resistor is too low or the braking resistor is short-circuited.	Replace the braking resistor.
		The motor is short-circuited to ground.	Replace the cable or motor.
Err04	Overcurrent during operation at constant speed	The output circuit of the AC drive is grounded or short-circuited.	Check whether the motor is short-circuited or disconnected.
		The control mode is SVC but motor auto-tuning is not performed.	Set the motor parameters according to the motor nameplate and perform motor parameter auto-tuning.
		The voltage is excessively low.	Adjust the voltage to a value within the normal range.
		A sudden load is applied during operating.	Remove the load added suddenly.
		The power rating of the drive is too low.	Replace the drive with the one of higher power rating.
		The resistance of the braking resistor is too low or the braking resistor is short-circuited.	Replace the braking resistor.
		The motor is short-circuited to ground.	Replace the cable or motor.
Err05	Overvoltage during acceleration	The input voltage is too high.	Adjust the voltage to a value within the normal range.
		An external force drives the motor during acceleration.	Remove the external force or install a braking resistor.
		The acceleration time is too short.	Increase the acceleration time.
		The braking unit or braking resistor is not installed.	Install the braking unit and braking resistor.

Fault code	Name	Cause	Solution
Err06	Overvoltage during deceleration	The input voltage is too high.	Adjust the voltage to a value within the normal range.
		An external force drives the motor during deceleration.	Remove the external force or install a braking resistor.
		The deceleration time is too short.	Increase the deceleration time.
		The braking unit or braking resistor is not installed.	Install the braking unit and braking resistor.
Err07	Overvoltage during operation at constant speed	The input voltage is too high.	Adjust the voltage to a value within the normal range.
		External force drives the motor during operating.	Remove the external force or install a braking resistor.
Err08	Pre-charge resistor fault	The input voltage is beyond the specified range.	Adjust the input voltage to the specified range.
Err09	Undervoltage	Instantaneous power failure occurs.	Reset the fault.
		The input voltage of the drive is beyond the specified range.	Adjust the voltage to a value within the normal range.
		The bus voltage is abnormal.	Contact the agent or Inovance for technical support.
		The rectifier bridge and pre-charge resistor are faulty.	Contact the agent or Inovance for technical support.
		The driver board is abnormal.	Contact the agent or Inovance for technical support.
		The control board is abnormal.	Contact the agent or Inovance for technical support.
Err10	Drive overload	The load is too heavy or the motor is stalled.	Reduce the load and check the motor and mechanical conditions.
		The power rating of the drive is too low.	Replace the drive with the one of higher power rating.
Err11	Motor overload	F9-01 is set improperly.	Set this parameter properly.
		The load is too heavy or the motor is stalled.	Reduce the load and check the motor and mechanical conditions.
		The power rating of the drive is too low.	Replace the drive with the one of higher power rating.
Err12	Input phase loss	The three-phase input power supply is abnormal.	Check and eliminate faults in peripheral circuits.
		The driver board is abnormal.	Contact the agent or Inovance for technical support.
		The lightning protection board is abnormal.	Contact the agent or Inovance for technical support.
		The main control board is abnormal.	Contact Inovance for technical support.

Fault code	Name	Cause	Solution
Err13	Output phase loss	The cable connecting the drive and the motor is faulty.	Rectify external faults.
		The three-phase outputs of the AC drive are unbalanced during operation.	Check whether the motor three-phase winding is normal and rectify the fault.
		The lightning protection board is abnormal.	Contact Inovance for technical support.
		The module is faulty.	Contact the agent or Inovance for technical support.
Err14	Drive overtemperature	The ambient temperature is too high.	Lower down the ambient temperature.
		The air duct is blocked.	Clean the air duct.
		The fan is damaged.	Replace the damaged fan.
		The thermistor is damaged.	Contact the agent or Inovance for technical support.
		The module is damaged.	Contact the agent or Inovance for technical support.
Err15	External device fault	External fault signals are inputted through the DI.	Reset the operation.
		An external fault signal is inputted through the virtual I/O.	Reset the operation.
Err16	Communication fault	Modbus communication times out.	Check whether the RS485 communication cable is connected properly. Check whether the setpoint of Fd-04 and PLC communication cycle are proper.
		CANopen communication times out.	Check whether the CAN communication cable is connected properly. View Fd-15...Fd-17 to check for interference.
		The PDO mapping configured by CANopen is inconsistent with the actual communication mapping.	Check the PDO mapping in group FE/AF.
		CANlink heartbeat times out.	Check whether the CAN communication cable is connected properly. View Fd-15...Fd-17 to check for interference.
		CANlink station numbers conflict.	Modify the repeated CAN station numbers through Fd-13.
		PROFIBUS DP communication times out.	Check whether the PROFIBUS DP communication cable is connected properly.
Err17	Contactor fault	The driver board and power supply are abnormal.	Replace the driver board or power supply board.
		The contactor is faulty.	Replace the contactor.
		The lightning protection board is abnormal.	Replace the lightning protection board.
Err18	Current detection circuit fault	The driver board is abnormal.	Replace the drive board.

Fault code	Name	Cause	Solution
Err19	Motor parameter auto-tuning fault	The motor parameters are not set according to the nameplate.	Set the motor parameters correctly according to the motor nameplate.
		Parameter auto-tuning timeout	Check the cables connecting the AC drive and the motor.
Err21	EEPROM read-write fault	The EEPROM chip is damaged.	Replace the main control board.
Err23	AC drive output short-circuited to ground	The motor is short-circuited to ground.	Replace the cable or motor.
Err26	Accumulative operating time reached	The accumulative operating time reaches the set value.	Clear the record by parameter initialization.
Err27	User-defined fault 1	The signal of user-defined fault 1 is inputted through the DI.	Reset the operation.
		The signal of user-defined fault 1 is inputted through virtual I/O.	Reset the operation.
Err28	User-defined fault 2	The signal of user-defined fault 2 is inputted through the DI.	Reset the operation.
		The signal of user-defined fault 2 is inputted through virtual I/O.	Reset the operation.
Err29	Accumulative power-on time reached	The accumulative power-on time reaches the set value.	Clear the record by parameter initialization.
Err30	Load loss	The load is disconnected during operation of the drive.	Check whether the load is disconnected.
Err31	PID feedback loss during operation	The PID feedback is lower than the setpoint of FA-26.	Check the PID feedback signal or set FA-26 properly.
Err33	Internal communication reception timeout of the driver board	1. The internal cables of the drive are connected loosely. 2. The driver board is abnormal. 3. The control board is abnormal.	1. Check whether the internal control board-driver cable is connected loosely. 2. Contact the agent or Inovance for technical support.
Err40	Pulse-by-pulse current limit fault	The load is too heavy or the motor is stalled.	Reduce the load and check the motor and mechanical conditions.
		The power rating of the drive is too low.	Replace the drive with the one of higher power rating.
Err41	Motor switchover fault during operating	The motor is switched through the terminal during operation of the drive.	Perform motor switchover after the AC drive stops.

Fault code	Name	Cause	Solution
Err42	Excessively high speed deviation	The motor is stalled.	Check the mechanical conditions. Check whether motor parameter auto-tuning is performed and whether F2-10 is set to an excessively low value.
		Speed deviation detection parameters F9-69 and F9-70 are set improperly.	Speed deviation detection parameters F9-69 and F9-70 are set improperly.
		The cable connecting the output side (UVW) of the drive and the motor is faulty.	Check whether the cables connecting the AC drive and the motor are disconnected.
Err45	Motor temperature fault	The cable of the temperature sensor is connected loosely.	Check whether the temperature sensor is connected loosely. If yes, connect the cable properly.
		Motor overtemperature occurs.	Increase the carrier frequency or take other measures to cool the motor down.
		The value of F9-57 (Motor overtemperature protection threshold) is too low.	Increase the motor overtemperature protection threshold (90°C to 100°C for normal motors).
Err55	Master-slave control fault	The slave is faulty.	Rectify the fault according to the slave fault code.
Err61	Braking transistor overload	The resistance of the braking resistor is too low.	Use a braking resistor of higher resistance.
Err62	Braking transistor short-circuited	The braking unit is short-circuited.	Check whether the braking transistor is normal. Check whether an external braking resistor is used.
Err96	Control board internal communication timeout	The internal cables are connected loosely.	Connect all cables properly.
		The driver board is abnormal.	Contact the agent or Inovance for technical support.
		The control board is abnormal.	Contact the agent or Inovance for technical support.

8.2 Symptoms and Solutions

The following symptoms may occur during use of the drive. When these symptoms occur, perform simple analysis according to the following table.

Table 8-2 Common faults and solutions

No.	Fault	Possible cause	Solution
1	There is no display upon power-on.	There is no voltage input or the input voltage is too low. The switched-mode power supply on the driver board is faulty. The rectifier bridge is damaged. The pre-charge resistor of the drive is damaged. Control board or the operating panel fault The control board is disconnected from the driver board and operating panel.	Check the input power supply. Check the bus voltage. Re-connect the 4-core and 28-core flat cables. Contact the agent or Inovance for technical support.
2	"HC" is displayed upon power-on.	The cable connecting the driver board and the control board is in poor contact. Related components on the control board are damaged. The motor or the motor cable is short-circuited to the ground. The mains voltage is too low.	Re-connect the 4-core and 28-core flat cables. Contact the agent or Inovance for technical support.
3	"Err23" is displayed upon power-on.	The motor or the motor cable is shorted to ground. The AC drive is damaged.	Check the insulation of the motor and the output cable with a megger. Contact the agent or Inovance for technical support.
4	The display is normal after power-on. After the drive is operating, "HC" is displayed and the drive stops immediately.	The fan is damaged or does not rotate. The cable of the external control terminal is short-circuited.	Replace the damaged fan. Rectify the external short circuit fault.
5	Err14 (Module overtemperature) is reported frequently.	The carrier frequency is set too high. The fan is damaged or the air duct is blocked. Components (thermocouple or others) inside the drive are damaged.	Reduce the carrier frequency (F0-15). Replace the cooling fan or clean the air duct. Contact the agent or Inovance for technical support.

No.	Fault	Possible cause	Solution
6	The motor does not rotate after the drive runs.	The cabling between the drive and the motor is abnormal. The motor parameters are set incorrectly. The cable connecting the driver board and the control board is in poor contact. The driver board is faulty.	Check that the cable between the AC drive and the motor is normal. Set the motor parameters correctly. Check and set the motor parameters again.
7	DI inactive	The related parameters are set incorrectly. The external signal is incorrect. The jumper between OP and +24 V is loose. The control board is faulty.	Check and set the parameters in group F4 again. Re-connect the external signal cables. Confirm the jumper between OP and +24V. Contact the agent or Inovance for technical support.
9	The drive detects overcurrent and overvoltage frequently.	Motor parameters in group F1 are set incorrectly. The acceleration/deceleration time is improper. The load fluctuates.	Set the motor parameters again or perform motor parameter auto-tuning. Set proper acceleration/deceleration time. Contact the agent or Inovance for technical support.
10	"Err17" is detected upon power-on or during operation.	The soft start contactor is not closed.	Check whether the contactor cable is loose. Check whether the contactor is faulty. Check whether 24 V power supply of the contactor is faulty. Contact the agent or Inovance for technical support.
11	There is no display upon power-on.	Related components on the control board are damaged.	Replace the control board.

9 Selection of Peripheral Electrical Devices

9.1 Selection of Peripherals and Options

Table 9-1 Selection of electrical peripheral components for the MD310 series drives (CE-compliant)

Drive model	Recommended fuse specifications		Recommended contactor specifications (ABB)	Recommended circuit breaker specifications (ABB)
	Rated current (A)	Model	Rated current (A)	Rated current (A)
MD310T0.4B	10	170M1358	9	4
MD310T0.7B	10	170M1358	9	6
MD310T1.5B	10	170M1358	9	10
MD310T2.2B	10	170M1358	12	10
MD310T3.7B	16	170M1359	18	16
MD310T5.5B	25	170M1361	25	20
MD310T7.5B	32	170M1362	25	25
MD310T11B	40	170M1363	32	32
MD310T15B	63	170M1365	50	50
MD310T18.5B	63	170M1365	50	50

◆ The recommended values in the preceding table are based on the following

- The ambient temperature of the device is 40°C and there is no forced air cooling method. The altitude is 2000 m. An individual drive is installed. The current-carrying density of the conductor or copper busbar is 1.3 A/mm^2.
- If the conditions are different, you need to select the model according to actual conditions.
- The fuse in the table is recommended according to the CE certification, which is based on 1 hour of overloaded (1.2 x rated load) operation.

Table 9-2 Selection of electrical peripheral components (UL-compliant)

Drive model	Recommended fuse specifications		Recommended contactor specifications (ABB)	Recommended circuit breaker specifications (ABB)
	Rated current (A)	Model	Rated current (A)	Rated current (A)
MD310T0.4B	5	FWP-5B	9	4
MD310T0.7B	10	FWP-10B	9	6
MD310T1.5B	15	FWP-15B	9	10
MD310T2.2B	15	FWP-15B	12	10
MD310T3.7B	25	FWP-25B	18	16

Drive model	Recommended fuse specifications		Recommended contactor specifications (ABB)	Recommended circuit breaker specifications (ABB)
	Rated current (A)	Model	Rated current (A)	Rated current (A)
MD310T5.5B	35	FWP-35C	25	20
MD310T7.5B	50	FWP-50C	25	25
MD310T11B	60	FWH-60C	32	32
MD310T15B	80	FWH-80C	50	50
MD310T18.5B	90	FWH-90C	50	50

◆ The recommended values in the preceding table are based on the following

- The ambient temperature of the device is 40°C and there is no forced air cooling method. The altitude is 2000 m. An individual drive is installed. The current-carrying density of the conductor or copper busbar is 1.3 A/mm^2.
- If the conditions are different, you need to select the model according to actual conditions.
- The fuse in the table is recommended according to the UL certification, which is based on 1 hour of overloaded (1.2 x rated load) operation.

9.2 Selection of Braking Unit and Braking Resistor

Braking resistor protection:

In applications where a braking resistor is installed, it is recommended to use a resistor with a temperature switch to ensure safety and avoid overtemperature and burning of the braking resistor. Connect the temperature switch output to the electromagnetic contactor control circuit on the front end of the AC drive (as shown in the following figure) to implement the interlock protection function. When the resistor overheats, a tripping fault occurs, preventing the resistor from being burned.

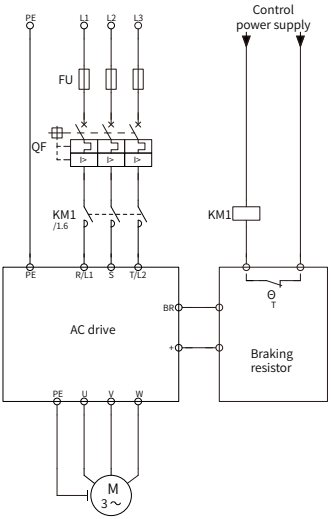


Figure 9-1 Braking resistor protection

The data in Table 9-3 is only for reference. You can select the resistance and power of the braking resistor as required. (Note that the resistance cannot be lower than the recommended minimum value, whereas the power can exceed or be equal to the recommended value.) The braking resistor model is dependent on the generating power of the motor in the actual system and is also related to the system inertia, deceleration time and potential energy load. You should select the braking resistor according to actual conditions. For systems featuring large inertia and requiring short deceleration time and frequent braking, select a braking resistor with high power and low resistance.

9.2.1 Calculating the Resistance

During braking, almost all the regenerative energy of the motor is consumed by the braking resistor. The power of the braking resistor can be obtained using the following formula:

$$U \times U/R = Pb$$

U: Braking voltage for stabilizing the brake (The braking voltage is considered as 700 V for the 380 VAC systems.)

Pb: Braking power

9.2.2 Power of the Braking Resistor

In theory, the power of the braking resistor is the same as the braking power. As the derating ratio is 70%, the power of the braking resistor can be obtained using the following formula:

$$0.7 \times Pr = Pb \times D$$

Pr: Power of the resistor

ED: Braking frequency (percentage of the regenerative process to the whole working process), which is 10% generally See the following table.

Type	Elevator	Decoiler and Recoiler	Centrifuge	Occasional Braking Load
Scale	20% to 30%	20% to 30%	50% to 60%	5%

Table 9-3 Models of MD310 series AC drive braking units

Drive model	Braking unit	125% of braking torque (ED: 10%; Max.: 10s)		Remarks	Minimum braking resistance
		Recommended braking resistor specifications	Quantity of braking resistors		
Three-phase 380 V					
MD310T0.4B	Built-in as standard	100 W 1556 Ω	1	No special remarks	250 Ω
MD310T0.7B		150 W 770 Ω	1		250 Ω
MD310T1.5B		250 W 380 Ω	1		250 Ω
MD310T2.2B		350 W 260 Ω	1		160 Ω
MD310T3.7B		600 W 140 Ω	1		124 Ω
MD310T5.5B		900 W 100 Ω	1		75 Ω
MD310T7.5B		1200 W 76 Ω	1		60 Ω
MD310T11B		2000 W 52 Ω	1		47 Ω
MD310T15B		1200 W 76 Ω	2		33 Ω
MD310T18.5B		2000 W 52 Ω	2		26 Ω

Appendix A: MD310 Modbus Communication Protocol

The MD310 series AC drive provides the RS-232/RS485 communication interface and supports the Modbus communication protocol. You can carry out centralized control through a PC or PLC and set the operation commands, modify or read parameters, and read the operating status and fault information of the drive through the communication protocol.

1. About the Protocol

This protocol defines content and format of information transmitted during serial communication. The format includes master polling (or broadcasting) and master coding method, and the content includes parameters for the action, transmission data, and error check. The slave uses the same structure in terms of response, including action confirmation, data returning and error check. If an error occurs when the slave receives a message, or the slave cannot perform the action required by the master, the slave returns a fault message as a response to the master.

Application mode

The AC drive is connected to a "single-master multi-slave" PC/PLC control network with RS-232/ RS485 bus.

Bus structure

(1) Interface mode

RS-232/RS485 hardware interface

(2) Transmission mode

The asynchronous serial and half-duplex transmission mode are used. At the same moment, either the master or the slave transmits the data and the other can only receive the data. During asynchronous serial communication, data is sent frame by frame in the form of messages.

(3) Topological structure

The system consists of a single master and multiple slaves. The address range of the slaves is from 1 to 247, and 0 is the broadcast address. A slave address must be unique in the network.

Protocol description

The Modbus communication protocol used by the MD310 series AC drive is an asynchronous serial master-slave Modbus communication protocol. In the network,only one device (master) can establish the protocol (called "inquiry/command"). Other devices (slaves) can only respond to the "inquiry/command" from the master by providing the data or act accordingly based on the "inquiry/command" from the master. The master here is a PC, an industrial device, or a PLC, and a slave is an MD310 AC drive. The master can communicate with a single slave or broadcast messages to all the slaves. The slave needs to return a message (response) to "query/command" from the master. For a broadcast message sent by the master, the slave does not need to return a response to the master.

(4) Communication data structure

The communication data format of the Modbus protocol used by the MD310 series drive is as follows.

In RTU mode, messages are sent with an interval of at least 3.5-byte. This is the byte time that can be achieved most easily at the network baud rate. The first field transmitted is the device address. The allowable transmitted bytes are hexadecimal 0 ... 9, A ... F. The network devices keep detecting the network bus, even during the silent interval. After receiving the first field (the address field), each device decodes the field to determined whether itself is the destination device. Following the last transmitted byte, an interval of at least 3.5-byte time marks the end of the message. A new message starts to be sent after this interval. A new message can be started after this pause.
The entire message frame must be transmitted as a continuous stream. If a silent interval of longer than 1.5-byte time occurs before completion of the frame, the receiving device refreshes the incomplete message and assumes that the next byte is the address field of a new message. Similarly, if a new message begins earlier than 3.5-byte time following a previous message, the receiving device considers the new message as a continuation of the previous message. This can lead to an error, as the value in the final cyclical redundancy check (CRC) field is incorrect.

RTU frame format:

<table>
<tr><td>Frame header (START)</td><td>3.5-byte time</td></tr>
<tr><td>Slave address (ADR)</td><td>Communication address: 1 to 247</td></tr>
<tr><td>Command code (CMD)</td><td>03: Read slave parameters; 06: Write slave parameters</td></tr>
<tr><td>Data content: DATA (N-1)</td><td rowspan="4">Content:
Indicates the parameter address, number of parameters, and parameter setpoints.</td></tr>
<tr><td>Data content: DATA (N-2)</td></tr>
<tr><td>…</td></tr>
<tr><td>Data content (DATA0)</td></tr>
<tr><td>CRC CHK high bit</td><td rowspan="2">Detection value: CRC16 value During transmission, low-order bytes follow the high-order bytes. For the calculation method, see the following descriptions of CRC.</td></tr>
<tr><td>CRC CHK low bit</td></tr>
<tr><td>END</td><td>3.5-byte time</td></tr>
</table>

CMD and DATA

Command code: 03H, reading N words (up to 12 words can be read continuously)
For example, the drive start address F002 of the slave 01 reads two consecutive values.

Command from the master

ADR	01H
CMD	03H
High bitof the start address	F0H
Low bitof the start address	02H

High bitof the number of registers	00H
Low bitof the number of registers	02H
CRC CHK low bit	56H
CRC CHK high bit	CBH

Response from the slave

When FD-05 is set to 0:

ADR	01H
CMD	03H
High bit of the number of bytes	00H
Low bit of the number of bytes	04H
Data F002H high bit	00H
Data F002H low bit	00H
Data F003H high bit	00H
Data F003H low bit	01H
CRC CHK low bit	82H
CRC CHK high bit	C7H

When FD-05 is set to 1:

ADR	01H
CMD	03H
Number of bytes	04H
Data F002H high bit	00H
Data F002H low bit	00H
Data F003H high bit	00H
Data F003H low bit	01H
CRC CHK low bit	3BH
CRC CHK high bit	F3H

Command code: 06H, writing one word
For example, write 5000 (1388H) into F00AH of the drive whose slave address is 02H.

Command from the master

ADR	02H
CMD	06H
Data address high bit	F0H

Data address low bit	0AH
Data content high bit	13H
Data content low bit	88H
CRC CHK low bit	97H
CRC CHK high bit	ADH

Response from the slave

ADR	02H
CMD	06H
Data address high bit	F0H
Data address low bit	0AH
Data content high bit	13H
Data content low bit	88H
CRC CHK low bit	97H
CRC CHK high bit	ADH

Check mode - CRC mode: The cyclical redundancy check (CRC) uses the RTU frame format. The data frame includes a CRC-based error-check field. The CRC field checks the content of the entire message. The CRC field is two bytes, containing a 16-bitbinary value. It is added to the message after being calculated by the transmission device. The reception device recalculates a CRC value in the message, and compares the calculated value with the CRC value in the received CRC field. If the two CRC values are different, transmission errors occur.

The CRC is first stored to 0xFFFF. Then a procedure is invoked to process the consecutive 8-bitbyte in the message and the value in the register. Only the 8-bitdata in each byte is valid for the CRC. The start bit, stop bitand the parity bitdo not apply to the CRC.

During generation of CRC, every 8-bitis in exclusive or (XOR) with the content in the register. The result is shifted to the least significant bit(LSB), and 0 is filled in the most significant bit(MSB) position. The LSB is extracted and examined. If the LSB is 1, the register then performs XOR with a preset value. If the LSB is 0, no XOR is performed. This process is repeated eight times. After the last (eighth bit) is done, the next 8-bitbyte is in XOR with the register's current value, and the process repeats for eight more shifts as described above. The final value of the register is the CRC value after all the bytes in the message have been applied.

The CRC is added to the message from the low-order byte to the high-order byte. A simple function for the CRC is as follows:

```
unsigned int  crc_chk_value (unsigned char *data_value, unsigned char length) {
        unsigned int crc_value=0xFFFF;
        int i;
        while (length--) {
                crc_value^=*data_value++;
```

```
                for (i=0;i<8;i++) {
                        if (crc_value&0x0001){
                                crc_value= (crc_value>>1^0xa001;
                        }
                        else{
                                crc_value=crc_value>>1;
                        }
        }
        return (crc_value);
}
```

- Definition of communication parameter addresses

1) This part describes the communication content used to control the operation, status, and parameter setting of the drive.
2) Some parameters cannot be changed, and can only be used by the manufacturer or for monitoring.
3) The group numbers and identifiers of function codes are used for expressing the parameter addresses.
4) High-order bytes: F0 to FF (group F), A0 to AF (group A), 70 to 7F (group U)
   Low-order bytes: 00 to FF
5) For example, the address of F3-11 is represented as F30B.

● Note

Group FF: Parameters cannot be read or modified.

Group U: Parameters are ready-only and cannot be modified.

Certain parameters cannot be modified when the AC drive is operating. Certain parameter cannot be modified regardless of the state of the AC drive. Pay attention to the parameter range, unit, and related description when modifying parameters.

Parameter group	Access address	Modifying parameter address in RAM through communication
Groups F0 to FE	0xF000 to 0xFEFF	0x0000 to 0x0EFF
Groups A0 to AC	0xA000 to 0xACFF	0x4000 to 0x4CFF
Group U0	0x7000 to 0x70FF	–

Note:

1) Besides, frequent storage to the EEPROM reduces its service life. Therefore, in the

communication mode, users can change the values of certain function code parameters in the RAM rather than storing the setting.

2) For the parameters of group F, you only need to change high-order F of the parameter address to 0.

3) For the parameters of group A, you only need to change the high-order A of the parameter address to 4.

The parameter addresses are expressed as follows:

High-order bytes: 00 to 0F (group F), 40 to 4F (group A)
Low-order bytes: 00 to FF

Example:

If F3-11 is not saved to EEPROM, the address is expressed as 030B.

If A1-05 is not saved to EEPROM, the address is expressed as 4105.

The address indicates that it can be only written to the RAM. When the address is read from the RAM, it is invalid.

For all parameters, you can also use command code 07H to implement this function.

- STOP/RUN parameters:

Address	Parameter
1000H	* Reference set through communication (-10000 to +10000) (decimal)
1001H	Operating frequency
1002H	Bus voltage
1003H	Output voltage
1004H	Output current
1005H	Output power
1006H	Output torque
1007H	Operating speed
1008H	DI input flag
1009H	DO output flag
100AH	AI1 voltage
100BH	AI2 voltage
100CH	AI3 voltage
100DH	Counting value input
100EH	Length value input
100FH	Load speed
1010H	PID setting
1011H	PID feedback
1012H	PLC step

Address	Parameter
1013H	Pulse input frequency (unit: 0.01 kHz)
1014H	Feedback speed (unit: 0.1 Hz)
1015H	Remaining operating time
1016H	AI1 voltage before calibration
1017H	AI2 voltage before calibration
1018H	AI3 voltage before calibration
1019H	Linear speed
101AH	Current power-on time
101BH	Current operating time
101CH	Pulse input frequency (unit: 1 Hz)
101DH	Communication setpoint
101EH	Actual feedback speed
101FH	Display of main frequency X
1020H	Display of auxiliary frequency Y

Note:

1) The reference set through communication is a relative percentage. The value 10000 corresponds to 100.00%, and -10000 corresponds to -100.00%.

2) The frequency dimension data is the percentage of F0-10 (maximum frequency). The torque dimension data is F2-10 or A2-48 (torque upper limit digital setting, corresponding to motor 1 and motor 2, respectively).

- Control command inputted to the drive (write-only)

Command word address	Command function
2000H	0001: Forward run
	0002: Reverse run
	0003: Forward jog
	0004: Reverse jog
	0005: Coast to stop
	0006: Decelerate to stop
	0007: Fault reset

- Reading the drive state (read-only)

Status word address	Status word function
3000H	0001: Forward run
	0002: Reverse run
	0003: Stop

Parameter verification locked by password: If "8888H" is returned, the password verification is succeeded.

Password address	Input the content of the password
1F00H	*****

- DO control: write-only

Command Address	Command
2001H	Bit0: DO1 output control Bit1: DO2 output control Bit2: Relay 1 output control Bit3: Relay 2 output control Bit4: FMR output control bit5: VDO1 bit6: VDO2 bit7: VDO3 bit8: VDO4 bit9: VDO5

- AO1 control: write-only

Command Address	Command
7313	0 to 7FFF represent 0% to 100%.

- AO2 control (write-only)

Command Address	Command
2003H	0 to 7FFF represent 0% to 100%.

- Pulse output control: write-only

Command Address	Command
2004H	0 to 7FFF represent 0% to 100%.

- AC drive fault description

AC drive fault address	AC drive fault code	
8000H	0000: Normal 0001: Reserved 0002: Overcurrent during acceleration 0003: Overcurrent during deceleration 0004: Overcurrent during operation at constant speed 0005: Overvoltage during acceleration 0006: Overvoltage during deceleration 0007: Overvoltage during operation at constant speed 0008: Pre-charge resistor overload 0009: Undervoltage 000A: AC drive overload 000B: Motor overload 000C: Input phase loss 000D: Output phase loss 000E: Module overtemperature 000F: External fault 0010: Communication exception 0011: Contactor fault 0012: Current detection fault 0013: Motor parameter auto-tuning fault	0014: Reserved 0015: Parameter reading/writing operation fault 0016: AC drive hardware fault 0017: Motor short-circuited to ground 0018: Reserved 0019: Reserved 001A: Operating time reach 001B: User-defined fault 1 001C: User-defined fault 2 001D: Accumulative power-on time reached 001E: Load loss 001F: PID feedback loss during operating 0028: Fast current limit timeout 0029: Motor switchover fault during operating 002A: Excessive speed deviation 002B: Motor overspeed 002D: Motor overtemperature 005A: Reserved 005B: Reserved 005C: Reserved 005E: Speed feedback error

- Communication fault information description data (this address is not readable or written, and is used only for error response)

Communication fault address	Fault Description
8001H	0000: Normal 0001: Password incorrect 0002: Command code incorrect 0003: CRC check error 0004: Invalid address 0005: Invalid parameter 0006: Parameter modification invalid 0007: System locked 0008: EEPROM error

It is valid only when FD-05 is set to 0 (non-standard Modbus protocol) and to respond to communication errors.

Example: If the master sends data (01 03...), the slave responds with the following frame when detecting CRC check error: 01 03 80 01 00 03 7D CB.

Standard protocol error code	Corresponding error code	Remark
01: Command code incorrect	0002: Command code incorrect	-
02: Address incorrect	0004: Invalid address	-
03: Data error	0005: Parameter invalid; 0001: Password incorrect	-
04: Command cannot be processed	0006: Parameter modification invalid; 0007: System locked	-

- Group FD Communication Parameters

FD-00	Baud rate	Default	5005
	Setting range	Ones: Modbus baud rate 0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	

This parameter is used to set transmission speed between host controller and the drive. Note that the baud rate of the host controller must be the same as that of the drive. Otherwise, communication can fail. The higher the baud rate, the faster the communication speed is.

FD-01	Data format	Default	0
	Setting range	0: No check (8-N-2) 1: Even parity (8-E-1) 2: Odd parity (8-O-1) 3: No parity (8-N-1)	

Note that the data format of the host controller must be the same as that of the AC drive. Otherwise, communication fails.

FD-02	Local address	Default	1
	Setting range	0: Broadcast address 1 to 247	

The address must be unique (except the broadcast address), which is the basis for point-to-point communication between the host controller and the drive.

FD-03	Response delay	Default	2 ms
	Setting range	0 ms to 20 ms	

Response delay defines the interval from when the AC drive finishes receiving data to when it sends data to the host controller. If the response delay is shorter than the system processing time, the system processing time will prevail. If the response delay is longer than the system processing time, the drive will not send data to the host controller unless the response delay elapses.

FD-04	Communication timeout time	Default	0.0s
	Setting range	0.0s (invalid) 0.1s to 60.0s	

When this parameter is set to 0.0s, the system does not detect communication timeout.

If this parameter is set to a valid value, when the drive does not receive the communication signal within the time set in this parameter, Err16 will be reported. Generally, set it to 0.0s. In a continuous communication system, you can monitor the communication state by setting this parameter.

FD-05	Communication protocol	Default	31
	Setting range	Ones: Modbus 1: Standard Modbus protocol 0: When reading the command, the number of bytes returned by the slave is one byte more than that returned by the standard Modbus protocol. For details, see "Appendix A: MD310 Modbus Communication Protocol". Tens: Reserved	

FD-05 = 0: When reading the command, the number of bytes returned by the slave is one byte more than that returned by the standard Modbus protocol. For details, see "Appendix A: MD310 Modbus Communication Protocol"

If Fd-05 is set to 1, the standard Modbus protocol applies.

FD-06	Current resolution read through communication	Default	0
	Setting range	0: 0.01 A 1: 0.1 A	

It determines the output unit of the current when the output current is read through communication.

FD-07	Software tool communication	Default	0
	Setting range	0 to 1	

Set FD-07 to 1 to connect the MD310 to the software tool. Otherwise, the software tool cannot be connected. RS485 communication and software tool cannot be used simultaneously.

FD-08	Expansion card mode selection	Default	0
	Setting range	0 to 11	
	Setpoint	Ones: Protection against disconnection 0: Disable 1: Enable Tens: CANlink heartbeat timeout enable switch 0: Disable 1: Enable	

Appendix B: Multi-functional I/O Expansion Card (MD310-IO1)

B.1 Overview

The MD310-IO1 card is an I/O expansion card developed by Inovance for use with the MD310 series AC drive. It contains five DI inputs, one analog voltage signal input, one relay signal output, one digital signal output, and one analog signal output.

B.2 Mechanical Installation and Control Terminal Function

1. Installation method

The installation method is shown in the following figure. Install the drive with power off. Align the expansion card to the interface and positioning holes of the driver board and fix the card with screws.

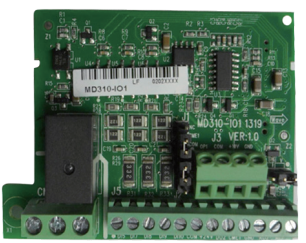
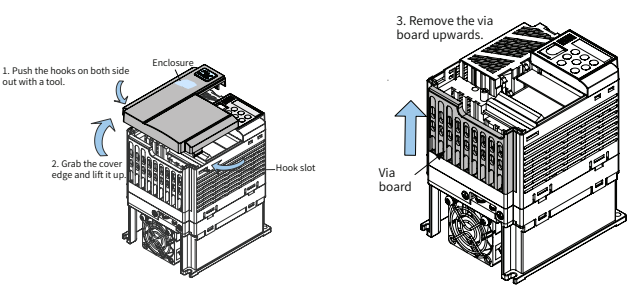


Figure B-1 Multi-functional I/O expansion card



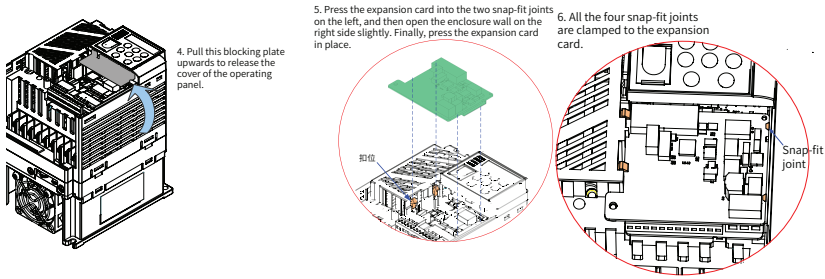


Figure B-2 Installation procedure of the expansion card

2. Control terminal functions

Table B-1 Functions of control terminals

Type	Mark	Name	Function
Power supply	+24 V-COM	External +24 V power supply	The terminal is used to provide +24 V power supply to external devices. Generally, it is used to power up the DI/DOs and external sensors. Maximum output current: 200 mA
	OP1	Digital input power terminal	OP1 hase been connected to +24V through jumper J2 by default. When an external power supply is needed, remove J2 and connect OP1 to the external power supply.
Analog input (AI)	AI3-GND	AI3	Input voltage range: -10 V to +10 V
Digital input	DI6-OP1	DI6	1. Optically-coupled isolation, compatible with dual-polarity inputs 2. Input impedance: 4.4 kΩ 3. Voltage upon level input: 9 V to 30 V
	DI7-OP1	DI7	
	DI8-OP1	DI8	
	DI9-OP1	DI9	
	DI10-OP1	DI10	
Analog output (AO)	AO2-GND	Analog output 2	1. Output voltage range: 0 V to 10 V 2. Output current range: 0 mA to 20 mA 3. Output current with impedance: 0 Ω to 500 Ω Connected through signal J4

Type	Mark	Name	Function
Digital output (DO)	DO2-CME1	Digital output 2	Optocoupler isolation; dual-polarity open collector output Output voltage range: 0 V to 24 V Output current range: 0 mA to 50mA Note: CME1 and COM are internally isolated and connected through J1 by default. When DO2 needs to be driven by an external power supply, disconnect J1 first.
Relay output (RELAY2)	PA- PB	NC terminal	Driving capacity of the contact: 250 VAC, 3 A, COS Ø = 0.4 30 VDC, 1 A
	PA-PC	NO terminal	

Table B-2 Description of MD310-IO1 jumper

Jumper	Position	Description
J1		Short COM to CME1 pin (shorted by default).
		Short NC to CME1.
J2		Short OP1 to +24 V (shorted by default).
		Short COM to OP1.
J4		Short pins 1 and 2 to make AO2 output analog voltage signal (shorted by default).
		Short pins 2 and 3 to make AO2 output analog current signal (pin 1 marked with a white dot)

Appendix C: CANlink Communication Expansion Card MD310-CANL

C.1 Overview

The MD310-CANL communication card is designed especially for the CANlink communication function of MD310 series AC drives. The expansion card is optional. For details on installation and use, see the instructions provided with the card.

C.2 Mechanical Installation and Control Terminal Functions

1. The installation method is the same as that of the mini I/O expansion card (MD310-IO1). The appearance and function of the wiring terminals are described below.

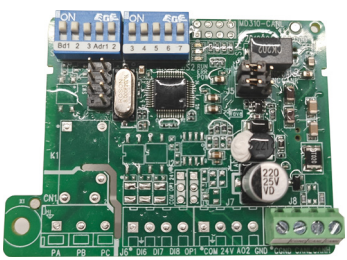


Figure C-1 CANlink communication expansion card M310-CANL

The relationship between the communication distance and baud rate is measured with the number of nodes less than 32. When the number of nodes is higher than 32, derate the length of the CAN bus, as shown below.

Table C-1 Relationship among communication distance, number of nodes, and baud rate

Baud rate (bps)	1 Mbps	500 kbps	250 kbps	125 kbps	100 kbps	50 kbps
Total length of the communication cable (m)	20	80	150	300	500	1000
Min. cross sectional area of the communication cable (mm2)	0.3	0.3	0.3	0.5	0.5	0.7
Max. number of nodes	18	32	63	63	63	63

2. Function of wiring terminals

Table C-2 Functions of control terminals

Mark	Name	Description
J4/J5	CAN termination resistor setting	Pins 2 and 3 shorted: resistor disabled Pins 1 and 2 shorted: resistor enabled

Mark	Name		Description
J8	CANlink wiring terminal.	-	-
		CGND	Used to connect the CAN communication cable shield.
		CANL	Used to connect thenegative pole of the CAN bus.
		CANH	Connected to the positive end of the CAN bus.

3. DIP switch

The DIP switches S1 and S2 form a 10-digit DIP switch for setting the baud rate and device address for CAN bus communication. The following figure shows the DIP switch numbers. Bd1, 2, and 3 are used to set the baud rate. Adr 1 to Adr 7 are set to set the CANlink address. Setting the DIP switch to ON represents "1". Setting the DIP switch to OFF represents "0". Changes to the baud rate and station number take effect immediately.

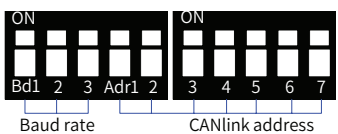


Figure C-2 DIP switches

Baud rate

The following table describes the relationship between the DIP switch and the baud rate.

Table C-3 Setting the baud rate

DIP switch number Bd			Baud rate
1	2	3	
0	0	0	20 kbps
0	0	1	50 kbps
0	1	0	100 kbps
0	1	1	125 kbps
1	0	0	250 kbps
1	0	1	500 kbps
1	1	0	800 kbps
1	1	1	1 Mbps

CANlink device address

The expansion card provides a 7-bit DIP switch for communication address setting. The DIP switch Adr1 represents the most significant bit, and the DIP switch Adr7 represents the least significant bit. DIP switches Adr1 to Adr7 corresponds to bit6 to bit0 of the address station number. The address range to be set is 1 to 63, as shown in the following table. Address 0 and addresses 64 to 127 are reserved and cannot be used. If the reserved address is used, the MD310-CANL card does not work.

Table C-4 Addresses set by the DIP switch

DIP switch Adr							Address
1	2	3	4	5	6	7	
0	0	0	0	0	0	0	Reserved
0	0	0	0	0	0	1	1
0	0	0	0	0	1	0	2
0	0	0	0	0	1	1	3
	...						…
0	1	1	1	1	1	1	63
1	x	x	x	x	x	x	Reserved

4. Status indicator

Table C-5 Description of status indicators

Indicator	Status	Description
POW	Solid on	Power-on OK
	Off	Power-on error (Check whether the installation is correct.)
Err	Off	No fault
	Solid on	Check whether the master times out and the connection with the master.
	Flashing at 5 Hz	Address error (Check the address.)
RUN	Off	CANlink bus not connected or disconnected
	Solid on	CANlink is connected successfully, but data exchange is not applied.
	Flashing at 1 Hz	Data exchange OK

Appendix D: Introduction to the MD310-KEY1 External Operating Panel

D.1 Appearance and Connection Method

You can modify the parameters, monitor the working status and start or stop the drive through the operating panel, as shown below.

Figure D-1 Appearance of MD310-KEY1 operating panel

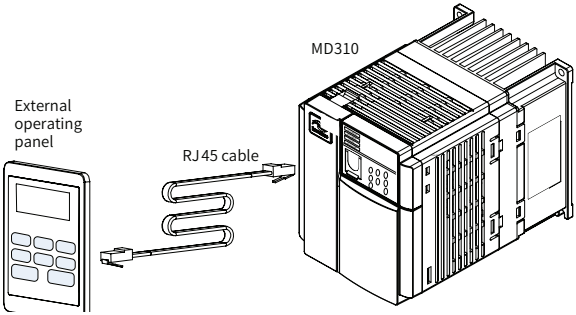


Figure D-2 Connecting MD310-KEY1 to the drive

D.2 Functions of Keys

After the external operating panel is connected properly, the operating panel is no longer available. The following table describes the functions of the keys on the external operating panel. The functions of the operating panel are consistent with those of the product. For details, see "4.1 Operating Panel Interface".

Table D-1 Functions of Keys

External operating panel keys	Name	Function
	Program-ming key	Used to enter or exit level I menus.
	ENTER key	Used to enter the menu interfaces level by level, and confirm the parameter setting.
	UP key	Used to increase the data or parameter.
	DOWN key	Used to decrease the data or parameter.
	SHIFT key	Used to select the displayed parameters in turn in the stop or operation state, and the digit to be modified when modifying parameters.
	RUN key	Used to start the drive in the operating panel control mode.
	Stop/Reset	Used to stop the drive when it is in the operating state or reset faults when it is in the fault state. The function of this key is restricted by F7-02.
	Multi-func-tion key	Used as the command source, quick direction switchover, or parameter display as defined by F7-01.

D.3 Installation Dimensions

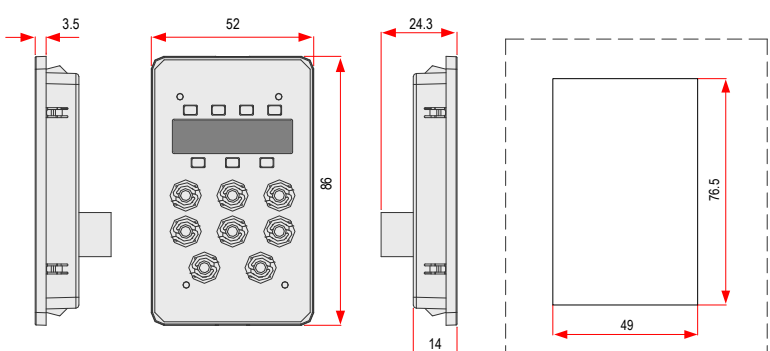


Figure D-3 Installation dimensions of MD310-KEY1 operating panel (unit: mm)

Appendix E: Introduction to InoDriverShop

The InoDriverShop, a commissioning software tool developed for MD310, supports real-time monitoring on the drive, parameter configuration, oscilloscope, and emergency stop through the PC. The commissioning process is as follows.

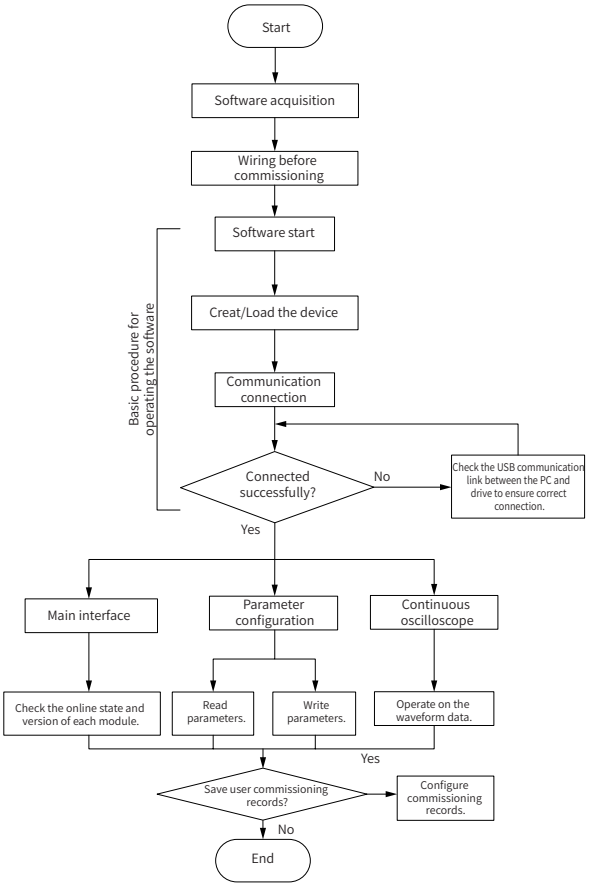


Figure E-1 Commissioning process through InoDriverShop

E.1 Access to the Software

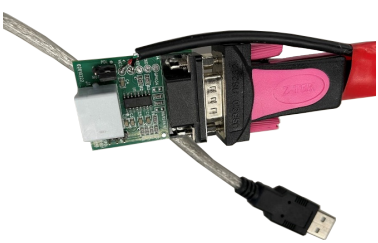
Download InoDriverShop through the following ways

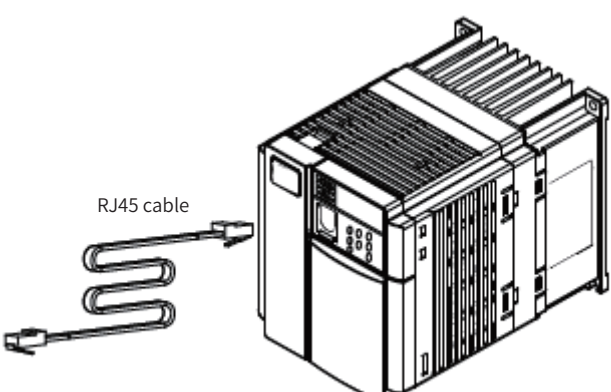
- Visit Inovance official website www.inovance.com, and click Service and Support > Downloads.

Note: It is recommended to update the software to the latest version due to continuous improvement on the product and documents.

E.2 Wiring Before Commissioning

Host controller





[Note]

The RJ45 cable in the preceding figure requires a special tooling cable. The standard 8-pin network cable cannot be connected. It is recommended to use the MD200 terminal of the tooling programming cable to connect the drive, or use the standard 8-pin network cable.

When connecting the RJ45 cable, make sure that the programming card is connected to the programming tooling interface and the control terminal is connected to the network port at the control panel of the drive.

E.3 Communication wiring

The following shows the connection procedure.

1. See "E.2 Wiring Before Commissioning" to check that the wiring is correct.

2. Make sure that parameters are set correctly (FD-07 = 1).

3. Confirm that the serial port device is connected successfully. Open the software tool, load the device, and select "MD200" to load the device.

4. After connected successfully, the MD310 device will be recognized. In this case, click "Finish" to start commissioning through the software tool.

E.4 Main interface of the InoDriverShop

For details on how to use InoDriverShop, obtain the InoDriverShop Software Operation Guide in the help menu of the InoDriverShop.

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