INOVANCE

Advanced User Guide

MD810 Series

Standard Drive (Multidrive System)

User Guide

A00
Data code 19011xxx

Preface

Thank you for purchasing the MD810 series AC drive developed and manufactured by Inovance.

The MD810, a new generation low voltage multidrive system, is a common DC bus drive system consisting of the unique power supply unit and multiple drive units. It is applicable to applications such as a single mechanical device with multiple drive points or continuous production line system. It is widely used in metal products, printing and packaging, textile printing and dyeing, chemical fiber and plastics, EU small- sized papermaking, hoisting and other industries.

The MD810 series AC drive consists of the MD810 power supply unit and MD810 drive units. This user guide describes the product information, installation, communication, troubleshooting, and parameters of both the power supply unit and drive unit.

The MD810 series power supply unit has a total of five outline structures, which can be divided into the booksize unit (with equal height and depth) and the vertical tower unit. The MD810 series drive unit can be a single-axis or dual-axis drive unit. The drive unit has two designs: booksize and vertical tower in five sizes. See the following table for details.

<table>
<tr><th colspan="2">Type</th><th>Structure</th><th>Width</th><th>Power</th></tr>
<tr><td colspan="2" rowspan="5">Power supply unit</td><td rowspan="4">Booksize</td><td>50 mm</td><td>22 kW</td></tr>
<tr><td>100 mm</td><td>45 kW</td></tr>
<tr><td>200 mm</td><td>110 kW</td></tr>
<tr><td>300 mm</td><td>160 kW</td></tr>
<tr><td>Vertical</td><td>180 mm</td><td>355 kW</td></tr>
<tr><td rowspan="7">Drive unit</td><td rowspan="5">Single-axis</td><td rowspan="4">Booksize</td><td>50 mm</td><td>1.5–7.5 kW</td></tr>
<tr><td>100 mm</td><td>11–37 kW</td></tr>
<tr><td>200 mm</td><td>45–75 kW</td></tr>
<tr><td>300 mm</td><td>90–160 kW</td></tr>
<tr><td>Vertical</td><td>230 mm</td><td>200–355 kW</td></tr>
<tr><td rowspan="2">Dual-axis</td><td rowspan="2">Booksize</td><td>50 mm</td><td>1.5–5.5 kW</td></tr>
<tr><td>100 mm</td><td>7.5–18.5 kW</td></tr>
</table>

First-time Use

For users who use this product for the first time, read the guide carefully. If you have any problem concerning the functions or performance, contact the technical support personnel of Inovance to ensure correct use.

Approvals

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

Certification	Directives		Standard
CE	EMC directive	2014/30/EU	EN 61800-3
	LVD directive	2014/35/EU	EN 61800-5-1
	RoHS directive	2011/65/EU	EN 50581
cULus	-		UL61800-5-1 CSA C22.2 NO. 274-17
STO	Machinery directive	2006/42/EC	EN 61800-5-2:2016 EN 62061 :2005/A2:2015 EN ISO 13849-1 :2015 EN 61508 ed.2:2010

NOTE

- ◆ The above EMC directive is complied with only when the EMC electric installation requirements are strictly observed.
- ◆ Certification marks on the product nameplate indicate compliance with the corresponding certificates and standards.
- ◆ 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 into other devices has the responsibility of ensuring compliance with CE standards and verifying that conditions meet European standards.
- ◆ The vertical tower drive units of 160 to 355 kW are equipped with the C3 filters (C2 filter not supported) and other models are equipped with the C2 filters (C3 filter not supported).
- ◆ For more information on certification, consult our distributor or sales representative.

Revision History

Date	Version	Change Description
March 2021	A00	First release

Memo NO. ____________

Date / /

Contents

Safety Instructions

Safety Precautions

1) Before installing, using, and maintaining this equipment, read the safety information and precautions thoroughly, and comply with them during operations.
2) To ensure the safety of humans and equipment, follow the signs on the equipment and all the safety instructions in this user guide.
3) "CAUTION", "WARNING", and "DANGER" items in the guide do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
4) Use this equipment according to the designated environment requirements. Damage caused by improper usage is not covered by warranty.
5) Inovance shall take no responsibility for any personal injuries or property damage caused by improper usage.

Safety Levels and Definitions

DANGER	Indicates that failure to comply with the notice will result in severe personal injuries or even death.
WARNING	Indicates that failure to comply with the notice may result in severe personal injuries or even death.
CAUTION	Indicates that failure to comply with the notice may result in minor or moderate personal injuries or equipment damage.

Safety Instructions

Unpacking

CAUTION

- ◆ Check whether the packing is intact and whether there is damage, water seepage, damp, and deformation.
- ◆ Unpack the package by following the package sequence. Do not hit the package with force.
- ◆ Check whether there are damage, rust, or injuries on the surface of the equipment or equipment accessories.
- ◆ Check whether the number of packing materials is consistent with the packing list.

WARNING

- ◆ Do not install the equipment if you find damage, rust, or indications of use on the equipment or accessories.
- ◆ Do not install the equipment if you find water seepage, component missing or damage upon unpacking.
- ◆ Do not install the equipment if you find the packing list does not conform to the equipment you received.

Storage and Transportation
CAUTION ◆ Store and transport this equipment based on the storage and transportation requirements for humidity and temperature. ◆ Avoid transporting the equipment in environments such as water splashing, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration. ◆ Avoid storing this equipment for more than three months. Long-term storage requires stricter protection and necessary inspections. ◆ Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation. ◆ Never transport this equipment with other equipment or materials that may harm or have negative impacts on this equipment.
WARNING ◆ Use professional loading and unloading equipment to carry large-scale or heavy equipment. ◆ When carrying this equipment with bare hands, hold the equipment casing firmly with care to prevent parts falling. Failure to comply may result in personal injuries. ◆ Handle the equipment with care during transportation and mind your step to prevent personal injuries or equipment damage. ◆ Never stand or stay below the equipment when the equipment is lifted by hoisting equipment.
Installation
WARNING ◆ Thoroughly read the safety instructions and user guide before installation. ◆ Do not modify this equipment. ◆ Do not loosen fixed bolts (especially those marked in red) on equipment components. ◆ Do not install this equipment in places with strong electric or magnetic fields. ◆ When this equipment is installed in a cabinet or final equipment, protection measures such as a fireproof enclosure, electrical enclosure, or mechanical enclosure must be provided. The IP rating must meet IEC standards and local laws and regulations.
DANGER ◆ Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. ◆ Installation, wiring, maintenance, inspection, or parts replacement must be performed only by experienced personnel who have been trained with necessary electrical information. ◆ Installation personnel must be familiar with equipment installation requirements and relevant technical materials. ◆ Before installing equipment with strong electromagnetic interference, such as a transformer, install an electromagnetic shielding device for this equipment to prevent malfunctions.

Wiring
DANGER
◆ Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. ◆ Never perform wiring at power-on. Failure to comply will result in an electric shock. ◆ Before wiring, cut off all equipment power supplies. Wait at least 10 minutes before further operations because residual voltage exists after power-off. ◆ Make sure that the equipment is well grounded. Failure to comply will result in an electric shock. ◆ During wiring, follow the proper electrostatic discharge (ESD) procedures, and wear an antistatic wrist strap. Failure to comply will result in damage to internal equipment circuits.
WARNING
◆ Never connect the power cable to output terminals of the equipment. Failure to comply may cause equipment damage or even a fire. ◆ When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation. ◆ Wiring cables must meet cross sectional area and shielding requirements. The shielding layer of the shielded cable must be reliably grounded at one end. ◆ After wiring, make sure that no screws are fallen and cables are exposed in the equipment.
Power-on
DANGER
◆ Before power-on, make sure that the equipment is installed properly with reliable wiring and the motor can be restarted. ◆ Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire. ◆ At 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 at power-on. Failure to comply will result in an electric shock. ◆ Do not remove any part of the equipment at power-on. Failure to comply will result in an 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 the equipment during operation. Failure to comply will result in an electric shock. ◆ Do not touch the equipment enclosure, fan, or resistor for temperature detection. Failure to comply will result in heat injuries. ◆ Signal detection must be performed only by professionals during operation. Failure to comply will result in personal injuries 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 using a 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 at power-on. Failure to comply will result in an electric shock.
- Before maintenance, cut off all equipment power supplies and wait at least 10 minutes.

WARNING

- Perform daily and periodic inspection and maintenance for 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 repair the equipment at power-on. Failure to comply will result in an electric shock.
- Before inspection and repair, cut off all equipment power supplies and wait at least 10 minutes.

WARNING

- Require for repair services according to the product warranty agreement.
- When the equipment is faulty or damaged, require professionals to perform troubleshooting and repair by following repair instructions and keep a repair record.
- Replace quick-wear parts of the equipment according to the replacement guide.
- Do not operate damaged equipment. Failure to comply may result in worse damage.
- After the equipment is replaced, perform wiring inspection and parameter settings again.

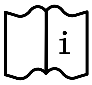
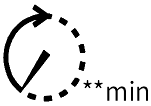
Disposal

WARNING

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

Safety Signs

■ Description of safety signs in the user guide

	Read the user guide before installation and operation.
	Reliably ground the system and equipment.
	Danger!
	High temperature!
	Prevent personal injuries caused by machines.
	High voltage!
	Wait xx minutes before further operations.

■ Description of safety signs on the equipment

For safe equipment operation and maintenance, comply with safety signs on the equipment, and do not damage or remove the safety labels. The following table describes the safety signs.

Safety Sign	Description
	◆ Read the user guide before installation and operation. Failure to comply will result in an electric shock. ◆ Do not remove the cover at power-on or within 10 minutes after power-off. ◆ Before maintenance, inspection, and wiring, cut off input and output power, and wait at least 10 minutes until the power indicator is off.

Memo NO. ____________

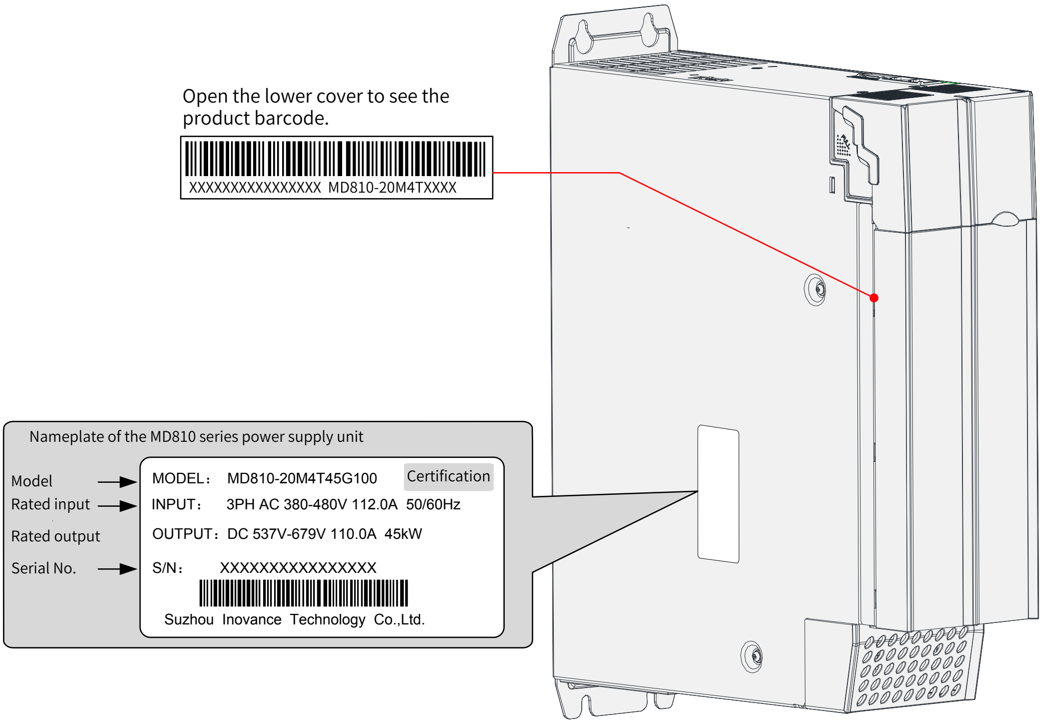
Date / /

1 Product Information

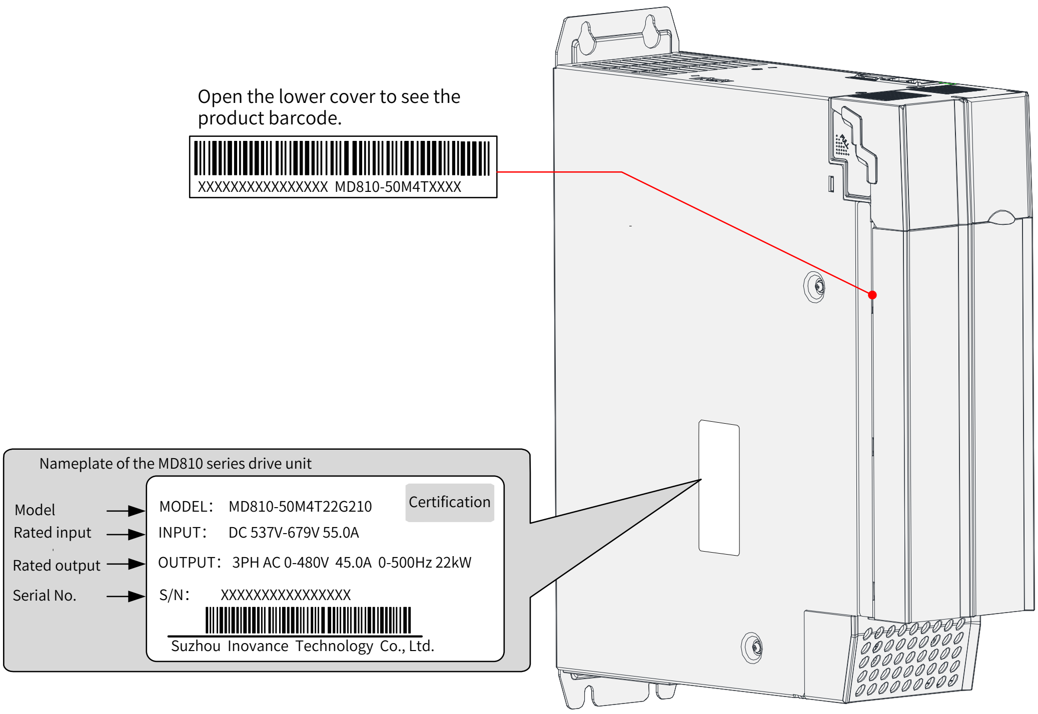
Safety Instructions
DANGER ◆ Never perform wiring at power-on. Failure to comply will result in electric shock. Keep the breaker in OFF state. WARNING ◆ When installing the drive in an enclosed cabinet or shell box, cool it fully with a cooling fan or air conditioner to keep the air inlet temperature of the drive below 50°C . Failure to comply may result in overheat or fire. CAUTION ◆ Cover the top of the drive with a cloth or paper during installation to prevent metal filing, oil, and water from entering the drive during drilling. ◆ If foreign objects enter the drive, a drive failure may occur. ◆ After the installation work is completed, remove the paper or cloth. If the cloth or paper continues to cover the top, the ventilation may become bad, resulting in abnormal heating of the drive. ◆ When operating the drive, follow the procedure specified the ESD to avoid static damage to any internal circuit of the drive. ◆ When the motor runs at a low speed, the cooling effect will drop. With the temperature increasing, it may result in motor failure due to overheat. Improvement on motor cooling conditions may be made in consideration. ◆ The motor speed control range varies with lubrication methods and manufacturers. ◆ When running the motor beyond the speed control range, consult the motor manufacturer. ◆ The torque characteristics with the drive used for the drive are different from those with the commercial power supply used for the drive. Please check the load torque characteristics of the machinery to be connected. ◆ Pay attention to this when selecting a drive capacity. In addition, when the wiring distance between the motor and the drive unit is long, the motor torque will be reduced due to voltage drop. Please use a cable with enough thickness to perform wiring. ◆ Do not lift the drive with the outer cover removed. Failure to comply may result in damage to the circuit board or terminal block of the drive.

1.1 Nameplate and Model Number

- Nameplate of the MD810 series power supply unit



- Nameplate of the MD810 series drive unit



MD810 - 50M 4T D 45 G 0 0 0 W

Code	Product Category
MD810	AC drive series
TD810	AC drive specialized for textile

Code	Unit Type
20M	Power supply unit
50M	Drive unit

Code	Voltage Class
4T	380–480 V

Code		Axis Type
Drive unit	None	Single-axis
	D	Dual-axis

Code		Power Class (kW)
Power supply unit	22	22
	45	45
	110	110
	160	160
	355	355
Drive unit	1.5	1.5
	...	...
	355	355

Code	Model
G	General purpose

Code	Cooling Mode
None	1.5–160 kW (booksize)
H	90–355 kW (vertical tower)
W	Single-axis drive unit: 11–30 kW Dual-axis unit: 7.5–18.5 kW Power supply unit: 160 kW

Code	Optional Extension Part
0	None
1	1.5–160 kW (built-in STO)

Code		Optional Communication Part
Power supply unit	0	Built-in RS-485 and CAN
	1	Built-in Profibus-DP or Profibus network bridge and CAN
	2	Built-in Profinet network bridge and CAN (unavailable for 355 kW)
Drive unit	0	Built-in RS485 and CAN
	1	Built-in Profibus-DP and CAN

Code		Optional Functional Part
Power supply unit	0	No optional built-in braking unit
	1	Built-in braking unit (for 22 kW and 45 kW models)
Drive unit	2	Built-in differential PG card
	3	Built-in 23-bit PG card
	4	Built-in resolver + frequency division

Figure 1-1 Nameplate and model number

NOTE

- The PROFINET gateway is not available for the 355 kW power supply unit.
- The following models adopts the liquid cooling mode: 160 kW power supply unit, single-axis 11 kW to 37 kW drive units, and dual-axis 7.5 kW to 18.5 kW drive units.
- The following models adopts the water cooling mode: 1.5 kW to 160 kW booksize units (The last code of the model number is empty) and 90 kW to 355 kW vertical tower units (The last code of the model number is H.)
- The braking unit is built-in for the 22 kW and 45 kW power supply units only.
- The drive units of 1.5 kW to 160 kW supports EtherCAT communication.

1.2 Components

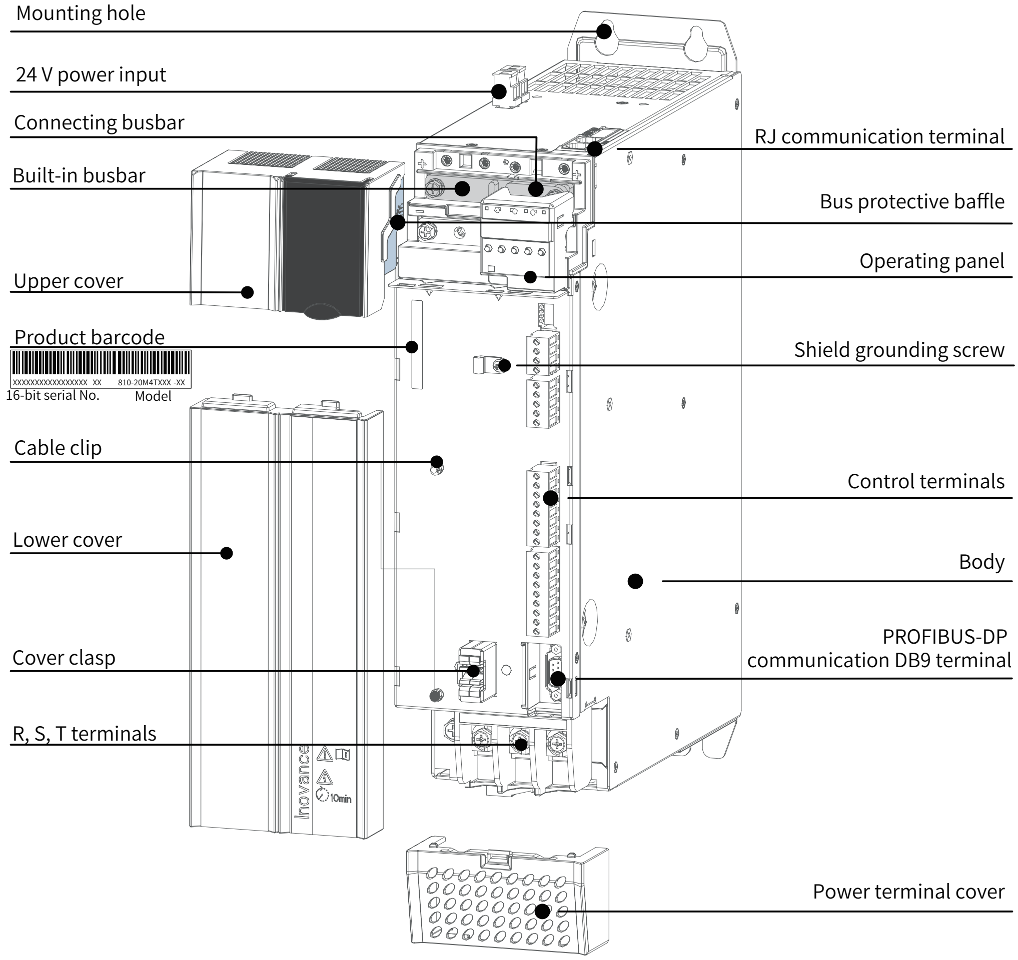


Figure 1-2 Components of the power supply unit

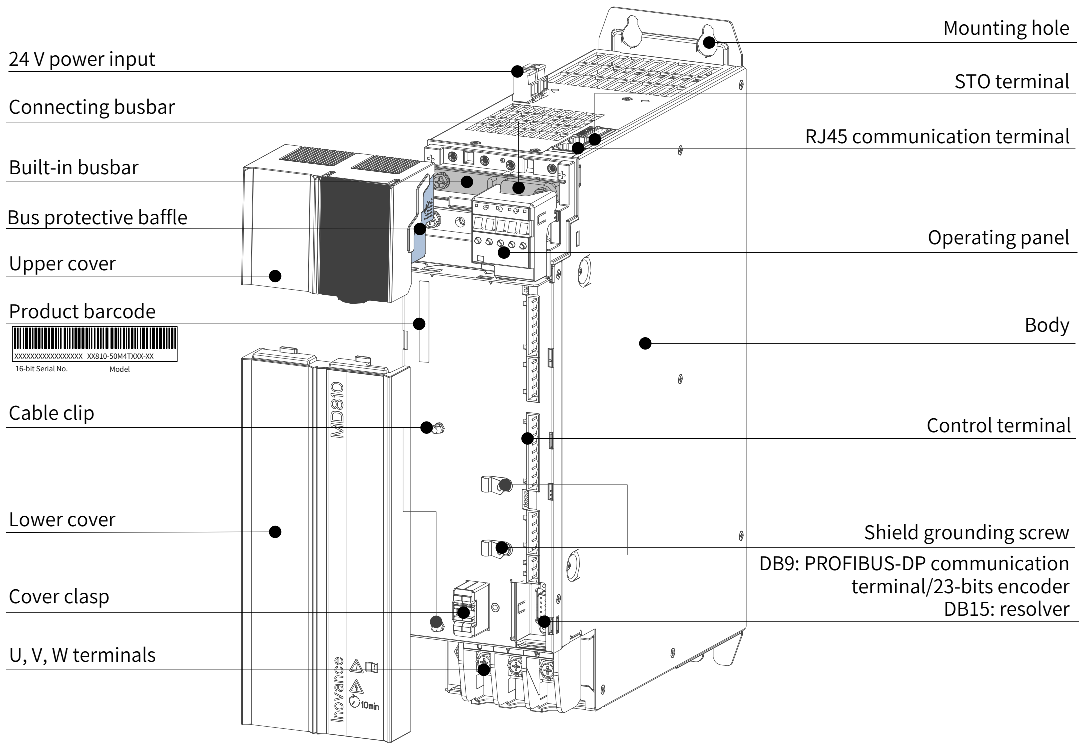


Figure 1-3 Components of the drive unit

1.3 System Connection

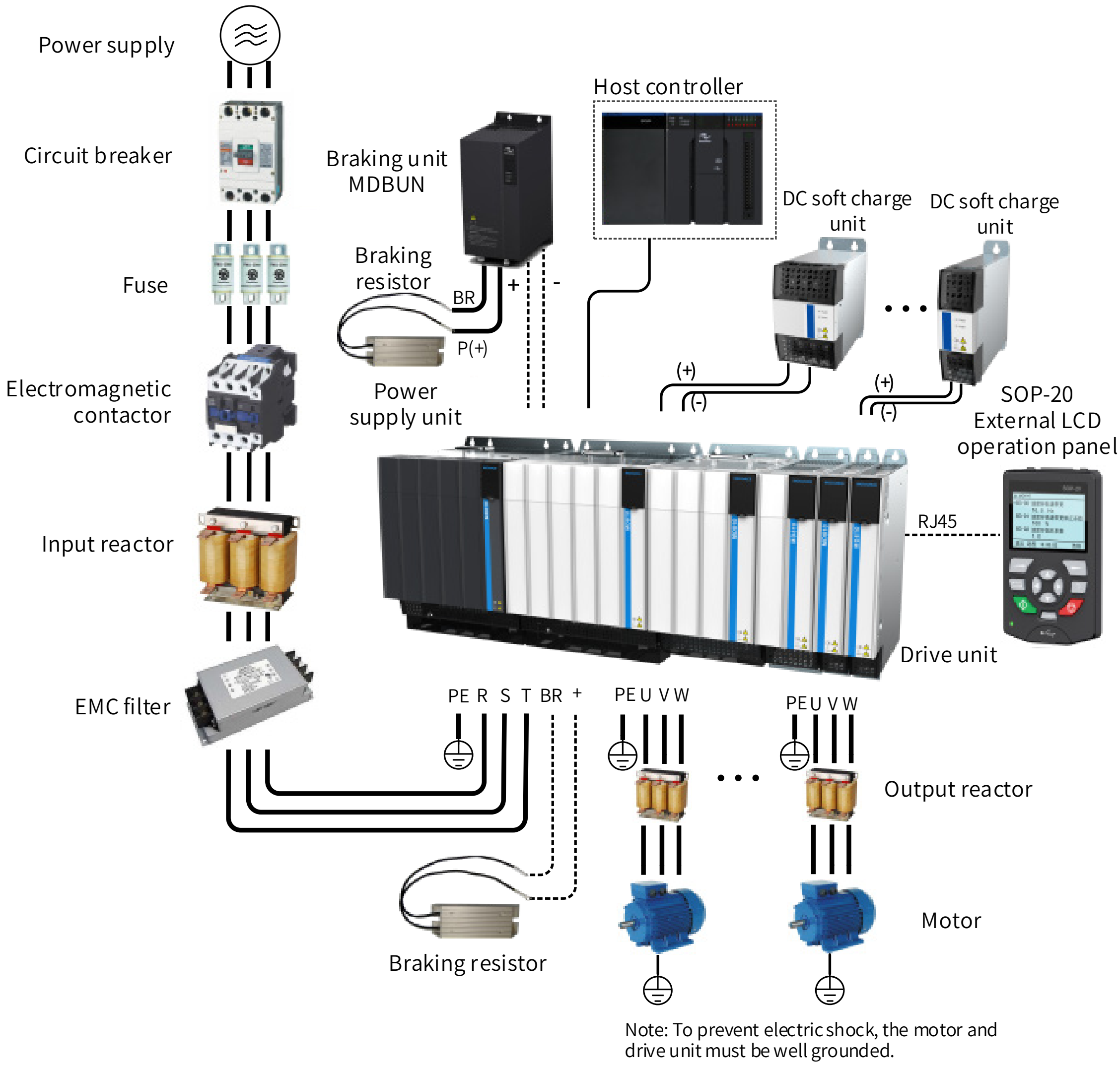


Figure 1-4 System connection

NOTE

◆ Figure 1-4 shows only the connections within the MD810 series AC drive system. For the model selection of the peripheral components, see "10 Technical Specifications and Model Selection".

Table 1-1 Description of peripheral components

Component Name	Installation Position	Function Description
Circuit breaker	Between the power supply and the input side of the power supply unit	MCCB: Cuts off the power when overcurrent occurs on downstream devices to prevent accidents. Leakage breaker: Provides protection against potential leakage current during drive running to prevent electric shock and even a fire. Install a proper breaker according to onsite situation. For the model selection, see "810 Series Power Supply Unit User Guide".
Fuse	Between the power supply and the input side of the power supply unit	Protects the semiconductor components on the downstream power supply unit if short circuit occurs. For the model selection, see "810 Series Power Supply Unit User Guide".

Component Name	Installation Position	Function Description
Electromagnetic contactor	Between the circuit breaker and the input side of the power supply unit	Powers on and off the drive. Do not power on and off the drive using the contactor frequently (the interval must be longer than one hour), or directly start the drive. For the model selection, see "810 Series Power Supply Unit User Guide".
Input reactor	Input side of the power supply unit	Improves the input-side power factor. Attenuates the input-side high-order harmonic components, protecting other devices against voltage waveform distortion. Eliminates the input current unbalance caused by phase-to-phase unbalance. The input reactor is recommended for the low-quality power grid with high pollution. For the model selection, see "810 Series Power Supply Unit User Guide".
EMC filter	Input side of the power supply unit	Reduces the conducted and radiated interference generated by the drive. Reduces the conducted interference from the power supply to drive, and improves the interference-resistant capability of the drive. For the model selection, see "810 Series Power Supply Unit User Guide".
Bus fuse	Between the power supply unit and drive unit	Protects the semiconductor components on the upstream power supply unit if short circuit occurs, preventing further system damage. For the model selection, see "11.5 Peripherals and Options".
Braking resistor	22/45 kW power supply unit	Use the braking resistor for the 22 kW or 45 kW power supply unit. Consumes the regenerative energy when the motor decelerates. For the model selection, see "810 Series Power Supply Unit User Guide".
Braking unit	Power supply unit of 110 kW or above	Use Inovance's braking unit MDBUN and recommended braking resistor for the power supply unit of 110 kW or higher. Consumes the regenerative energy when the motor speeds down. For the model selection, see "810 Series Power Supply Unit User Guide".
Output reactor	Between the output side of the drive unit and the motor, and close to the drive	There are many high-order harmonic components on the output side of the drive. When the motor is far away from the drive, there is much distributed capacitance in the circuit. Certain harmonics may cause resonance in the circuit, which will: a) Degrade motor insulation performance and damage motor in long run. b) Generate large leakage current and cause frequent drive protection trips. Generally, if the distance between the drive and motor exceeds 100 m, an AC output reactor is recommended. For the model selection, see "11.5 Peripherals and Options".
dv/dt reactor	On the output side of the drive unit, and close to the drive unit	Optional. Protects motor insulation and reduce bearing currents. For the model selection, see "11.5 Peripherals and Options".
Output magnetic ring	Output side within the drive unit	Reduces bearing currents.
Motor	Output side of the drive	Select an appropriate motor as recommended. For the model selection, see "11.1 Technical Specifications".

Component Name	Installation Position	Function Description
DC soft charge unit	Between the power supply unit and drive unit	Enable the drive unit to be powered on and off independently so that the rectifier power is not interrupted when the drive unit is damaged and need to be replaced. For the model selection, see "11.5 Peripherals and Options".
DC circuit breaker	Between the power supply unit and the DC soft charge unit	Install a DC circuit breaker in front of the DC soft charge unit if a DC soft charge unit is used. For the model selection, see "11.5 Peripherals and Options".
SOP-20 external LCD operating panel	Connect a network cable to the RJ45 B port on the top.	Optional. Facilitates debugging and parameter settings. For more information, see "4.2 External LCD Operating Panel".

NOTE

- Do not install a capacitor or surge suppressor on the drive output side; otherwise, the drive, capacitor or surge suppressor may be damaged.
- There is harmonic on the input/output side (main circuit) of the drive, which may have interference on nearby communication devices. Anti-interference filter can be installed to minimize the interference.

1.4 Networking

Either the power supply unit or drive unit has an independent 24 V powering interface, and provides the Modbus, CAN, and PROFIBUS-DP bus interfaces. The MD810 system supports four types of bus networking (for details, see "Appendix B Communication").

1.4.1 Modbus Topology

Figure 1-4 shows the Modbus connections between system components. It is recommended to use the shielded twisted pairs to connect the reference ground of 485 signals of all nodes. Connect 120 Ω termination resistors on the two ends of the bus to prevent signal reflection. A maximum of 128 nodes can be connected, and the distance between two nodes must be shorter than 3 m.

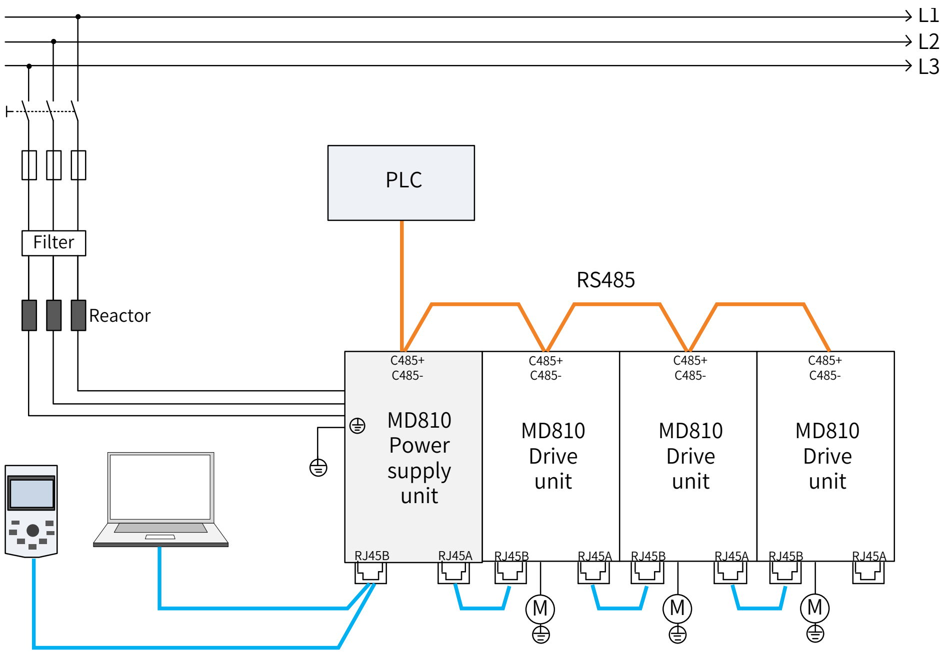


Figure 1-5 Modbus connections

1.4.2 CAN Bus Topology

The 3-pin CAN bus of the power supply unit can be connected to third-party PLC or Inovance's PLC card. The PLC or PLC card functions as the master station of the system to remotely control slave stations through the CAN bus, output control information, and return status information. The power supply unit and drive units are cascaded through RJ45 interfaces with the CAN bus.

To facilitate wiring, locate the power supply unit in the front or end of the CAN bus.

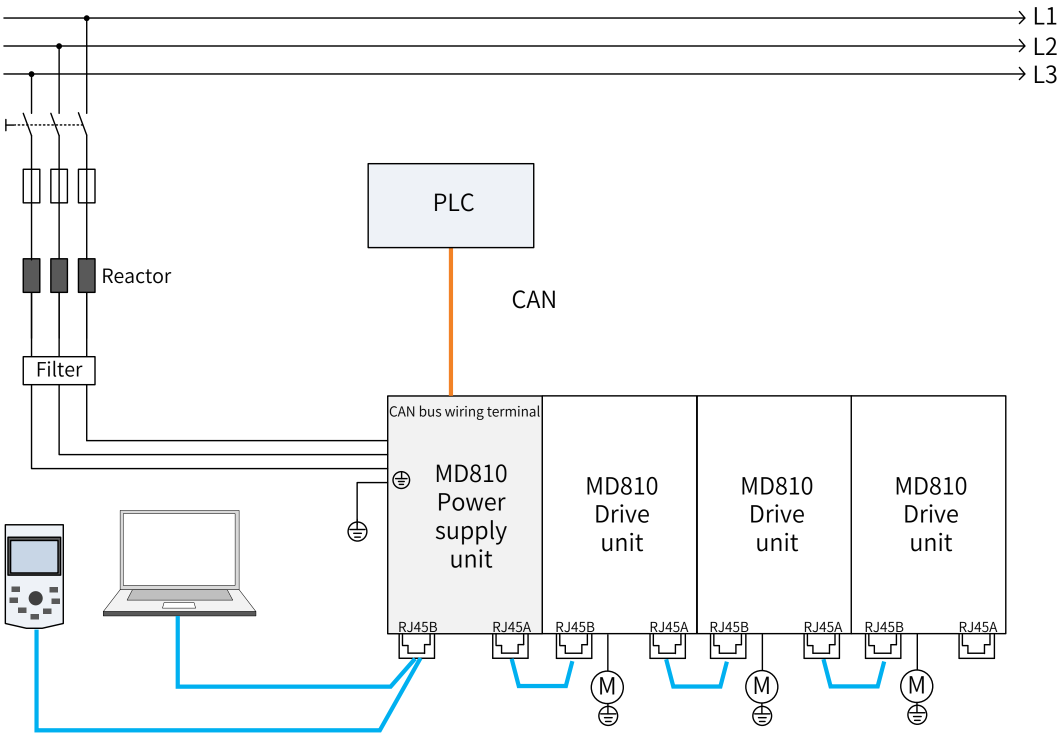


Figure 1-6 CAN bus connections (power supply unit on either end)

If the power supply unit is in the middle of CAN bus, do not connect the PLC to CAN terminals of the power supply unit. The PLCs can be connected to the front and bottom ends of the CAN bus.

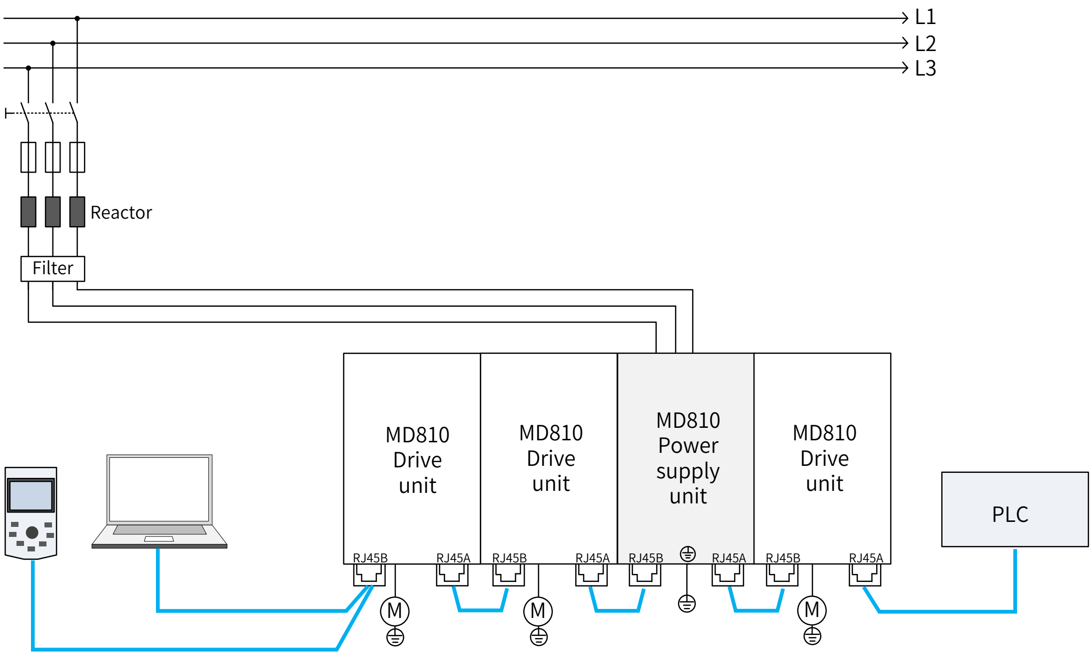


Figure 1-7 CAN bus connections (power supply unit in the middle)

1.4.3 PROFIBUS-DP Bus Topology

The third-party PLC, power supply unit, and drive units are connected through the DB9 interface with the PROFIBUS-DP bus. The PLC functions as the master station of the system to output control information and return status information. The power supply unit and drive units function as the slave stations to input control information and output status information. If there are more than 32 nodes, repeaters are required. On the segment between two repeaters, a maximum of 32 nodes are allowed (including the repeaters).

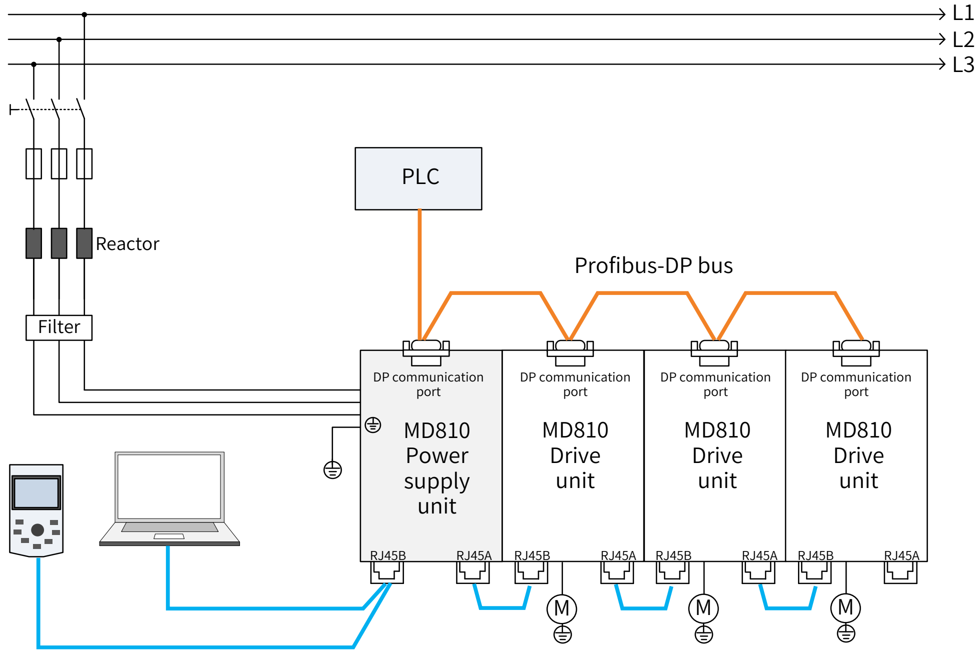


Figure 1-8 PROFIBUS-DP bus connections

1.4.4 EtherCAT Bus Topology

For the MD810 series drives, only the drive units support EtherCAT communication. The drive units communicate with the power supply units through the CAN bus. With the EtherCAT I/O terminals, the drive units can be connected to Inovance's or any third party's PLCs or PCs with EtherCAT communication functions. The PLCs or PCs work as the master stations in the EtherCAT system to output control information and return status information, while the drive units work as the slaves to input control information and output status information. The power supply units and drive units are cascaded using RJ45. The following figure shows the EtherCAT bus connnections.

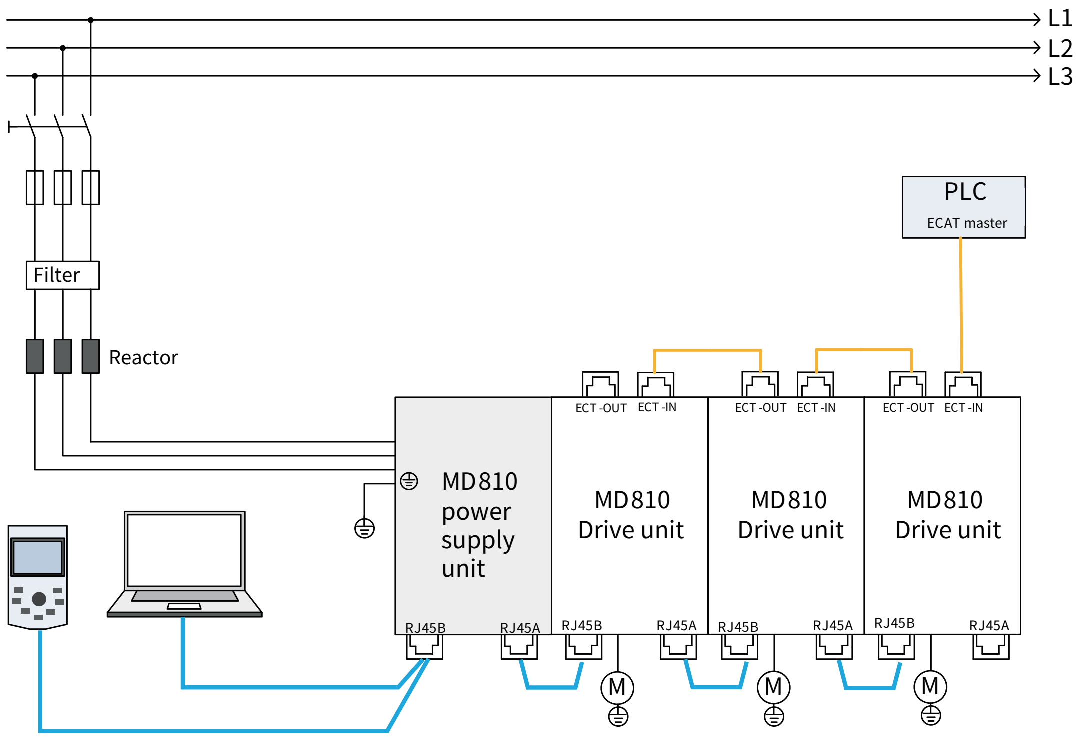


Figure 1-9 EtherCAT bus connection

1.4.5 PROFIBUS-DP-to-CANopen Bus Topology

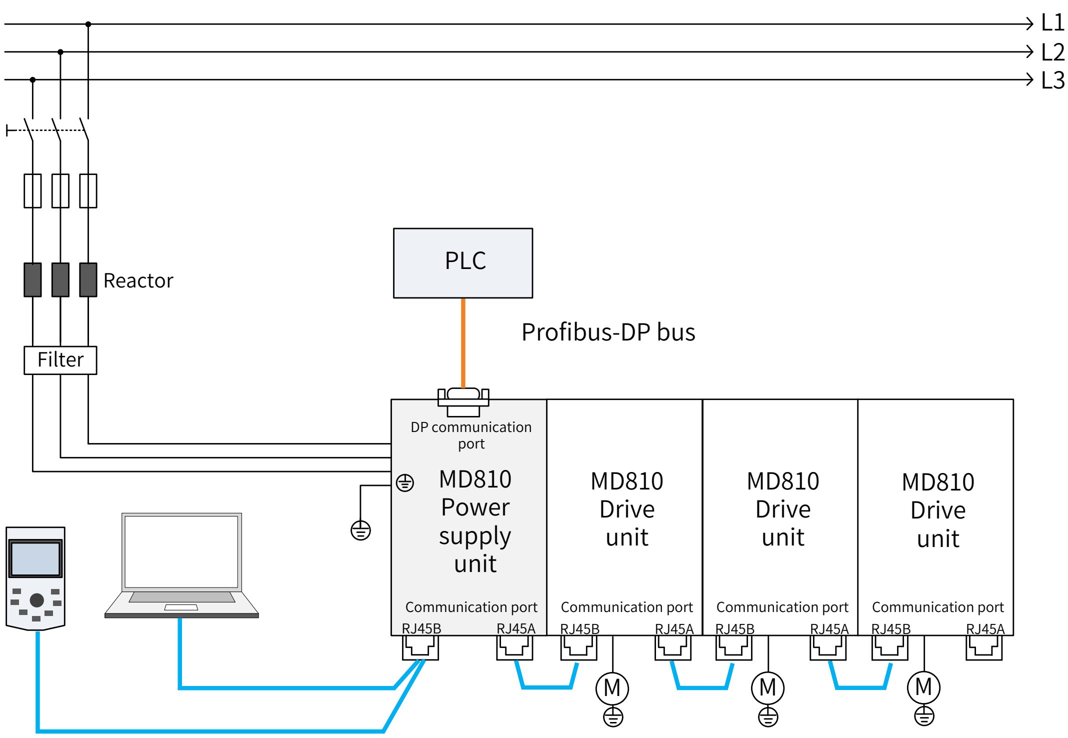


Figure 1-10 PROFIBUS-DP-to-CANopen connections

1.4.6 PROFINET-to-CANopen Bus Topology

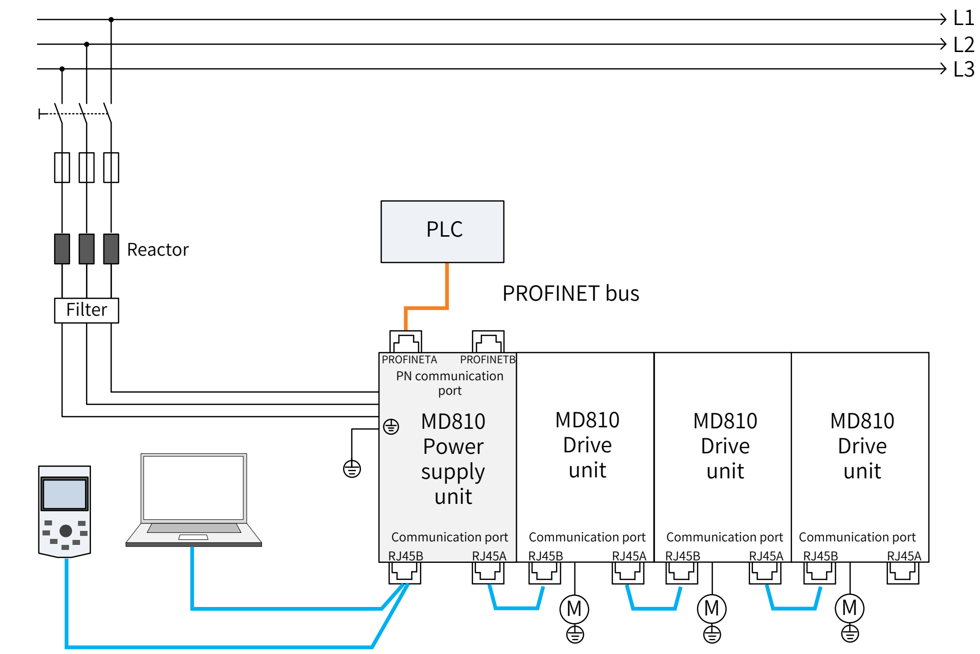


Figure 1-11 PROFINET-to-CANopen connections (single power supply unit)

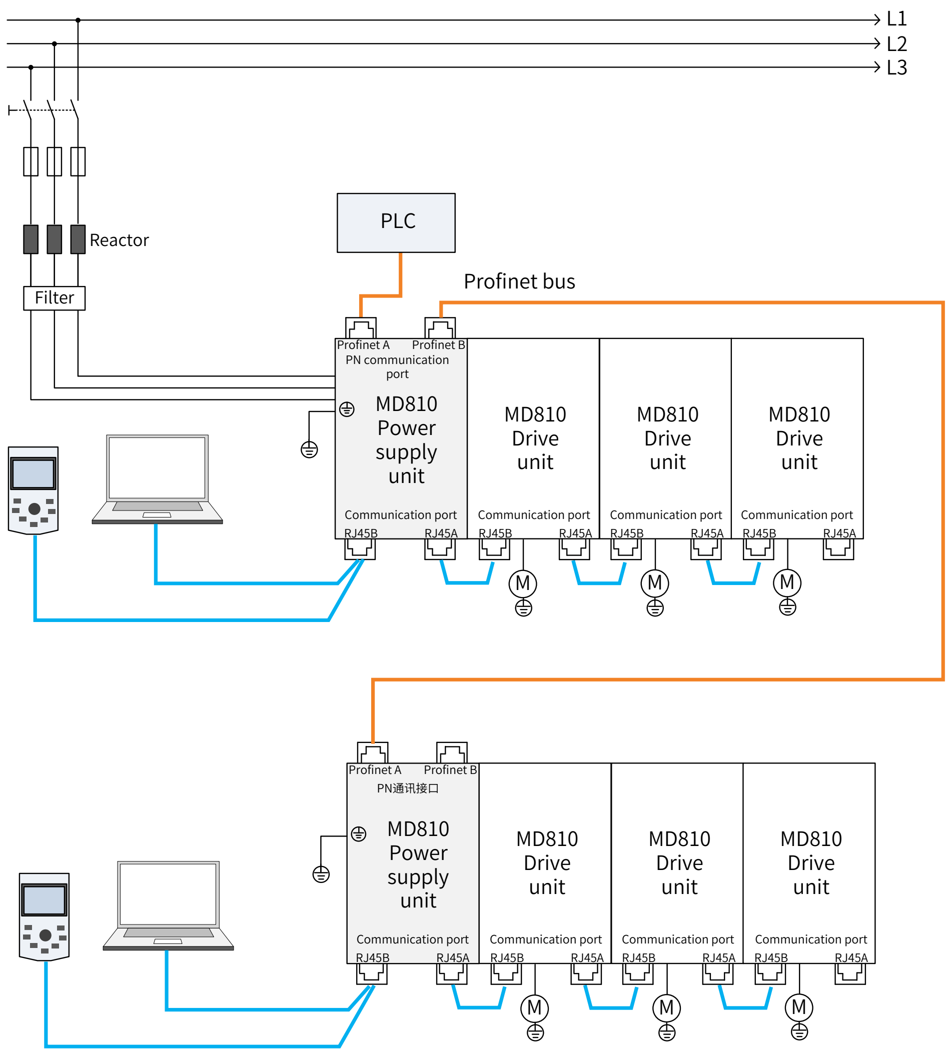


Figure 1-12 PROFINET-to-CANopen connections (multiple power supply units)

2 Mechanical Installation

2.1 Precautions

2.1.1 Transportation Precautions

■ Transportation loss precautions

1) When receiving goods from a transportation company, check the MD810 series AC drive carefully.
2) Check received goods according to the supply list.
3) If any goods loss or damage is found, notify the transportation company immediately.
4) If you find any invisible loss or damage, please notify the transportation company immediately and ask it to perform equipment qualification.
5) If you do not notify the transportation company immediately, you may lose the right of compensation for goods loss or damage.
6) If necessary, contact your local Inovance technical office for support.

■ Transportation precautions

1) Pack the equipment according to the requirements and climatic conditions in transit and the destination before the equipment leaves the factory.
2) Follow precautions for transportation, storage, and correct operation indicated on the package.
3) The equipment must be placed on a wooden chassis (pallet) when being transported with a forklift.
4) Do not disassemble the equipment as long as it is still placed on this wooden chassis and continues to be transported.
5) Allowable ambient temperature during transportation:

-25°C to +70°C, level 2K3 according to IEC 60721-3-2, maximum 24 h at as low as -40°C .

6) For precautions on auxiliary installation for cabinet transportation, see "2.5 Auxiliary Installation for Cabinet Transportation" to avoid damage to the drive during transportation.

DANGER

◆ Transportation loss indicates that the AC drive is under improper stress so that the electrical safety performance of the AC drive cannot continue to be ensured. Do not connect the equipment before a professional test is performed.

◆ The storage period cannot exceed one year. If the storage period exceeds one year, the DC bus capacitor in the power component must be recharged during commissioning.

WARNING

◆ Failure to comply with the preceding requirements may result in death, serious injuries, or great property loss.

2.1.2 Storage Precautions

1) The AC drive must be placed in a clear and dry space. Temperature must be kept in the range of -25°C to +55°C (level 1K4 according to IEC 60721-3-1). The temperature fluctuation cannot exceed 20°C/h.
2) Covering or corresponding measures must be taken during long-term storage to ensure that the

AC drive is not polluted and environmentally affected. Otherwise, the right of compensation for damage will lose effectiveness.

2.1.3 Installation Environment Precautions

1) Ambient temperature: Ambient temperature has a great effect on the AC drive life. The operating ambient temperature of the AC drive must not exceed an allowable temperature range (-10°C to 50°C).

2) Altitude: When the installation altitude exceeds 1000 m, the MD810 series AC drive must be derated according to any recommended capacitance value.

3) Installation surface requirements: The installation surface of the MD810 series AC drive must be flame retardant. Its structural strength must meet the strength requirements for device transportation, storage, and running under normal conditions to avoid damage to the AC drive device due to vibration or excessive deformation of the installation surface. The installation surface must remain vertical to the horizontal ground and be secured to the cabinet properly. The installation surface must be able to withstand no less than four times the total weight of the installed device.

4) Cooling requirements: A large amount of heat may be generated during the operation of the AC drive. There must be plenty of cooling space in the installation area. It must be ensured that the cooling holes of the AC drive cabinet are not blocked.

5) Vibration requirements: Install the drive in a place with no vibration. Vibration must not be greater than 0.6 g. Keep away from devices such as punch presses.

6) Other requirements: Install the drive in an environment free from a) direct sunlight, moisture, and water drops; b) corrosive, inflammable, or explosive gases; and c) grease dirt and dust.

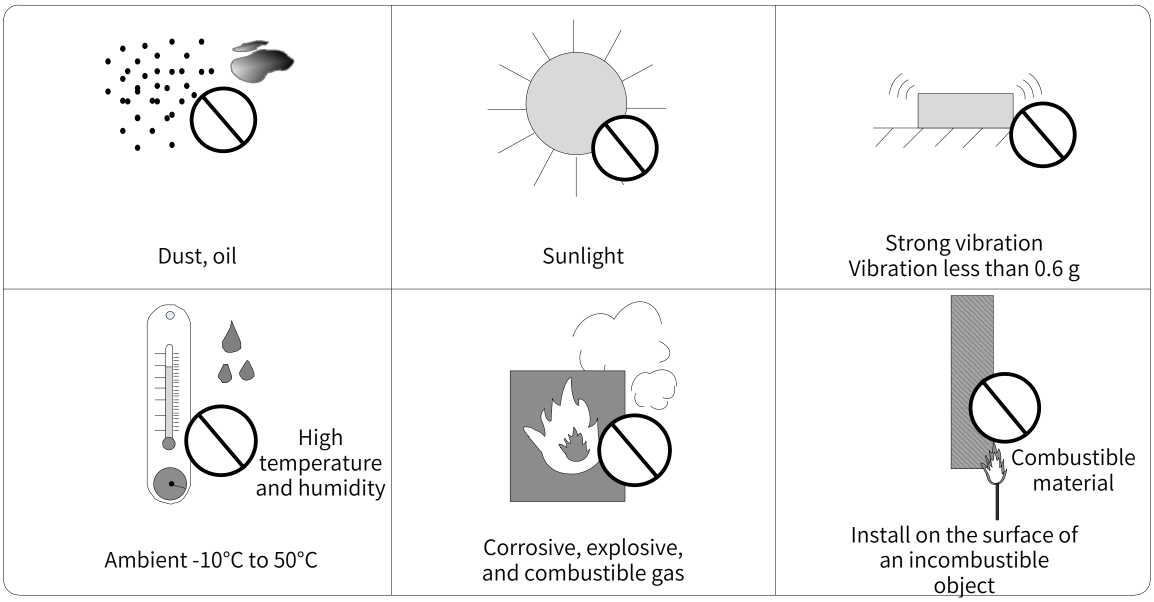


Figure 2-1 Installation environment

7) The drive units must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations, and to relevant IEC requirements.

2.2 System Selection

2.2.1 System Selection Flowchart

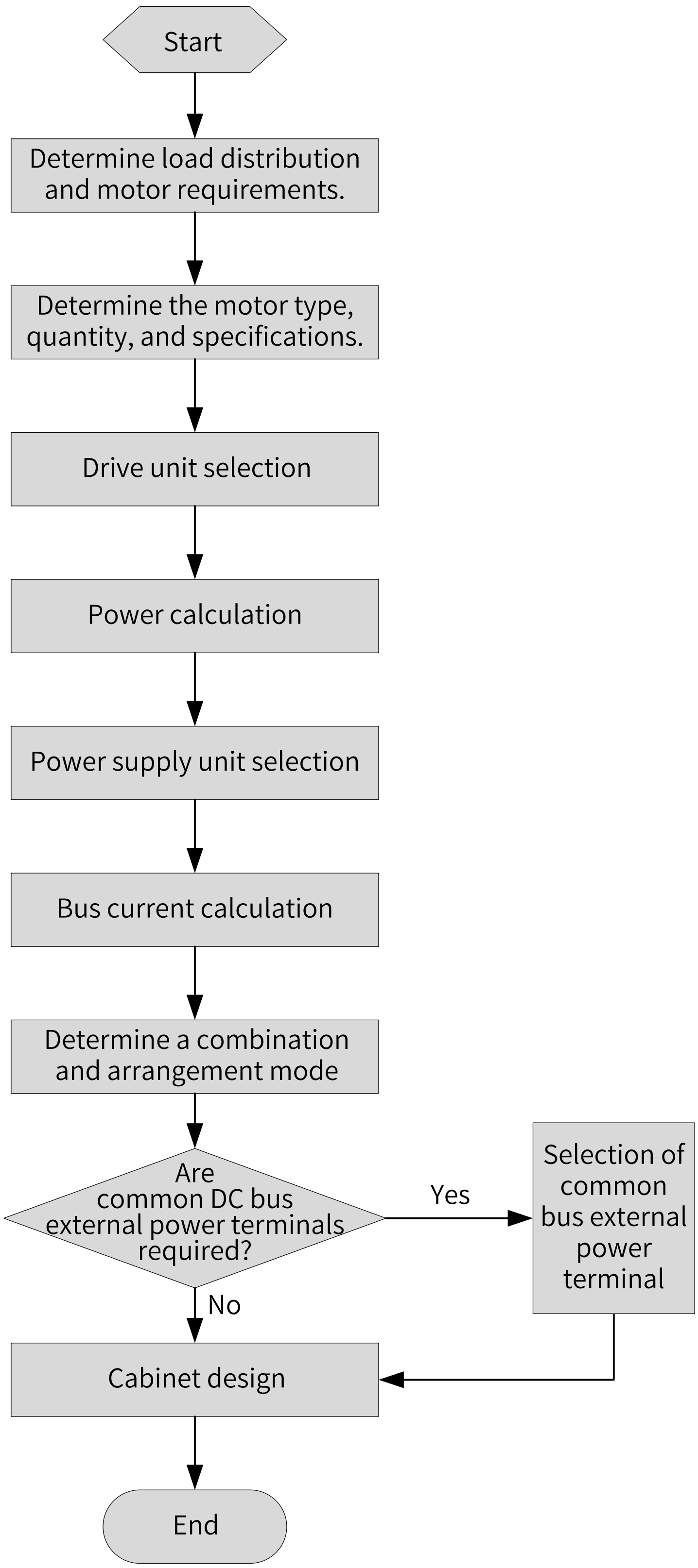


Figure 2-2 Selection flowchart

2.2.2 Load and Motor Selection

1) Determine a motor type and quantity according to the load and operating mode of the mechanical equipment.
2) Determine the requirements of the mechanical equipment for the power, torque, speed, startup, speed regulation, braking, overload, heating, and temperature rise of the motor.
3) Select the rated power, rated voltage, and rated speed in the motor product catalog.
4) Economically and correctly select a motor capacity provided that the load of the mechanical equipment is fully satisfied.

$$P_n = \sqrt{3} \times U_n \times I_n \times \cos\theta \times \eta$$

P_n — Rated power; U_n — Rated voltage; I_n — Rated current; $\cos\theta$ — Power factor;

η — Efficiency

2.2.3 Drive Unit Selection

1) Determine the drive unit quantity according to the motor quantity. One single-axis drive unit matches one motor. One dual-axis drive unit matches two motors.
2) Select the power and model of the drive unit according to the rated power of the motor.

Table 2-1 Parameter specifications of the drive unit

Drive Unit Model	Rated Power (kW)	DC Input Current (A)	AC Output Current (A)	Motor	
				kW	HP
Input voltage: 537 VDC to 679 VDC (Operating range: 350 VDC to 800 VDC); Output voltage: 0 VAC to 480 VAC					
MD810-50M4T1.5GXXX	1.5	4.9	3.8	1.5	2
MD810-50M4T2.2GXXX	2.2	7	5.1	2.2	3
MD810-50M4T3.7GXXX	3.7	12	9	3.7	5
MD810-50M4T5.5GXXX	5.5	17	13	5.5	7.5
MD810-50M4T7.5GXXX	7.5	22	17	7.5	10
MD810-50M4T11GXXX	11	31	25	11	15
MD810-50M4T15GXXX	15	40	32	15	20
MD810-50M4T18.5GXXX	18.5	46	37	18.5	25
MD810-50M4T22GXXX	22	55	45	22	30
MD810-50M4T30GXXX	30	73	60	30	40
MD810-50M4T37GXXX	37	90	75	37	50
MD810-50M4T45GXXX	45	105	91	45	60
MD810-50M4T55GXXX	55	129	112	55	70
MD810-50M4T75GXXX	75	172	150	75	100
MD810-50M4T90GXXX	90	294	184	90	125
MD810-50M4T110GXXX	110	358	224	110	150
MD810-50M4T132GXXX	132	420	262	132	180

Drive Unit Model	Rated Power (kW)	DC Input Current (A)	AC Output Current (A)	Motor	
				kW	HP
MD810-50M4T160GXXX	160	474	304	160	220
MD810-50M4T200GXXXH	200	420	377	200	270
MD810-50M4T250GXXXH	250	515	465	250	330
MD810-50M4T315GXXXH	315	650	585	315	420
MD810-50M4T355GXXXH	355	725	650	355	475
MD810-50M4TD1.5GXXX	1.5	10	3.8	1.5	2
MD810-50M4TD2.2GXXX	2.2	14	5.1	2.2	3
MD810-50M4TD3.7GXXX	3.7	24	9	3.7	5
MD810-50M4TD5.5GXXX	5.5	34	13	5.5	7.5
MD810-50M4TD7.5GXXX	7.5	44	17	7.5	10
MD810-50M4TD11GXXX	11	62	25	11	15
MD810-50M4TD15GXXX	15	80	32	15	20
MD810-50M4TD18.5GXXX	18.5	92	37	18.5	25

2.2.4 Power Supply Unit Selection

1) Calculate the sum of rated powers of all selected drive units.
2) The power of the power supply unit must be greater than or equal to 80% of the sum of rated powers of all drive units.

$$P \geqslant 80\% \, (P1 + P2 + P3 + P4 + P5 + ...)$$

where p is the power of the power supply unit and P1, P2, P3, P4, P5, etc. are the rated powers of drive units.

3) Select a power supply unit model from the following table. When one power supply unit cannot meet the power requirements, parallel connection of multiple power supply units may be used.

Table 2-2 Parameter specifications of the power supply unit

Power Supply Unit Model	Rated Power (kW)	Power Capacity (kVA)	AC Input Current (A)	DC Output Current (A)	Braking Unit
Input voltage: 380 VAC to 480 VAC (Operating range: 323 VAC to 528 VAC); Output voltage 537 VDC to 679 VDC					
MD810-20M4T22GXXX	22	54	49	56	Optional built-in
MD810-20M4T45GXXX	45	81	89	107	Optional built-in
MD810-20M4T110GXXX	110	179	196	240	Optional external MDBUN series
MD810-20M4T160GXXX	160	263	292	358	Optional external MDBUN series
MD810-20M4T355GXXX	355	565	619	759	Optional external MDBUN series
TD810-20M4T22GXXX	22	54	59	56	Optional built-in
TD810-20M4T45GXXX	45	81	112	110	Optional built-in
TD810-20M4T110GXXX	110	179	196	240	Optional external MDBUN series

Power Supply Unit Model	Rated Power (kW)	Power Capacity (kVA)	AC Input Current (A)	DC Output Current (A)	Braking Unit
TD810-20M4T160GXXX(W)	160	263	292	358	Optional external MDBUN series
TD810-20M4T355GXXX	355	565	619	759	Optional external MDBUN series

NOTE

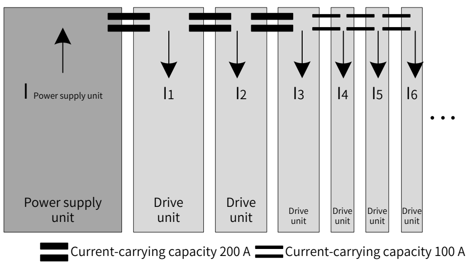
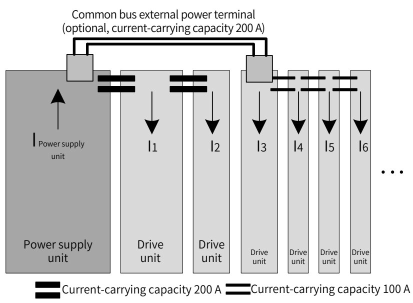
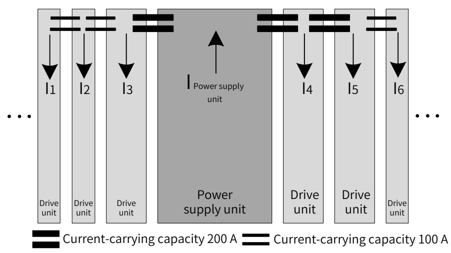
- ◆ The configuration coefficient of the power supply and drive units is generally 80%. When the requirements for the overload capacity of the mechanical equipment load are high, the configuration coefficient needs to be adjusted between 100% to 150%. When the requirements for the overload capacity of the mechanical equipment load are low, the configuration coefficient can be adjusted between 60% to 80%.
- ◆ Only a maximum of four power supply units with the same power size can be paralleled. If more than four power supply units are required, select power supply units with a greater power level.
- ◆ For details about the selection of the braking unit, see 19010680 "810 Series Power Supply Unit User Guide."

2.2.5 System Combination and Arrangement

The MD810 series drive unit adopts the booksize and vertical tower formats. The combination and arrangement modes are very flexible. Single or dual rack installation is allowed. A power supply unit may be located between or on the left side of the drive units.

■ Single rack installation

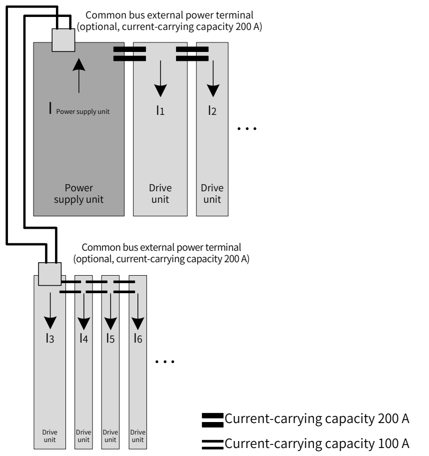
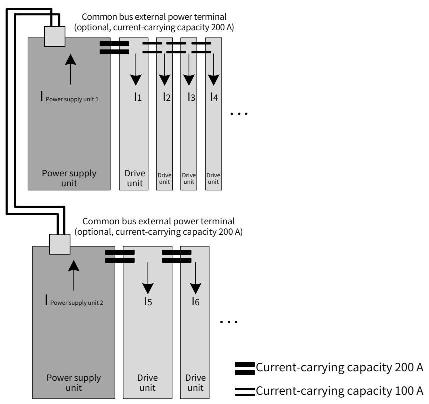
It is recommended to use a single rack paralleled arrangement with a power supply unit placed on the left or in the middle provided that physical space in the cabinet allows doing so. The following table shows typical single rack combination and arrangement modes:

Arrangement Mode	Schematic Diagram of Combination and Arrangement	Bus Current Calculation
Power supply unit placed on the left		$I_{power\ supply\ unit} \geq 80\% (I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + ...)$ $I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + ... \leq 200$ A $I_4 + I_5 + I_6 + ... \leq 100$ A
Power supply unit placed on the left Common bus external terminal		$I_{power\ supply\ unit} \geq 80\% (I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + ...)$ $I_1 + I_2 \leq 200$ A $I_3 + I_4 + I_5 + I_6 + ... \leq 200$ A $I_4 + I_5 + I_6 + ... \leq 100$ A
Power supply unit placed in the middle		$I_{power\ supply\ unit} \geq 80\% (I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + ...)$ $I_1 + I_2 + I_3 + ... \leq 200$ A $I_4 + I_5 + I_6 + ... \leq 200$ A $I_1 + I_2 + ... \leq 100$ A $I_6 + ... \leq 100$ A

- Dual rack installation

If space in the cabinet is limited, dual rack installation can be performed. A power supply unit is generally placed on the left during dual rack installation. If there are two power supply units, it is recommended to provide one power supply unit in each rack. If there are more power supply units, it is recommended to separately install them in multiple cabinets.

The following table shows typical dual rack combination and arrangement modes:

Arrangement Mode	Schematic Diagram of Combination and Arrangement	Bus Current Calculation
One power supply unit		$I_{power\ supply\ unit} \geqslant 80\% (I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + ...)$ $I_1 + I_2 + ... \leqslant 200A$ $I_3 + I_4 + I_5 + I_6 + ... \leqslant 200\ A$ $I_4 + I_5 + I_6 + ... \leqslant 100\ A$
Two power supply units		$I_{power\ supply\ unit\ 1} + I_{power\ supply\ unit\ 2} \geqslant 80\% (I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + ...)$ $I_1 + I_2 + I_3 + I_4 + ... \leqslant 200\ A$ $I_2 + I_3 + I_4 + ... \leqslant 100\ A$ $I_5 + I_6 + ... \leqslant 200A$ $I_{power\ supply\ unit\ 1}/I_{power\ supply\ unit\ 2} \approx (I1 + I2 + I3 + I4 + ...)/(I5 + I6 + ...)$

2.3 Cabinet Design

2.3.1 Space Requirements

The MD810 units comprise of:

- Power supply units and drive units in "Booksize" format with common height and different widths (50 mm, 100 mm, 200 mm, 300 mm)
- Larger rating power supply and drive units in "vertical tower" format (180 mm, 230 mm)

Single and dual rack installation is supported for the MD810 series AC drive. When installing two racks of booksize units, one above the other, as shown in Figure 2-1, observe the recommended air clearance distances between the top and bottom racks (see the following table for details) and install an air guide plate to allow for proper heat dissipation to avoid overheating the top rack.

Table 2-3 Minimum clearance during the installation of the units

Item	50 mm Wide Unit	100 mm Wide Unit	200 mm Wide Unit	300 mm Wide Unit	180 mm Wide Unit	230 mm Wide Drive Unit
	Booksize Unit				Vertical Tower Unit	
S1	⩾ 300mm	⩾ 300mm	⩾ 300mm	⩾ 300mm	⩾ 300mm	⩾ 300mm
S2	⩾ 300mm	⩾ 300mm	⩾ 300mm	⩾ 300mm	⩾ 500mm	⩾ 500mm
S3	⩾ 300mm	⩾ 300mm	⩾ 300mm	⩾ 300mm	-	-

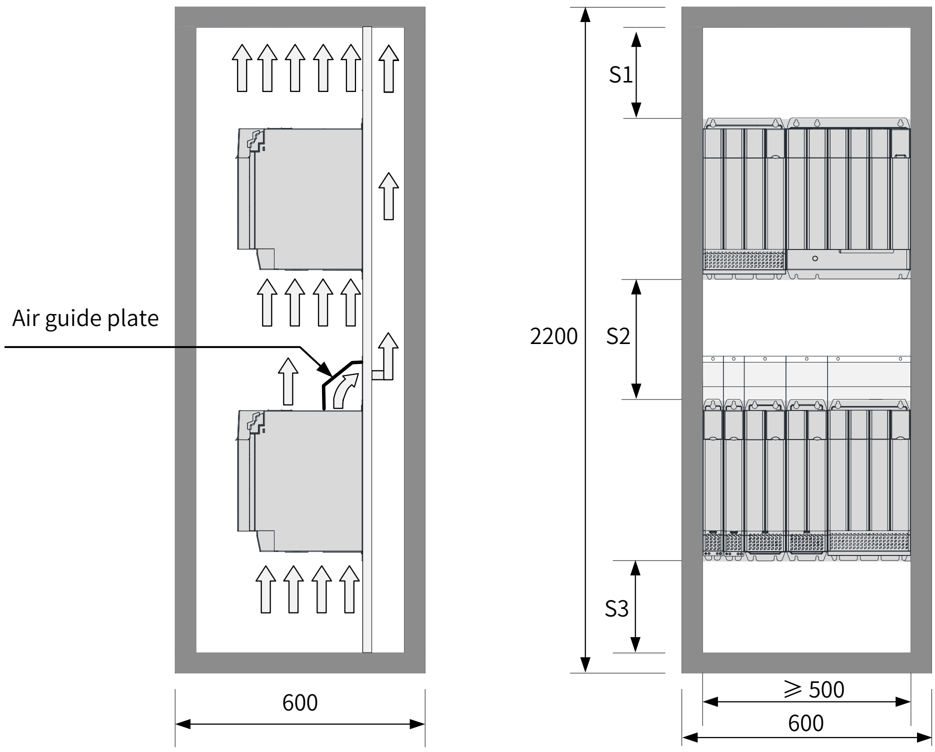


Figure 2-3 Heat dissipation clearances for the booksize unit (dual rack installation)

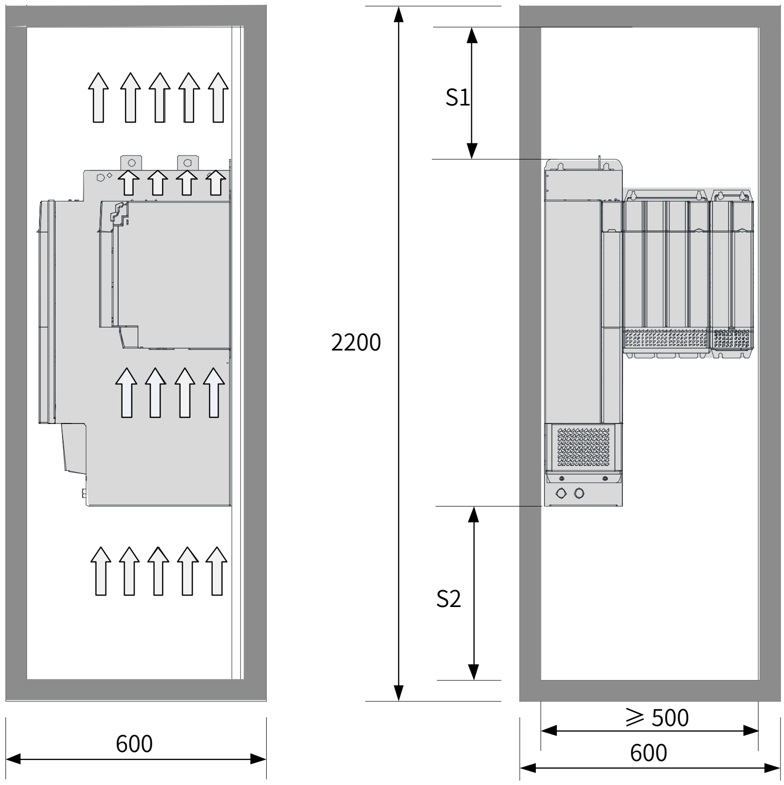


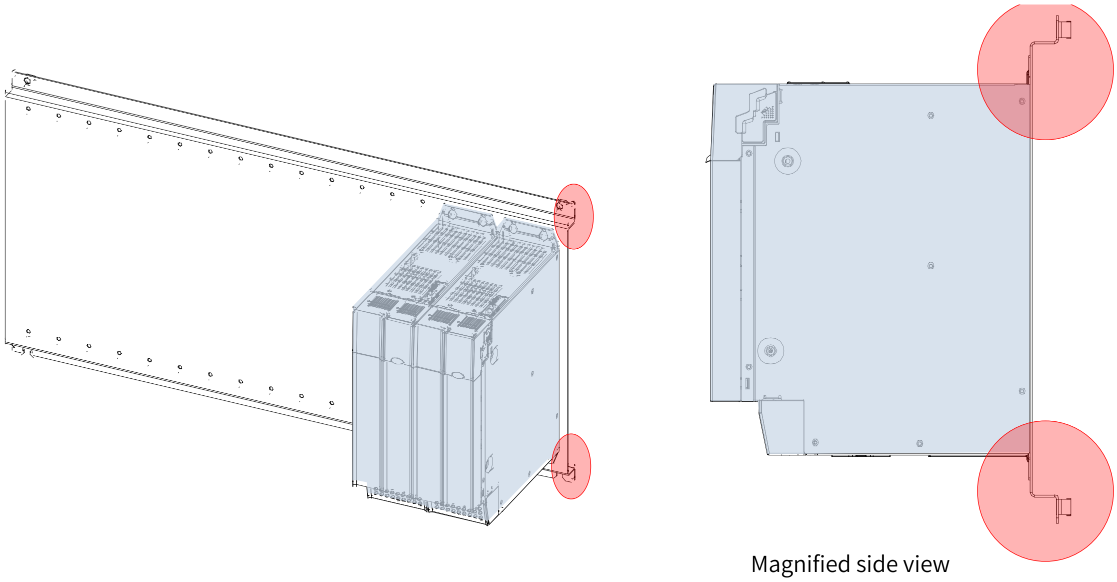
Figure 2-4 Heat dissipation clearances for the vertical tower unit

2.3.2 Mounting Backplate Design Requirements

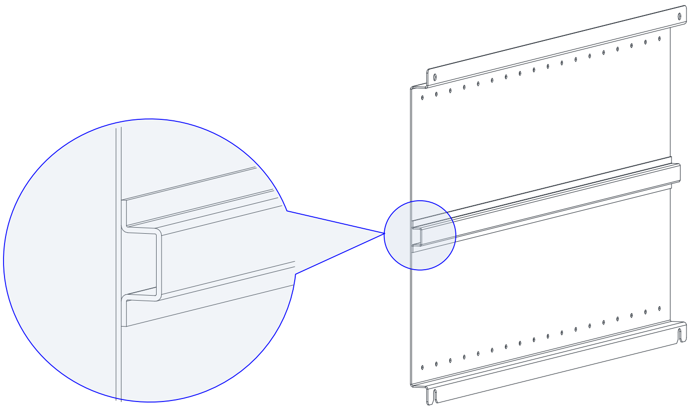
1) Thickness and stiffness reinforcing principles of a mounting backplate

To avoid damage to the unit during transportation and ensure its normal operation, a 2 mm or thicker mounting backplate with enough stiffness and strength is required. The top and bottom mounting feet of the backplate must be reinforced. The recommended reinforcement scheme is as follows:

- Scheme 1: Reinforce the lateral bending of the backplate.



■ Scheme 2: Weld a lateral reinforced beam on the back of the backplate.



2) Mounting hole drilling principles:

■ The booksize unit features the equal height and an equal mounting hole interval of 50 mm. The mounting holes must be drilled in backplate processing to enable flexible combined installation.

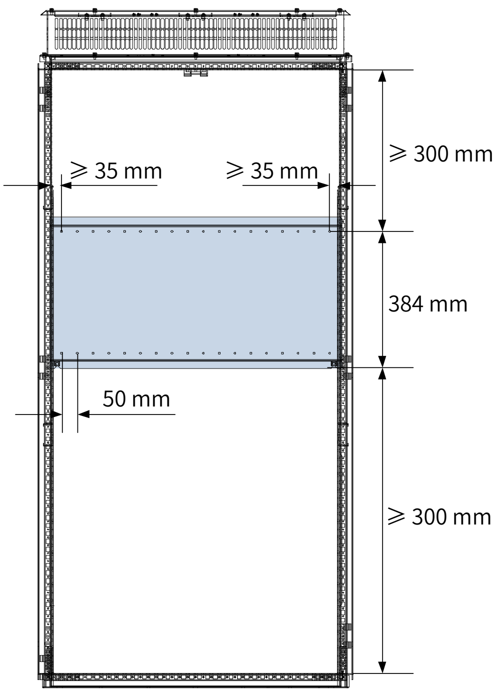
■ To avoid damage to the unit during transportation, you must install screws on the backplate by tapping, and install the self-clinching nuts or independent nuts on the rear side of the backplate. Use more screw threads and enhance the strength to the maximum degree.

NOTE

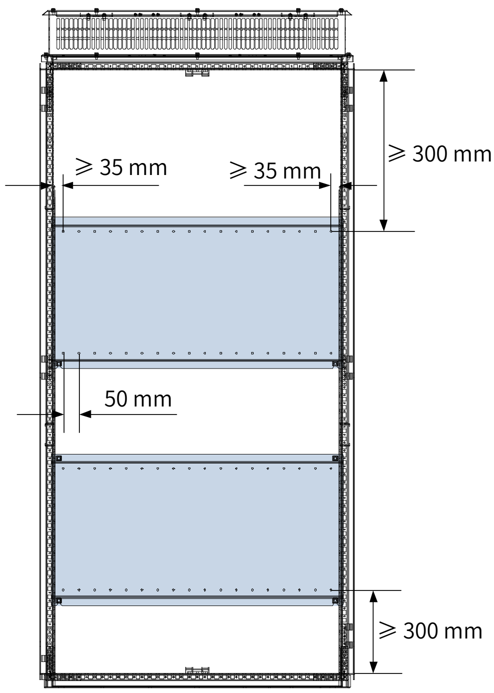
◆ The relative position of the mounting holes for the unit must be accurate to ensure that the built-in DC busbar of the unit is reliably connected. It is strongly recommended to prepare mounting holes during backplate processing. Onsite drilling is not recommended.

3) Mounting hole dimensions

■ Dimensions of mounting holes for the booksize unit

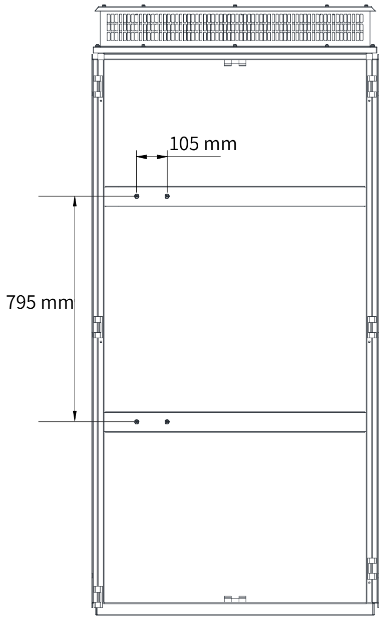


Single rack installation



Dual rack installation

■ Dimensions of mounting holes for the vertical tower unit



2.3.3 Cabinet Cooling Design

1) Cabinet door sheet cooling design

The unit is forcibly cooled by a built-in fan. Therefore, an air inlet with an appropriate size must be opened on the cabinet door sheet to ensure that enough cooling air enters the cabinet.

The air flows from bottom to top after being heated, so the cabinet air inlet must be at least 50 mm lower than the air inlet of the unit, as shown below.

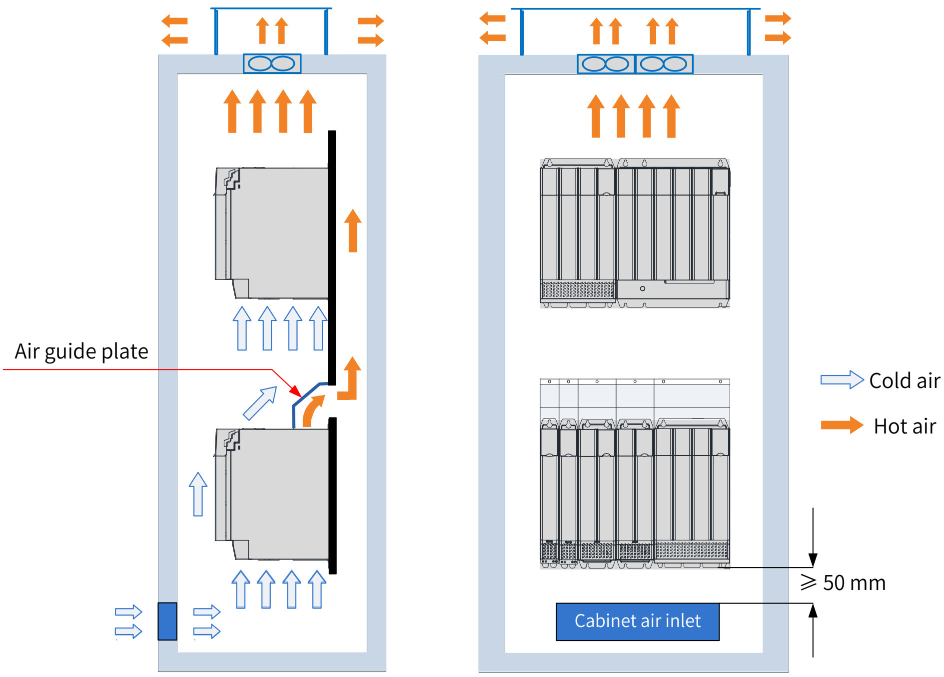


Figure 2-5 Position of the cabinet air inlet

NOTE

◆ If air is blown through the air inlet using a fan into the cabinet where multiple units are installed, the air distribution for the units in the cabinet will be disordered, affecting the overall cooling effect. Therefore, do not place a fan at the cabinet air inlet to blow air into the cabinet.

After a unit is mounted to the cabinet, the minimum ventilation area of the air inlet is as follows.

Table 2-4 Minimum ventilation area of the air inlet for the power supply unit

Power Supply Unit Model	Minimum Ventilation Area of the Cabinet Air Inlet (cm^2)
MD810-20M4T22GXXX	15
MD810-20M4T45GXXX	50
MD810-20M4T110GXXX	90
MD810-20M4T160GXXX	150
MD810-20M4T355GXXX	150

Table 2-5 Minimum ventilation area of the air inlet for the drive unit

Drive Unit Model	Minimum Ventilation Area of the Cabinet Air Inlet (cm^2)
MD810-50M4T1.5GXXX	15
MD810-50M4T2.2GXXX	15
MD810-50M4T3.7GXXX	15
MD810-50M4T5.5GXXX	15
MD810-50M4T7.5GXXX	15
MD810-50M4T11GXXX	45
MD810-50M4T15GXXX	45
MD810-50M4T18.5GXXX	45
MD810-50M4T22GXXX	70
MD810-50M4T30GXXX	70
MD810-50M4T37GXXX	70
MD810-50M4T45GXXX	90
MD810-50M4T55GXXX	90
MD810-50M4T75GXXX	90
MD810-50M4T90GXXX	147
MD810-50M4T110GXXX	147
MD810-50M4T132GXXX	147
MD810-50M4T160GXXX	147
MD810-50M4T200GXXXH	1400
MD810-50M4T250GXXXH	1400
MD810-50M4T315GXXXH	1400
MD810-50M4T355GXXXH	1400
MD810-50M4TD1.5GXXX	15
MD810-50M4TD2.2GXXX	15
MD810-50M4TD3.7GXXX	15
MD810-50M4TD5.5GXXX	45
MD810-50M4TD7.5GXXX	45
MD810-50M4TD11GXXX	70
MD810-50M4TD15GXXX	70
MD810-50M4TD18.5GXXX	70

NOTE

- The preceding tables apply to only a single unit. When multiple units are installed in the cabinet, the total area of required ventilation area is the sum of all the above-mentioned ventilation areas. For example, a cabinet contains eight 7.5 kW drive units, two 22 kW drive units, and one 160 kW power supply unit, the minimum ventilation area is 8 x 15 + 2 x 70 + 1 x 150 = 410 cm^2.
- If an air filter is installed at the inlet, the air inlet resistance will rise significantly and the air inlet area must be increased to 1.2 to 1.5 times the values indicated in the tables.
- The effective areas indicated in the preceding tables are actual through-hole areas in the hole zone. Effective area = Area of the hole zone x Hole ratio.

2) Exhaust air design on the top of cabinet

Hot air within the cabinet must be exhausted to the outside to ensure sufficient cooling of the power supply unit and drive unit. Air exhaust of the cabinet has two modes: passive and active.

■ Passive mode (Direct air exhaust)

The air flows from bottom to top after being heated. By utilizing this feature, passive air exhaust enables air to flow outside the unit through the air outlet at the top of the cabinet.

In the passive mode, hot air accumulates at the top of the cabinet, increasing the air pressure in this zone. However, the air pressure at the cabinet air inlet is low due to the suction effect of the fan at the unit air inlet. Therefore, an air pressure difference among the inside, air outlet, and air inlet of the cabinet generates an air flow. This air flow forces hot air at the air outlet to flow towards the air inlet so that it is absorbed into the unit again, causing a great temperature rise of the unit and an adverse effect on the performance of the unit.

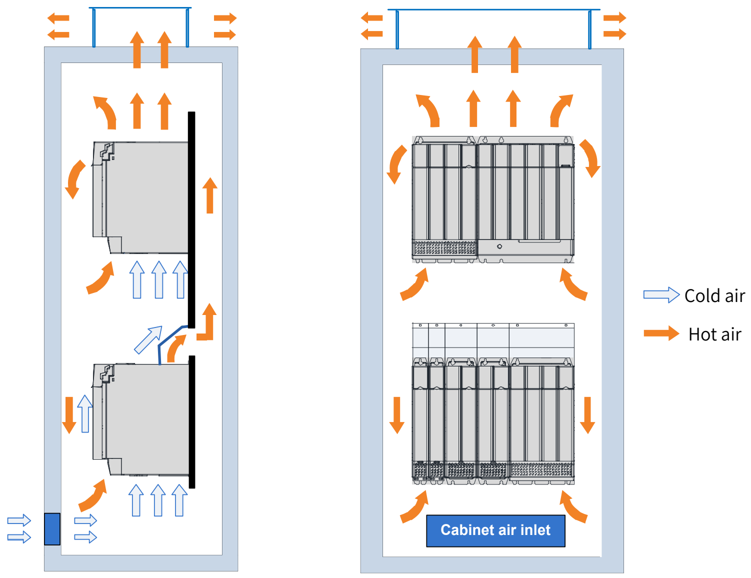


Figure 2-6 Backflow of hot air in the passive air exhaust mode (without isolating device)

To prevent backflow of hot air, an isolating device must be used in the cabinet using the passive mode. The isolating device may be a plate or exhaust duct.

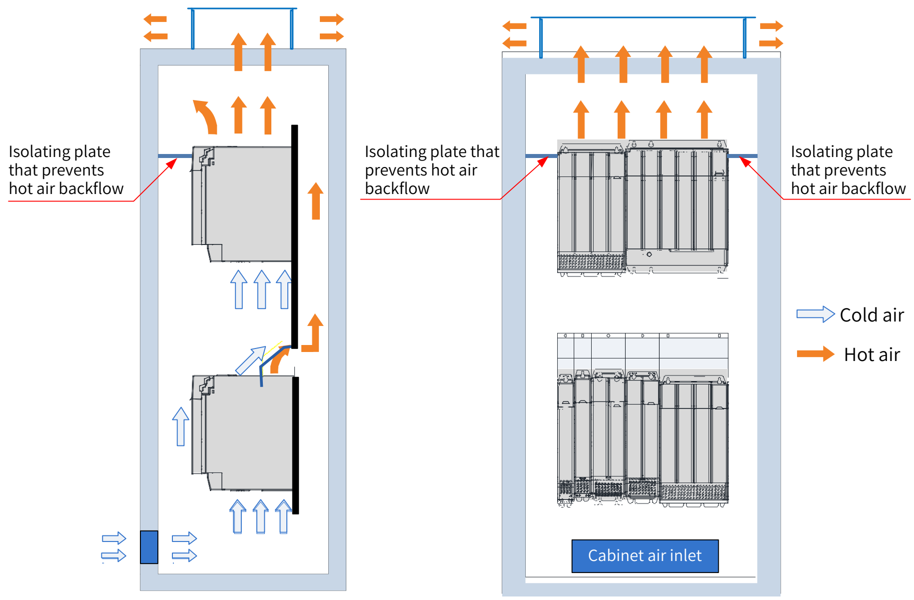


Figure 2-7 Backflow of hot air in the passive air exhaust mode (with an isolating device)

The temperature at the air outlet of the power supply unit and drive unit is high and the density is lower than that at the air inlet. When passive air exhaust is used, the minimum ventilation area of the cabinet air outlet must meet the requirements in the following table to ensure smooth air exhaust.

Table 2-6 Minimum ventilation area in passive air exhaust mode for the power supply unit

Power Supply Unit Model	Minimum Ventilation Area of the Cabinet Air Outlet (cm^2)
MD810-20M4T22GXXX	24
MD810-20M4T45GXXX	80
MD810-20M4T110GXXX	145
MD810-20M4T160GXXX	240
MD810-20M4T355GXXX	240

Table 2-7 Minimum ventilation area in passive air exhaust mode for the drive unit

Drive Unit Model	Minimum Ventilation Area of the Cabinet Air Outlet (cm^2)
MD810-50M4T1.5GXXX	24
MD810-50M4T2.2GXXX	24
MD810-50M4T3.7GXXX	24
MD810-50M4T5.5GXXX	24
MD810-50M4T7.5GXXX	24
MD810-50M4T11GXXX	72
MD810-50M4T15GXXX	72
MD810-50M4T18.5GXXX	72
MD810-50M4T22GXXX	112
MD810-50M4T30GXXX	112
MD810-50M4T37GXXX	112
MD810-50M4T45GXXX	145
MD810-50M4T55GXXX	145
MD810-50M4T75GXXX	145
MD810-50M4T90GXXX	235.1

Drive Unit Model	Minimum Ventilation Area of the Cabinet Air Outlet (cm^2)
MD810-50M4T110GXXX	235.1
MD810-50M4T132GXXX	235.1
MD810-50M4T160GXXX	235.1
MD810-50M4T200GXXXH	2100
MD810-50M4T250GXXXH	2100
MD810-50M4T315GXXXH	2100
MD810-50M4T355GXXXH	2100
MD810-50M4TD1.5GXXX	24
MD810-50M4TD2.2GXXX	24
MD810-50M4TD3.7GXXX	24
MD810-50M4TD5.5GXXX	72
MD810-50M4TD7.5GXXX	72
MD810-50M4TD11GXXX	112
MD810-50M4TD15GXXX	112
MD810-50M4TD18.5GXXX	112

NOTE

- The preceding tables apply to only a single unit. When multiple units are installed in the cabinet, the total area of required ventilation area is the sum of all the above-mentioned ventilation areas.
- If an air filter is installed at the air outlet, the air outlet resistance will rise significantly and the air outlet area must be increased to 1.2 to 1.5 times the value indicated in the tables.
- The effective areas indicated in the tables are actual through-hole areas in the hole zone. Effective area = Area of the hole zone x Hole ratio.

■ Active air exhaust

In the active air exhaust mode, a fan is installed on the top of the cabinet to exhaust hot air to outside of the cabinet. Active air exhaust is a commonly used ventilation mode.

To ensure that the hot air can be exhausted to the outside, the total air volume of the fan cannot be smaller than the air volume of all units in the cabinet. The cooling air volumes required by MD810 series power supply units and drive units are as follows:

Table 2-8 Cooling air volumes for the power supply units

Power Supply Unit Model	Cooling Air Volume (CFM)
MD810-20M4T22GXXX	15
MD810-20M4T45GXXX	40
MD810-20M4T110GXXX	100
MD810-20M4T160GXXX	285
MD810-20M4T355GXXX	310

Table 2-9 Cooling air volumes for the drive units

Drive Unit Model	Cooling Air Volume (CFM)
MD810-50M4T1.5GXXX	10
MD810-50M4T2.2GXXX	10
MD810-50M4T3.7GXXX	10
MD810-50M4T5.5GXXX	10
MD810-50M4T7.5GXXX	10
MD810-50M4T11GXXX	40

Drive Unit Model	Cooling Air Volume (CFM)
MD810-50M4T15GXXX	40
MD810-50M4T18.5GXXX	55
MD810-50M4T22GXXX	65
MD810-50M4T30GXXX	75
MD810-50M4T37GXXX	105
MD810-50M4T45GXXX	130
MD810-50M4T55GXXX	175
MD810-50M4T75GXXX	195
MD810-50M4T90GXXX	145
MD810-50M4T110GXXX	311
MD810-50M4T132GXXX	270
MD810-50M4T160GXXX	270
MD810-50M4T200GXXXH	265
MD810-50M4T250GXXXH	353
MD810-50M4T315GXXXH	447
MD810-50M4T355GXXXH	706
MD810-50M4TD1.5GXXX	11
MD810-50M4TD2.2GXXX	11
MD810-50M4TD3.7GXXX	11
MD810-50M4TD5.5GXXX	16
MD810-50M4TD7.5GXXX	21
MD810-50M4TD11GXXX	39
MD810-50M4TD15GXXX	37
MD810-50M4TD18.5GXXX	104
Note: 1 CFM = 0.02832 m^3/min	

3) Cabinet fan selection

Cabinet fan selection procedure:

- Calculate the sum of cooling air volume required for all drive units according to "Table 2-8 Cooling air volumes for the power supply units" and "Table 2-9 Cooling air volumes for the drive units".
- Determine the maximum air volume (Qmax) of the cabinet fan.
- Determine the fan specifications and quantity according to the maximum air volume (Qmax).

Note that:

Maximum air volume of the cabinet = (1.3 to 1.5 times) the sum of cooling air volume

Maximum air volume of the cabinet = (1.6 to 2.2 times) the sum of cooling air volume (if the components such as dry nets and shutters are installed at the cabinet air outlet)

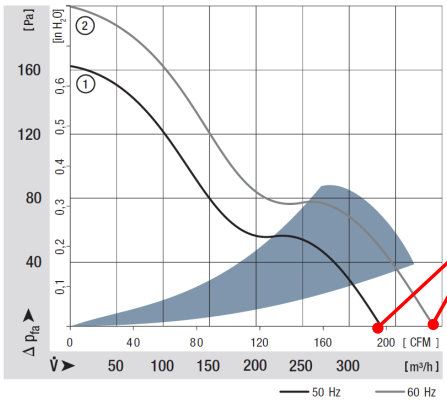
NOTE

◆ The air volume of the selected fan cannot be smaller than the maximum air volume Qmax. If a single fan cannot meet this requirement, multiple fans can be used.

The following figure shows typical fan air volume specifications.

Air flow	Air flow	Nominal voltage	Frequency	Sound pressure level	Sound power level	Sintec sleeve bearings / Ball bearings	Power input	Nominal speed	Temperature range	Service life L_{10} at 40 °C	at T_{max}	Curve
m^3/h	CFM	V	Hz	dB(A)	Bel(A)	□/■	Watts	RPM	°C	Hours	Hours	
320	188,3	230	50	51	6,4	■	27,0	2 800	-25...+55	60 000 / 32 000		1
380	223,6	115	60	56	6,8	■	28,0	3 350	-25...+65	55 000 / 18 000		2

This column in the fan specifications is the maximum air flow Qmax of this fan.



Qmax of fan

Figure 2-8 Qmax of a system fan

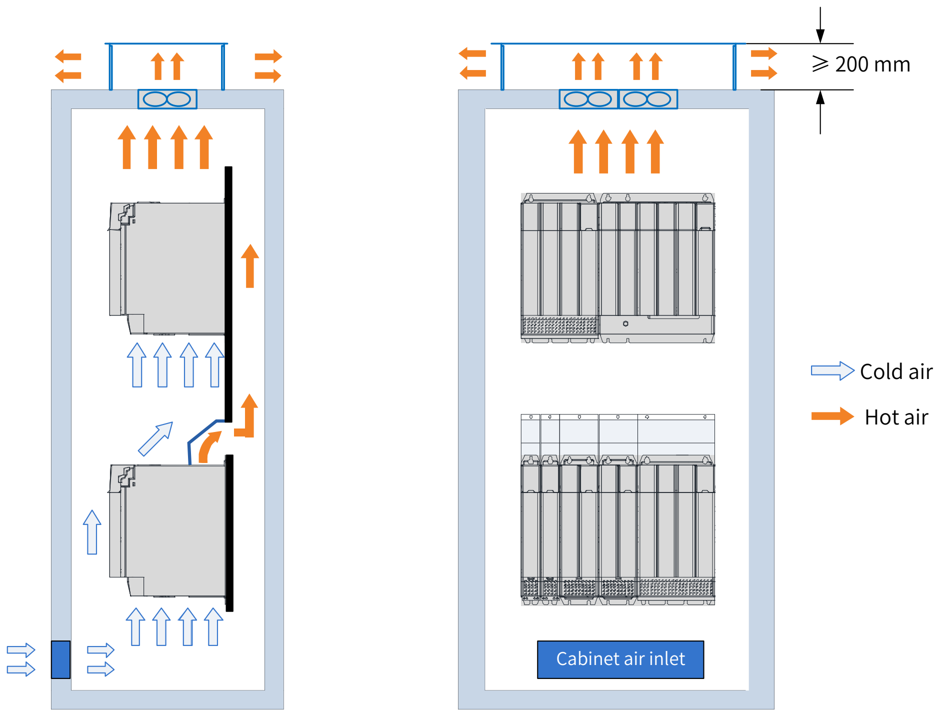


Figure 2-9 Cabinet exhaust air system

NOTE

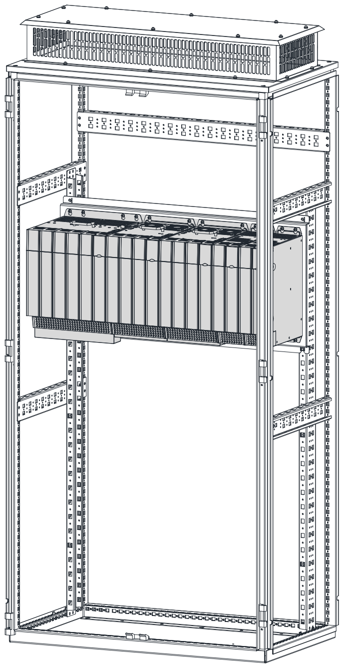
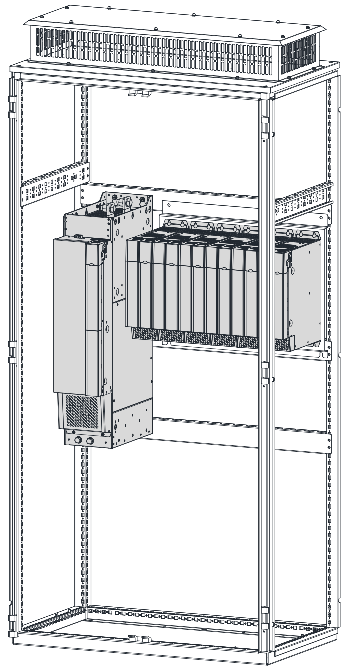
- Install the fan in the correct air exhaust direction to ensure that air flows from inside to outside of the cabinet; otherwise, hot air cannot be exhausted and the power supply unit or drive unit may be overheated or damaged.
- The distance between the top air outlet and the fan outlet must be at least 200 mm; otherwise, the cooling performance of the fan will be degraded

2.4 Installation

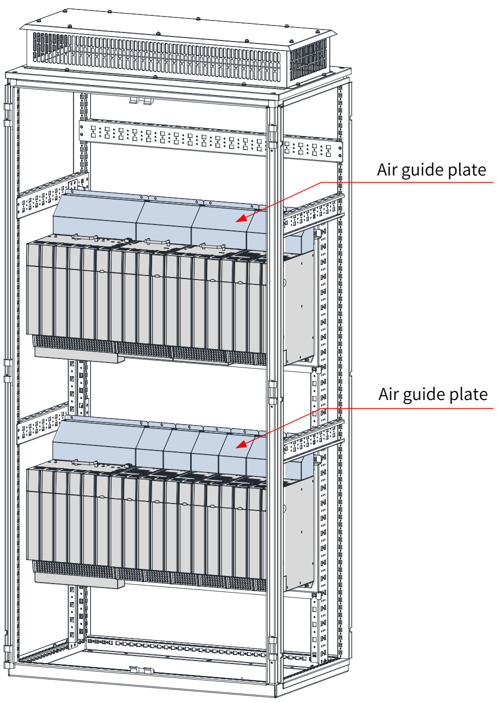
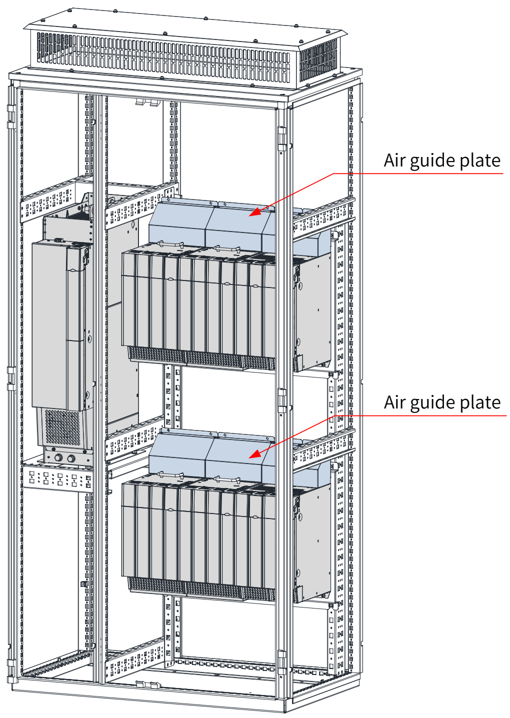
2.4.1 Installation Method

The installation method of this product in a cabinet supports single rack installation and dual rack installation. The booksize unit must be installed in close arrangement to avoid damage to the power supply unit in transit. Do not install two or less units and even separately install them. The through-hole mounting method supports only single rack installation.

1) Single rack installation

Booksize	Vertical Tower
	

2) Dual rack installation

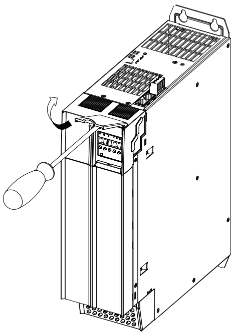
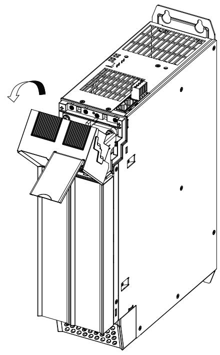
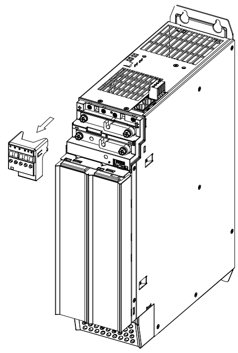
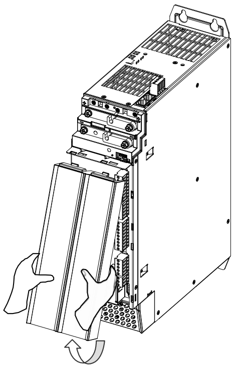
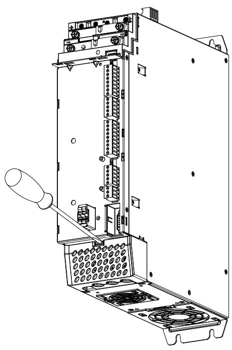
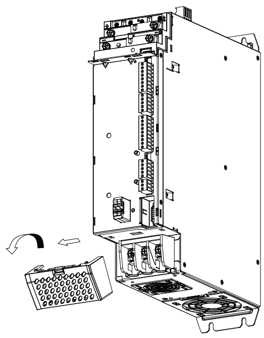
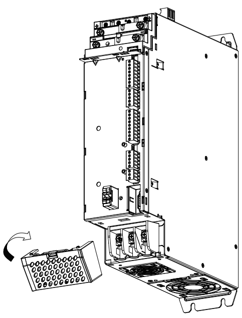
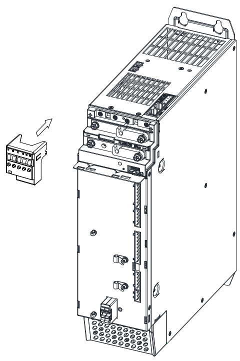
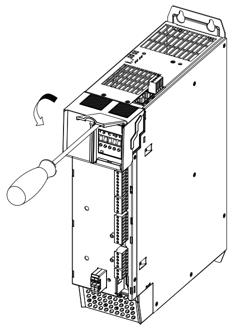
<table>
<tr><th>Booksize</th><th>Vertical Tower</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

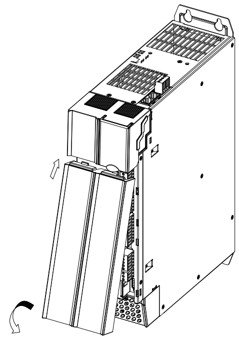
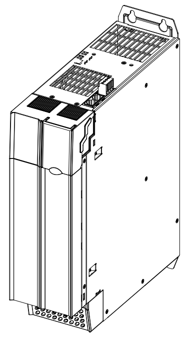
NOTE

- ◆ In case of dual rack installation, an air guide plate may be installed in the units of the upper rack.
- ◆ Do not separately install two or less units.
- ◆ The through-hole mounting method is possible only for single rack installation.

2.4.2 Unit Installation

1 Removal and installation of covers

Removal		
1) Lift the translucent keypad cover. Loosen the screws in the upper cover with a screwdriver. 	2) Remove the upper cover by turning it frontward. 	3) Pull the whole keypad box frontward. 
4) Hold the bottom of the lower cover with your hands. Remove the lower cover by turning it forward. 	5) Insert the tool (screwdriver) into the clasp of the power terminal cover. Pry the clasp. 	6) Remove the power terminal cover. 
Installation		
1) Align the power terminal cover with the position of the clasp of the bus socket. Press the power terminal cover to clasp and fix it. 	2) Insert the keypad. 	3) Align the upper cover with the position of the clasp. Press the upper cover to clasp and fix it. Tighten the screw with a screwdriver. 

Installation		
4) Insert the top end of the lower cover below the upper cover. Turn the bottom end of the lower cover to clasp it. 	5) The installation is complete. 	

2 Backplate installation

- Backplate installation of the booksize unit (50 mm wide)

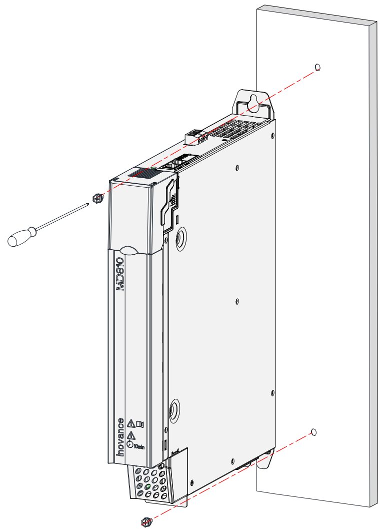


Figure 2-10 Backplate installation of the the booksize unit (50 mm wide)

- Backplate installation of the booksize unit (100 mm wide)

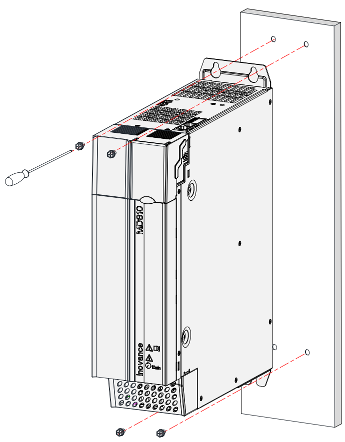


Figure 2-11 Backplate installation of the booksize unit (100 mm wide)

- Backplate installation of the booksize unit (200 mm wide)

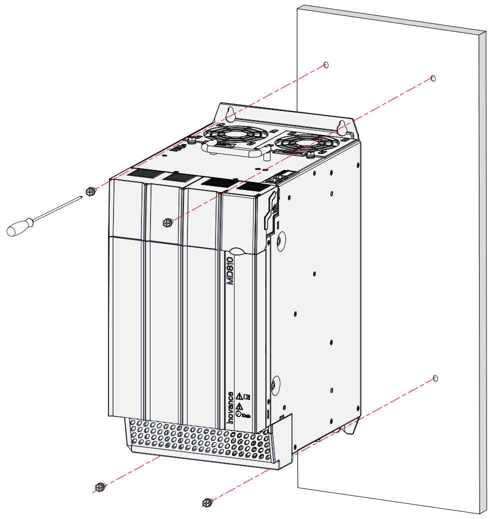


Figure 2-12 Backplate installation of the booksize unit (200 mm wide)

- Backplate installation of the booksize unit (300 mm wide)

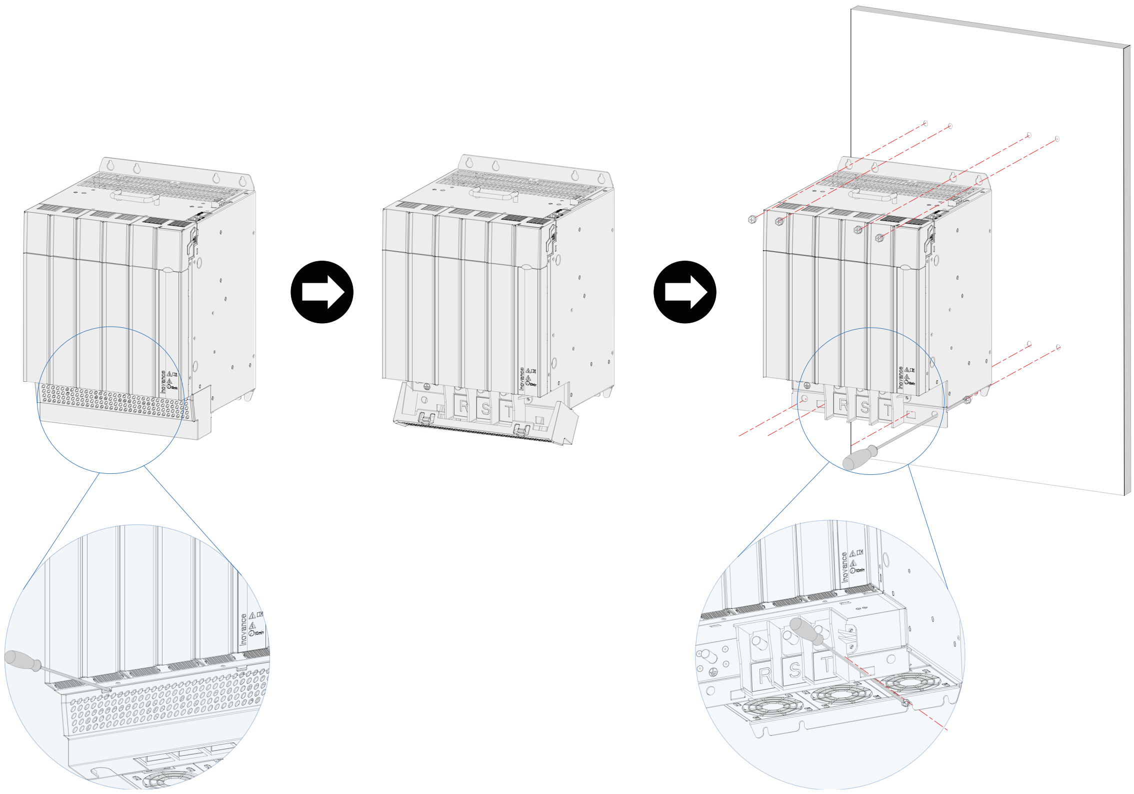


Figure 2-13 Backplate installation of the booksize unit (300 mm wide)

The installation procedure is as follows:

1) Insert a screwdriver in the left and right clasps of the power terminal cover and push them up lightly to loosen the clasps.
2) Turn downwards the terminal cover loosen from the clasps and remove it from the shell.
3) Fabricate mounting holes shown in the figure on the mounting backplate. The M6 mounting nuts are used.
4) Attach the unit to the mounting backplate with M6X15 screws and fix screws.

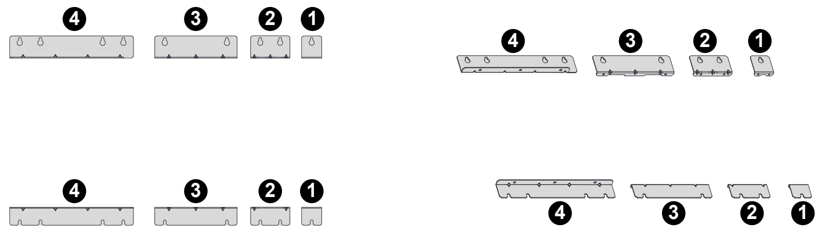
5) Align the power terminal cover with the limit holes on the shell and press it lightly. If a click is heard, the installation is proper.

NOTE

- ◆ When fixing two screws in the bottom, the screwdriver must be placed into the limit holes of the power terminal clasp to tighten screws. The recommended Phillips screwdriver model for installation is slot No. 3 with a rod length ≥ 190 mm.
- ◆ The preceding contents only describes the mounting of the 50 mm to 300 mm wide booksize drive units. The mounting of the power supply units is similar to that of the drive unit.

3 Through-hole mounting

■ Through-hole mounting brackets



❶ Upper and lower through-hole mounting brackets of 50 mm wide unit

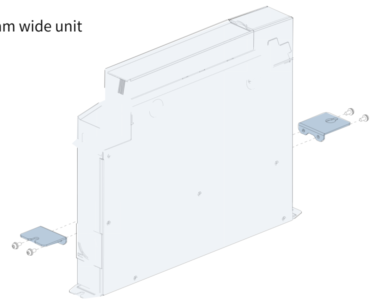
❷ Upper and lower through-hole mounting brackets of 100mm wide unit

❸ Upper and lower through-hole mounting brackets of 200mm wide unit

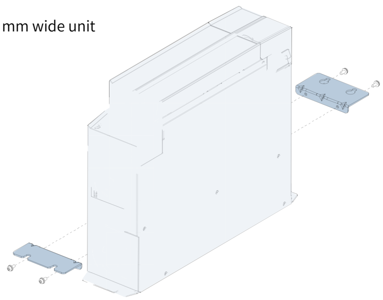
❹ Upper and lower through-hole mounting brackets of 300mm wide unit

■ Installation of upper and lower through-hole mounting brackets on the drive unit

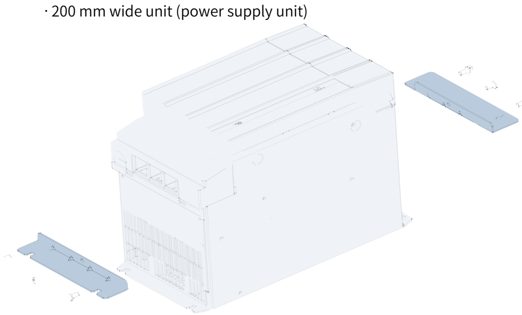
· 50 mm wide unit



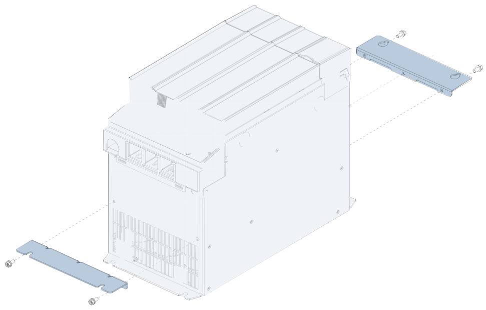
· 100 mm wide unit



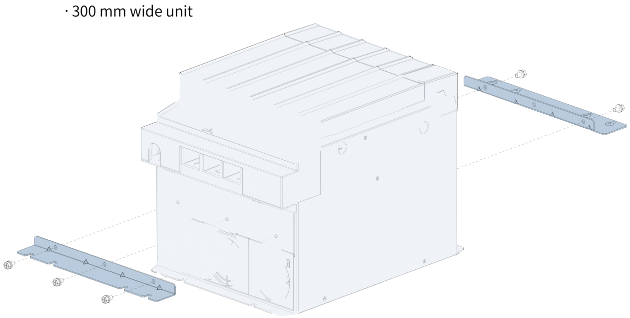
· 200 mm wide unit (power supply unit)



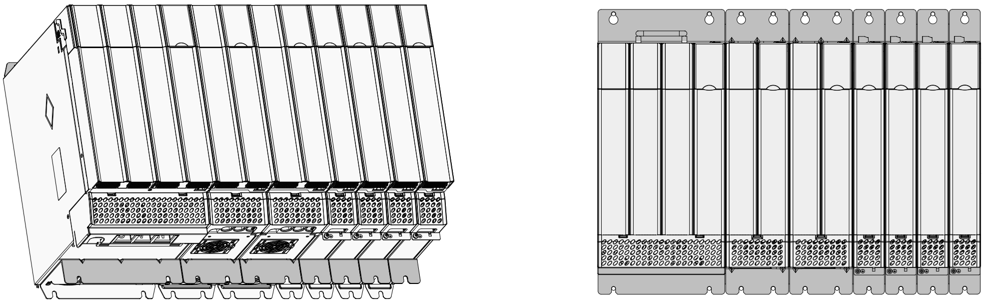
· 200 mm wide unit (drive unit)



· 300 mm wide unit

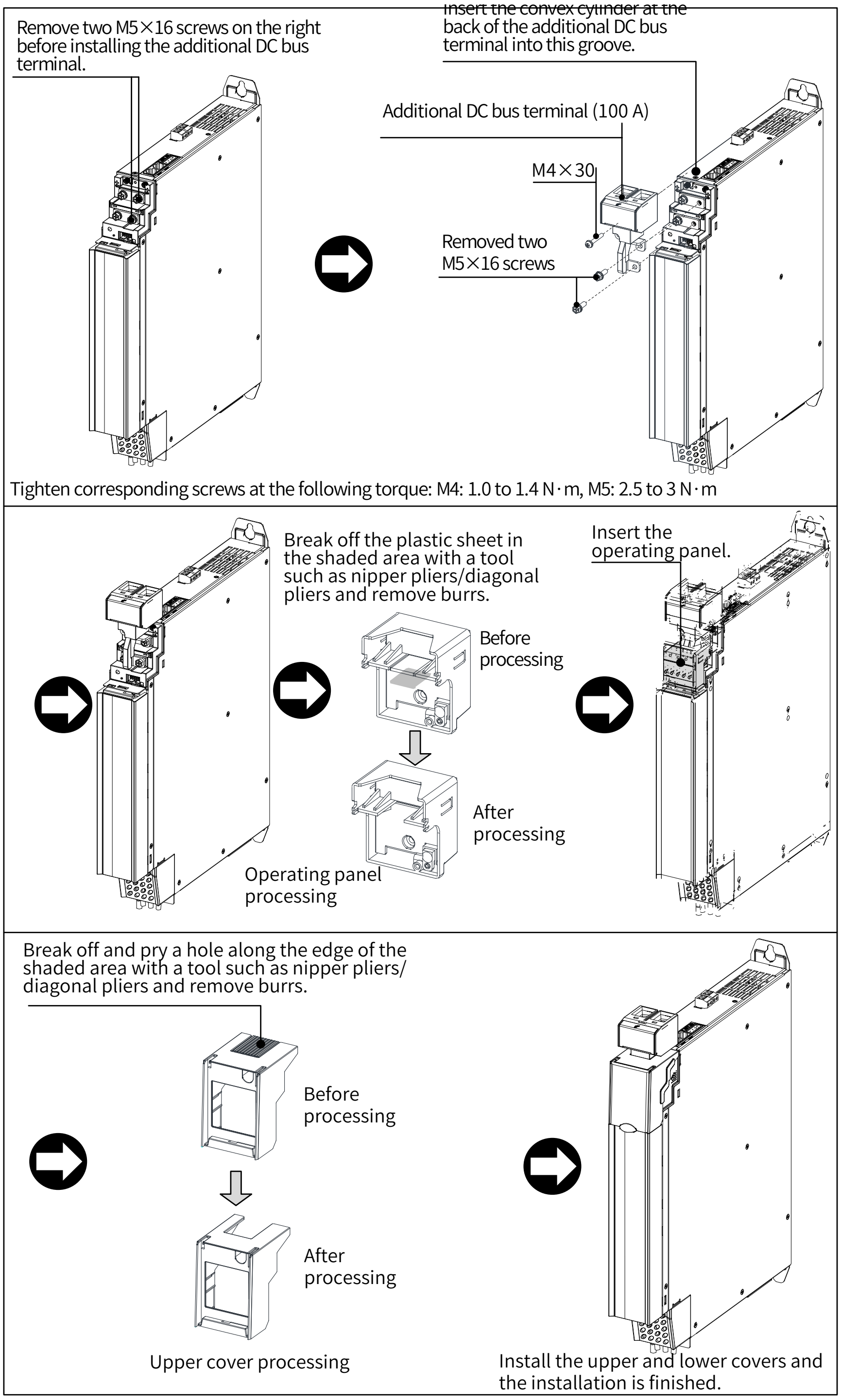


■ Installation completed

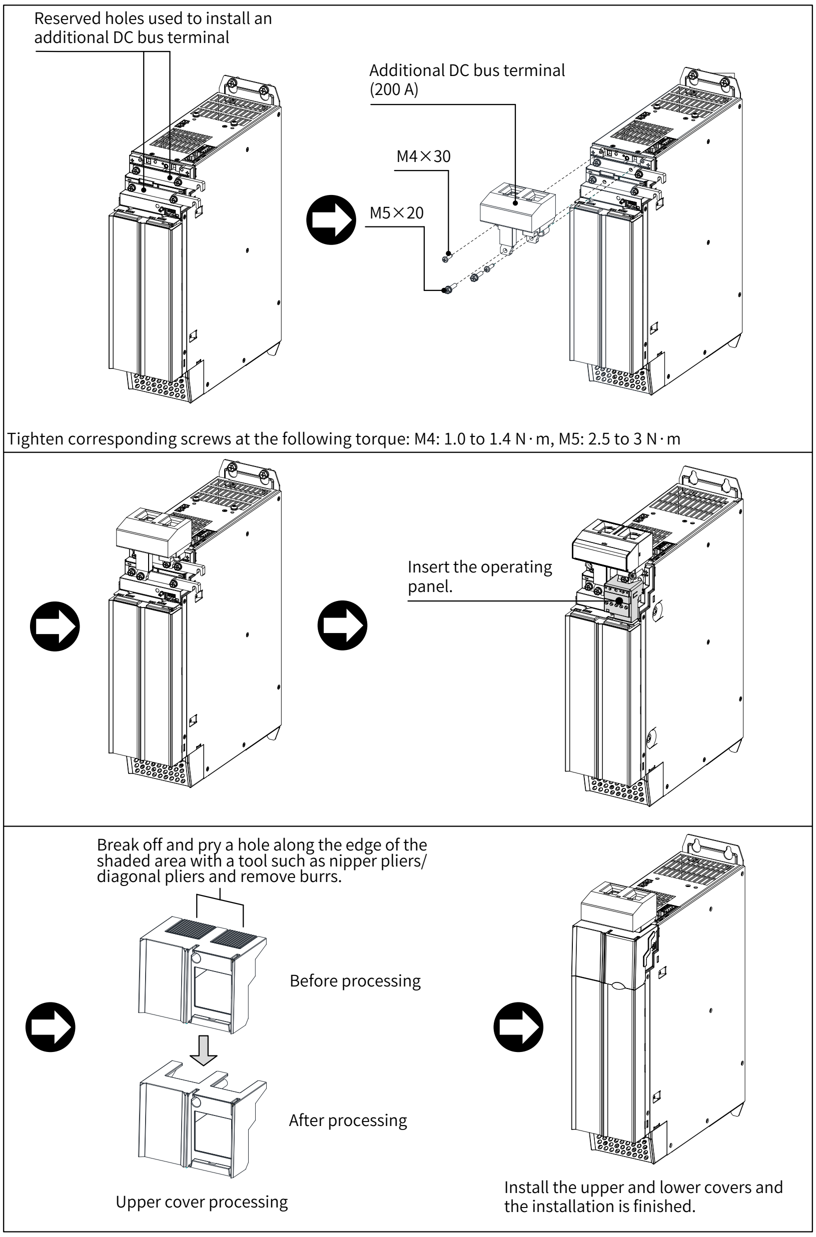


4 Installation of additional DC bus terminals

■ Installation example of 100 A additional DC bus terminal (50 mm wide unit)

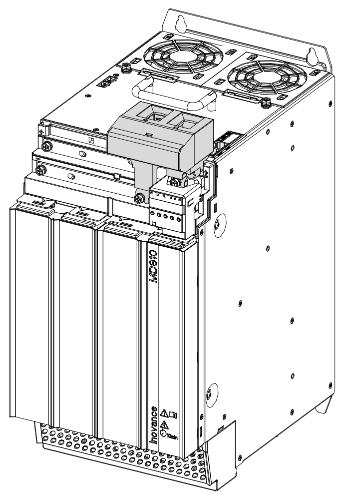


■ Installation example of 200 A additional DC bus terminal (100 mm wide unit)



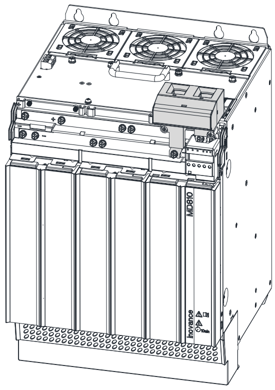
■ Installation example of 200 A additional DC bus terminal (200 mm wide unit)

The installation procedure of the 200 mm wide unit is the same as the 100 mm wide unit. The following figure shows the position example after the installation is complete.



- Installation example of 200 A additional DC bus terminal (300 mm wide unit)

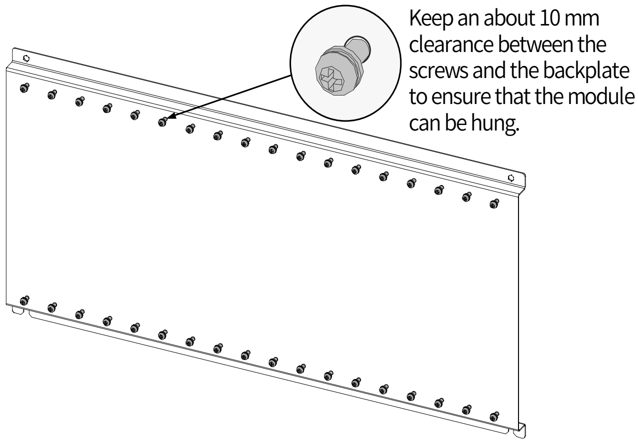
The installation procedure of the 300 mm wide unit is the same as the 100 mm wide unit. The following figure shows the position example after the installation is complete.



2.4.3 Cabinet Installation

- Cabinet Installation of the booksize unit

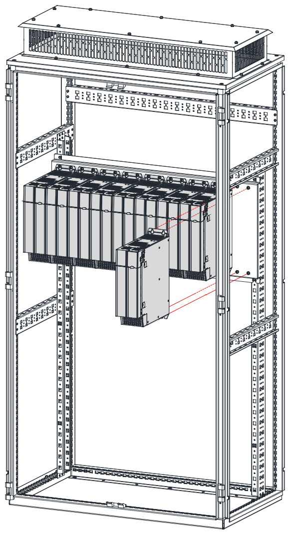
Step 1: Install screws in the backplate.



Step 2: Remove the covers.

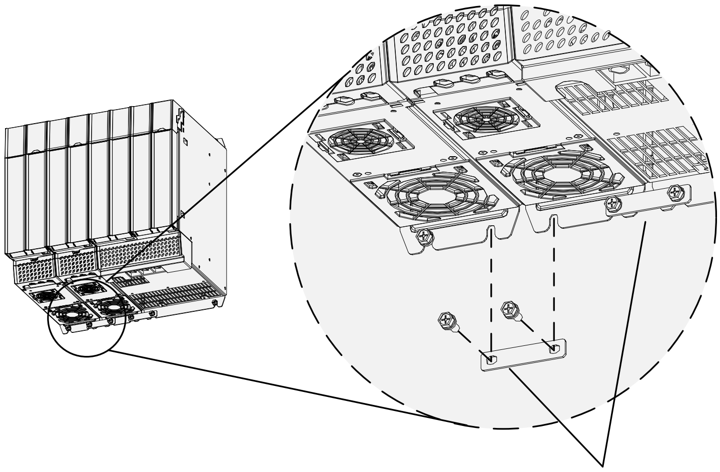
For details, see "2.4.2 Unit Installation".

Step 3: Hang the units with the pre-installed screws.



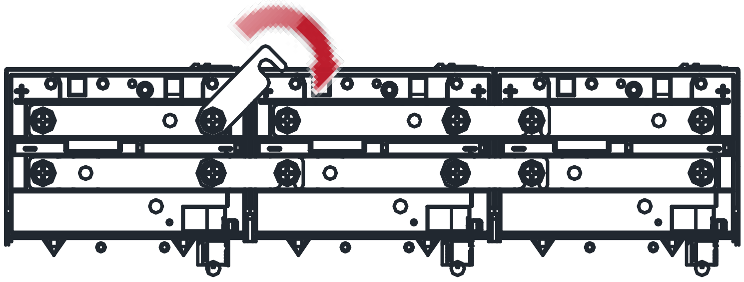
Step 4: Install the EMC grounding aluminum bar.

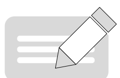
To achieve correct grounding in the overall system and form an entirety (equipotential body), when the power supply unit and multiple drive units are installed on the installation face, grounding aluminum bars must be added on the mounting holes between units and fixed on the installation face to ensure that units are connected together using the grounding aluminum bars. (A grounding aluminum bar must be connected between two modules.)



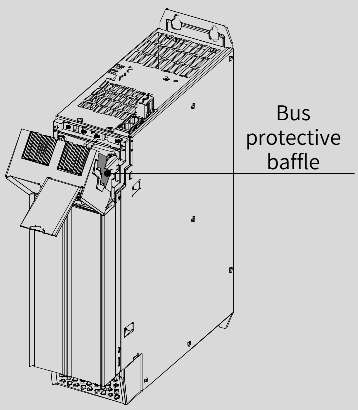
Step 5: Fasten the screws.

Step 6: Connect the built-in busbar. Loosen and turn over the busbar, and fasten the screws.



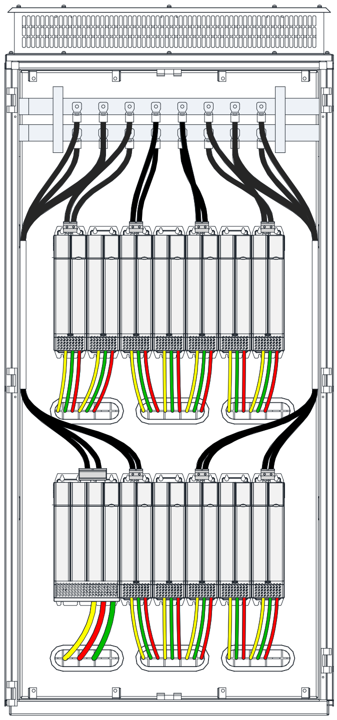


- Before connecting the built-in busbar, remove the left and right bus protective baffles in the top cover with tools such as nipper pliers/diagonal pliers. The following figure shows the position of the bus protective baffle.



- When a row of units are installed, the left bus protective baffle of the leftmost unit and the right bus protective baffle of the rightmost unit must be reserved to prevent electric shock.

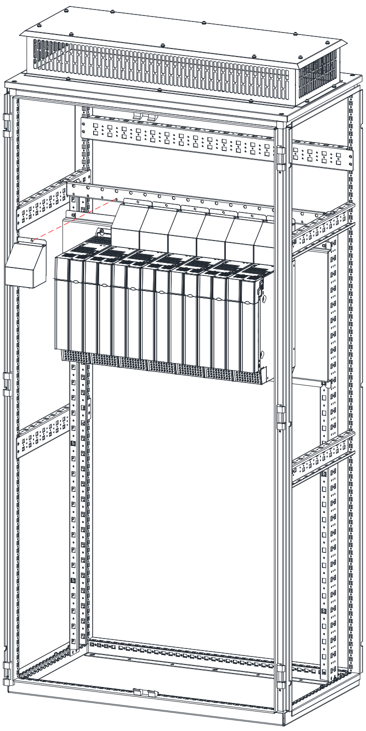
Step 7: Connect the busbar inside the cabinet, and wire the common bus power terminals.



Step 8: Connect cables to the control circuit terminals and PE cable by referring to "3 Electrical Installation".

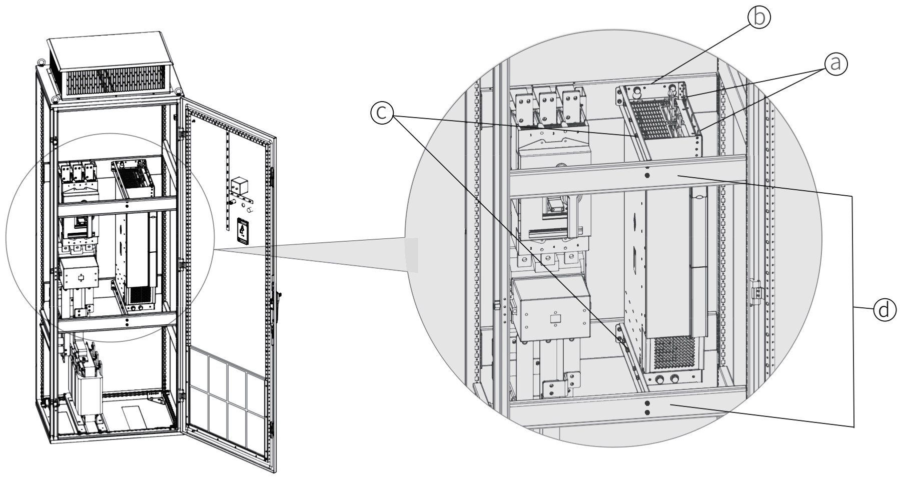
Step 9: Install the covers by referring to "2.4.2 Unit Installation".

Step 10: Install the ventilation hood (option).



Step 11: The installation is complete.

■ Cabinet Installation of the vertical tower unit (180 mm wide)



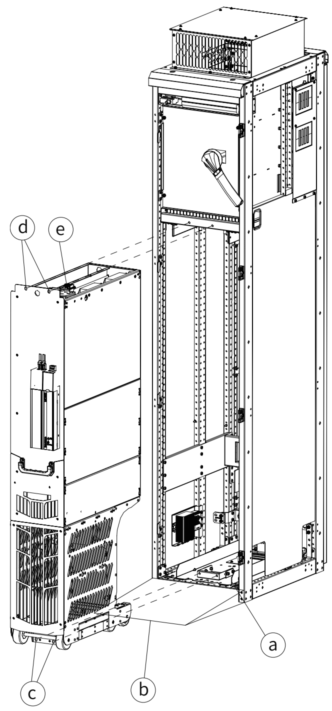
Step 1: Hoist the power supply unit into the cabinet by using the lifting holes (a) with hoisting equipment.

Step 2: Fix the drive unit on the beam at the back of the cabinet (or on the backplate) (b).

Step 3: Fix the left beams (c) and front beam (d) for the drive unit.

Step 4: Fix the screws with the specified tightening torque. Now the installation is completed.

■ Cabinet Installation of the vertical tower unit (230 mm wide)



Step 1: Design a beam at the bottom of the cabinet according to the dimensions of the mounting bracket, and fix the mounting bracket (a) on the beam.

Step 2: Place a ramp (b) before the cabinet.

Step 3: Push the drive unit into the cabinet along the ramp.

Step 4: Tighten the screws (c) and (d) of the drive unit.

Step 5: Connect all control cables (e) of the drive unit and fix the cable on one side.

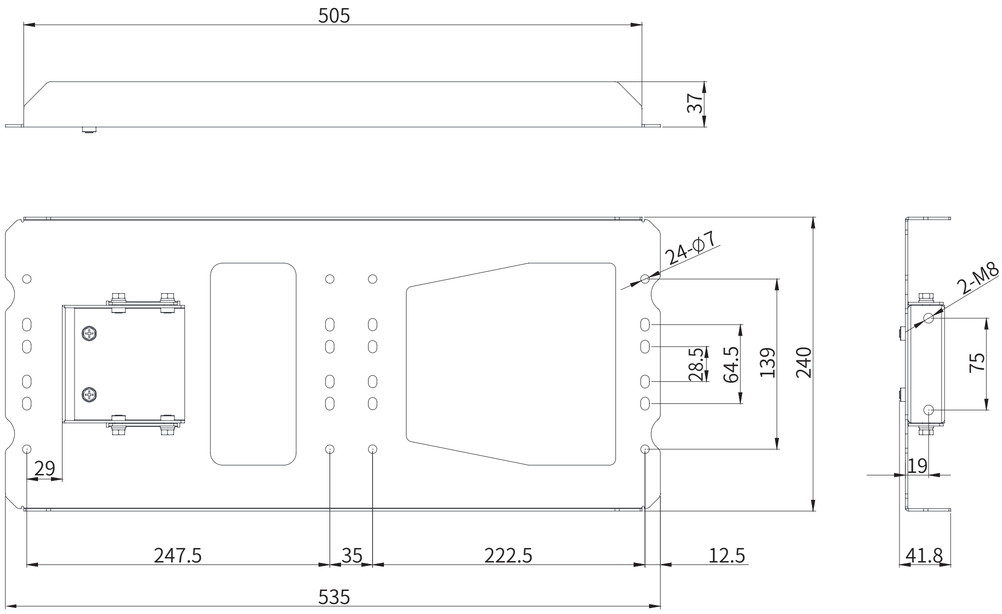
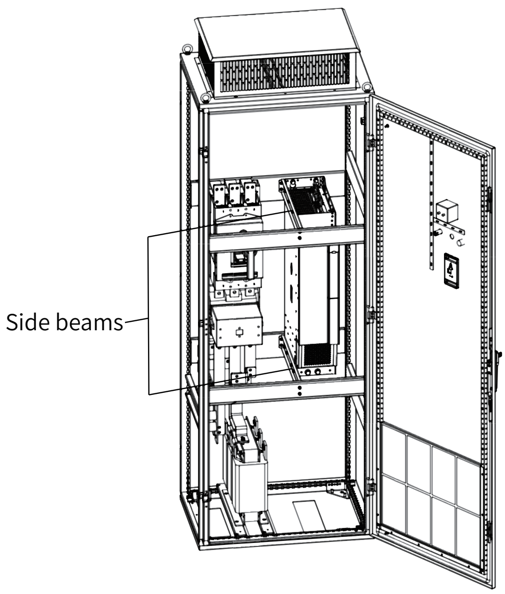


Figure 2-14 Bottom mounting bracket

2.5 Auxiliary Installation for Cabinet Transportation

The following principles must be followed before cabinet transportation to avoid damage to the drive during cabinet transportation:

- The booksize units must be installed in close arrangement. Do not install two or fewer sets separately.
- A cross beam must be added on the side for auxiliary fixing in case of installation of the vertical tower unit, as shown in the figure below.
- The mounting screws must be not only fixed on the mounting backplate by tapping, but also riveted with nuts or added with independent nuts on the back of the backplate to engage the screw threads and strength as much as possible.
- The mounting backplate must have enough stiffness and strength and a thickness of 2 mm or more. Backplate reinforcement must be performed at the top and bottom mounting feet. For details of the recommended reinforcement scheme, see "2.3.2 Mounting Backplate Design Requirements".



2.6 Mounting of the DC Soft Charge Units

NOTE

◆ The drive units of 90 kW to 160 kW in booksize format and 200 kW to 355 kW in vertical tower format do not support the DC soft charge units.

■ The INOV-SU-30, INOV-SU-60, INOV-SU-100, and INOV-SU-170 DC soft charge units can be installed with the MD810 series drive unit (booksize), as shown in the following figure:

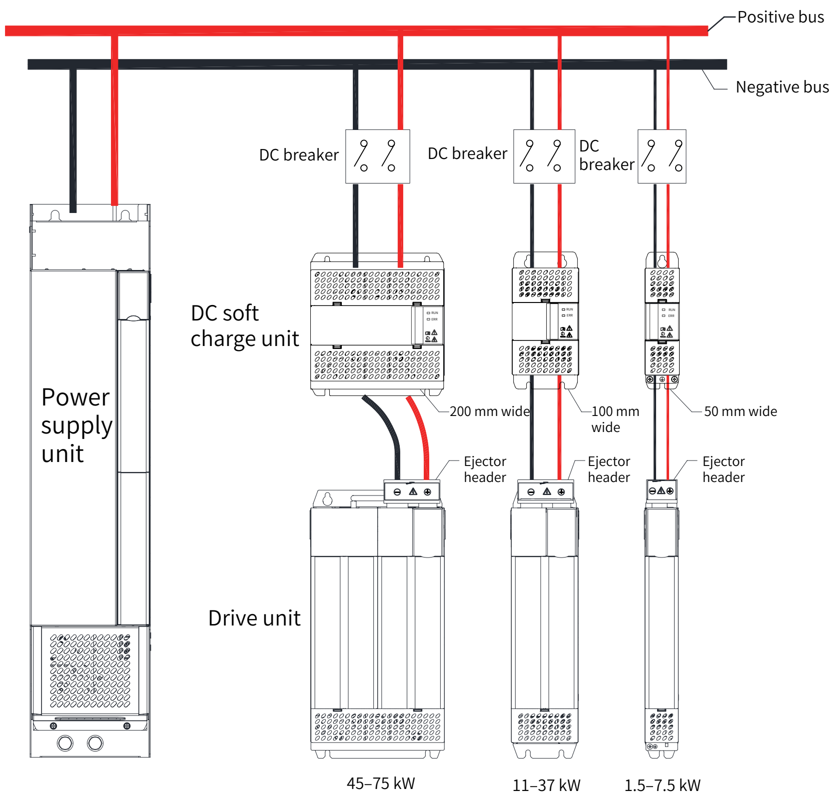


Figure 2-15 Installation diagram of the INOV-SU-30/INOV-SU-60/INOV-SU-100/INOV-SU-170 DC soft charge units

■ Install the HST-6004/HST-7004 DC soft charge unit and connect it to the drive unit by the following steps (the HST-6004 DC soft charge unit is used as an example):

1) As shown in Figure a, unscrew two M6 screws at the front end of the HST-6004 DC soft charge unit.

2) As shown in Figure b, rise the upper assembly slightly to remove it.

3) Then, the HST-6004 DC soft charge unit is disassembled into an assembly and a base as shown in Figures c and d, respectively.

4) As shown in Figure e, connect the cables to the terminals on the DC soft charge unit.

5) As shown in Figure f, unscrew four M4 screws on the top and rear end of the assembly.

6) As shown in Figure g, fix the removed base into four M4 holes; then, install it in place as shown in Figure h.

7) Install the removed assembly to its original position on the base, and connect the terminals on the HST-6004 DC soft charge unit to the corresponding terminals on the drive unit. Fix the terminals at the bottom of the assembly to the negative terminals on the H6 assembly by using M10 x 30 square neck bolts (GB14), flat gaskets, spring gaskets, and nuts, as shown in Figure i.

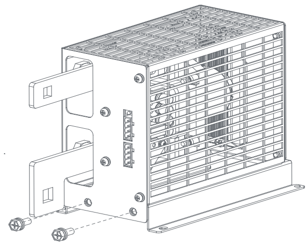


Figure a

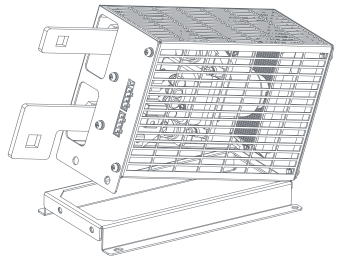


Figure b

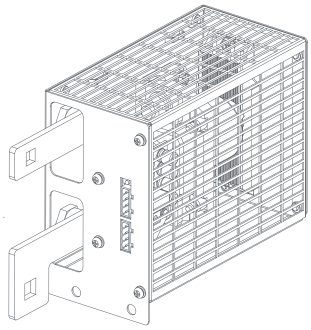


Figure c

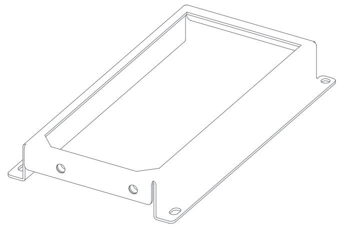


Figure d

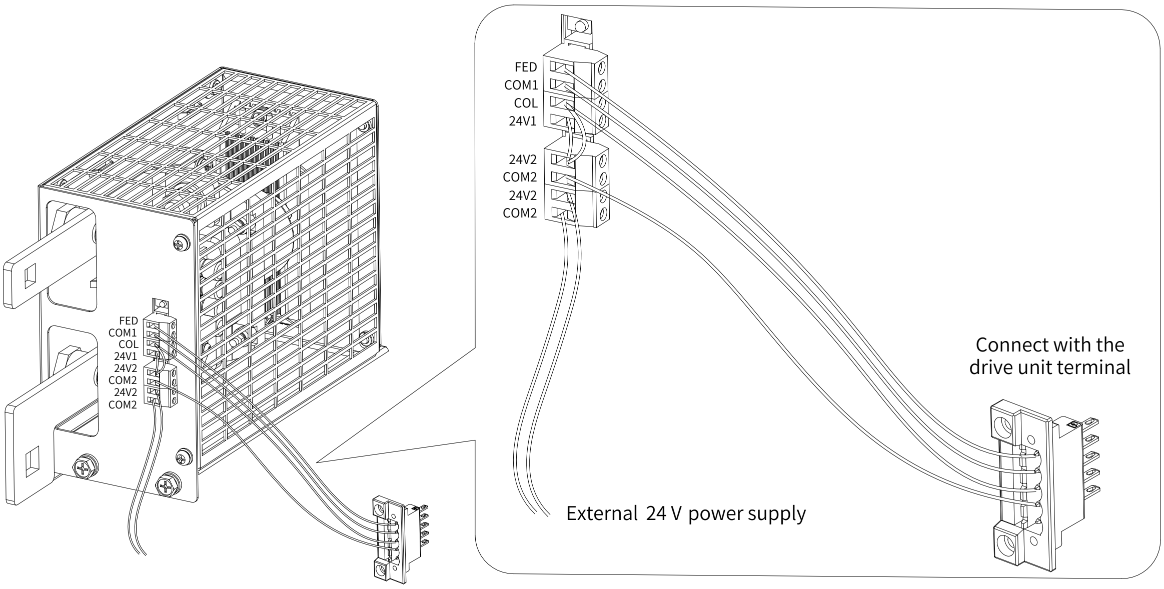


Figure e

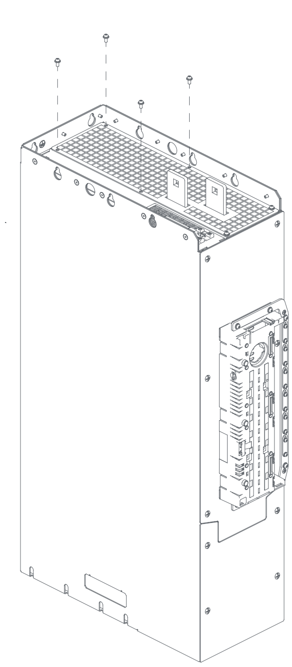


Figure f

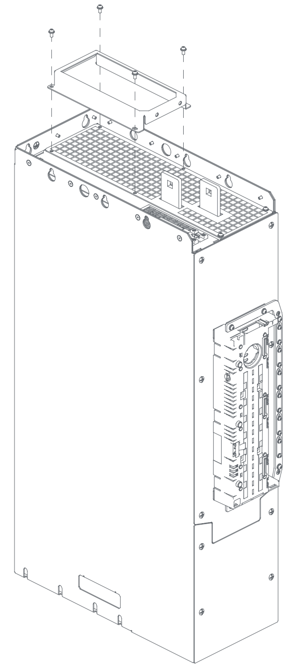


Figure g

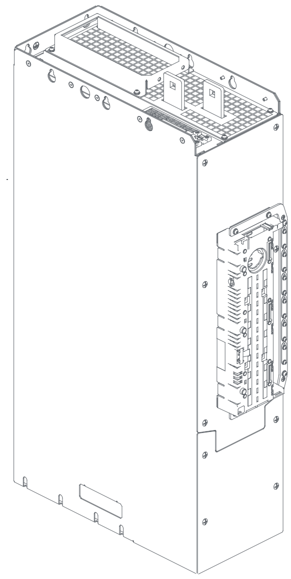


Figure h

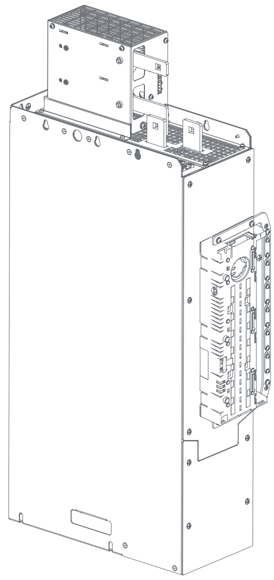


Figure i

Figure 2-16 Installation diagram of the HST-6004/HST-7004 DC soft charge unit (example)

Memo NO. ___________

Date / /

3 Electrical Installation

Safety Instructions

DANGER

◆ Never perform wiring at power-on. Failure to comply will result in electric shock. Keep the breaker in OFF state.

WARNING

◆ When installing the drive in an enclosed cabinet or shell box, cool it fully with a cooling fan or air conditioner to keep the air inlet temperature of the power supply below 50°C . Failure to comply may result in overheat or fire.

CAUTION

◆ Cover the top of the drive with a cloth or paper during installation to prevent metal filing, oil, and water from entering the drive during drilling.

◆ If foreign objects enter the drive, a drive failure may occur.

◆ After the installation work is complete, remove the paper or cloth. If the cloth or paper continues to cover the top, the ventilation may become bad, resulting in abnormal heating of the drive.

◆ When operating the drive, follow the procedure specified the ESD to avoid static damage to any internal circuit of the drive.

◆ When the motor runs at a low speed, the cooling effect will drop. With the temperature increasing, it may result in motor failure due to overheat. Improvement on motor cooling conditions may be taken into consideration.

◆ The motor speed control range varies with lubrication methods and manufacturers.

◆ When running the motor beyond the speed control range, consult the motor manufacturer.

◆ The torque characteristics are different from those with the commercial power supply. Please check the load torque characteristics of the machinery to be connected.

◆ Pay attention to this when selecting a drive capacity. In addition, when the wiring distance between the motor and the drive unit is long, the motor torque will be reduced due to voltage drop. Please use a cable with an enough thickness to perform wiring.

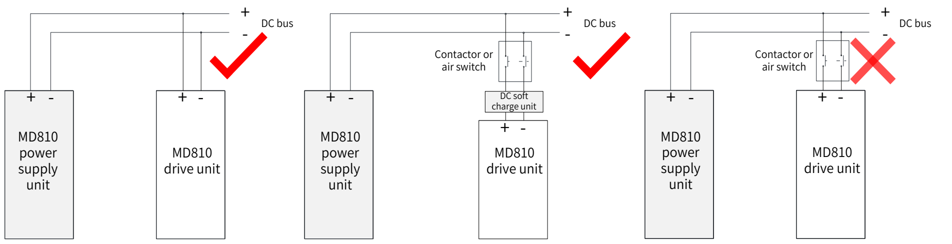
◆ The rated current of a pole changing motor is different from that of a standard motor. Therefore, confirm the maximum current of your motor and select a drive accordingly. Note that the number of poles must be altered only after the motor is stopped.

3.1 System Wiring

When using the MD810 at customer sites, if a drive unit fails and needs a replacement, the drive unit supports independent power-on and power-off without having to shut down the power supply unit. It is recommended to install a DC soft charge unit with each drive unit. For information about wiring, see "Figure 3-1 Typical system wiring diagram". For details about DC soft charge unit selection, see "11.5.4 DC Soft Charge Units".

WARNING

◆ The drive unit has a fuse. Independent power-on without a DC soft charge unit is not allowed because such power-on will damage the drive unit.



◆ For applications with common DC bus, do not independently power on or off a drive unit with an air switch or circuit breaker which is connected with the bus in serial using a cable. Otherwise, the drive unit will be direclty powered on when the system is powered on, and the large inrush current generated thereby will damage the drive unit.

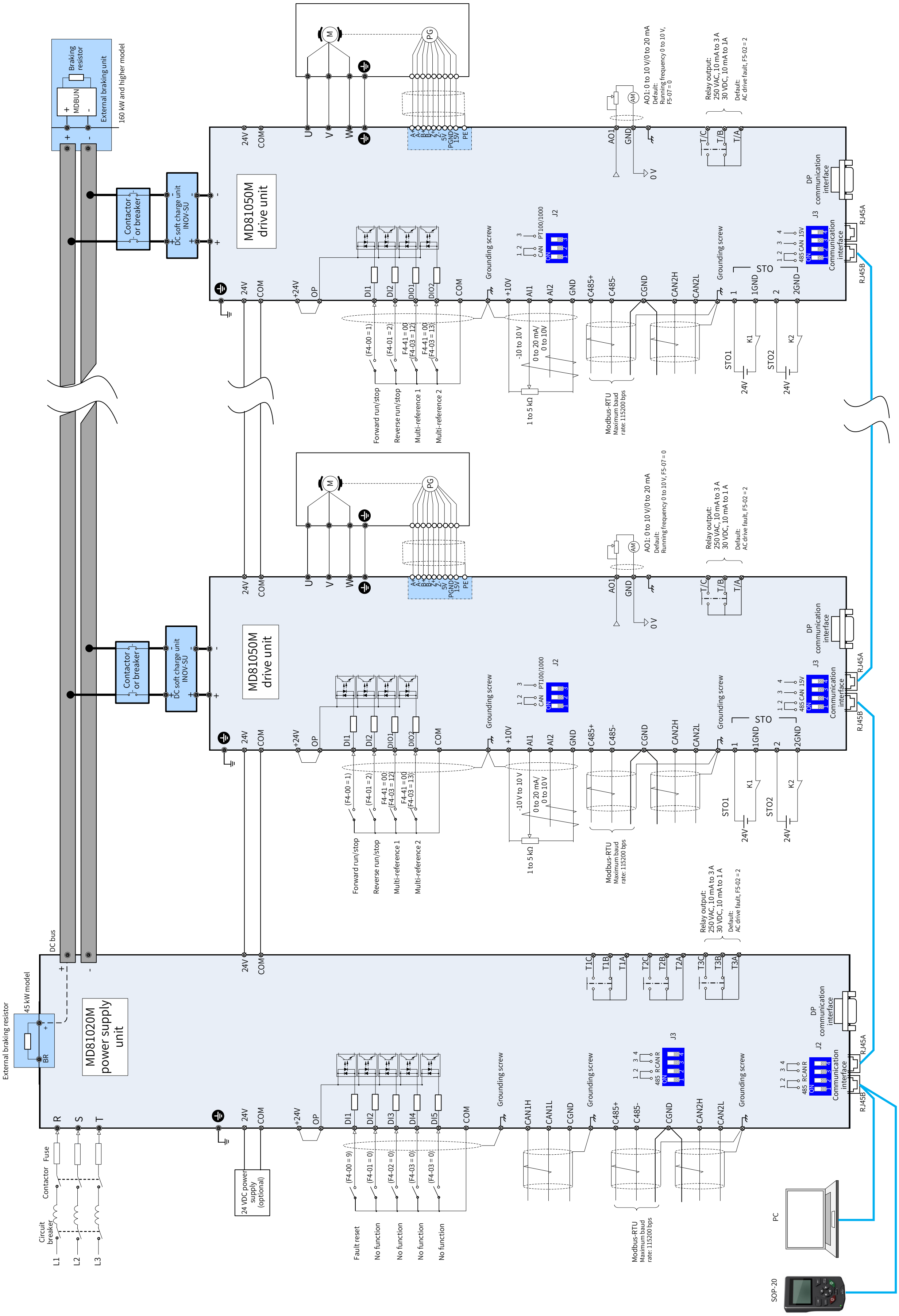


Figure 3-1 Typical system wiring diagram

3.2 Main Circuit Wiring

3.2.1 Terminal Arrangement of the Main Circuit

1) Terminal arrangement of the power supply unit

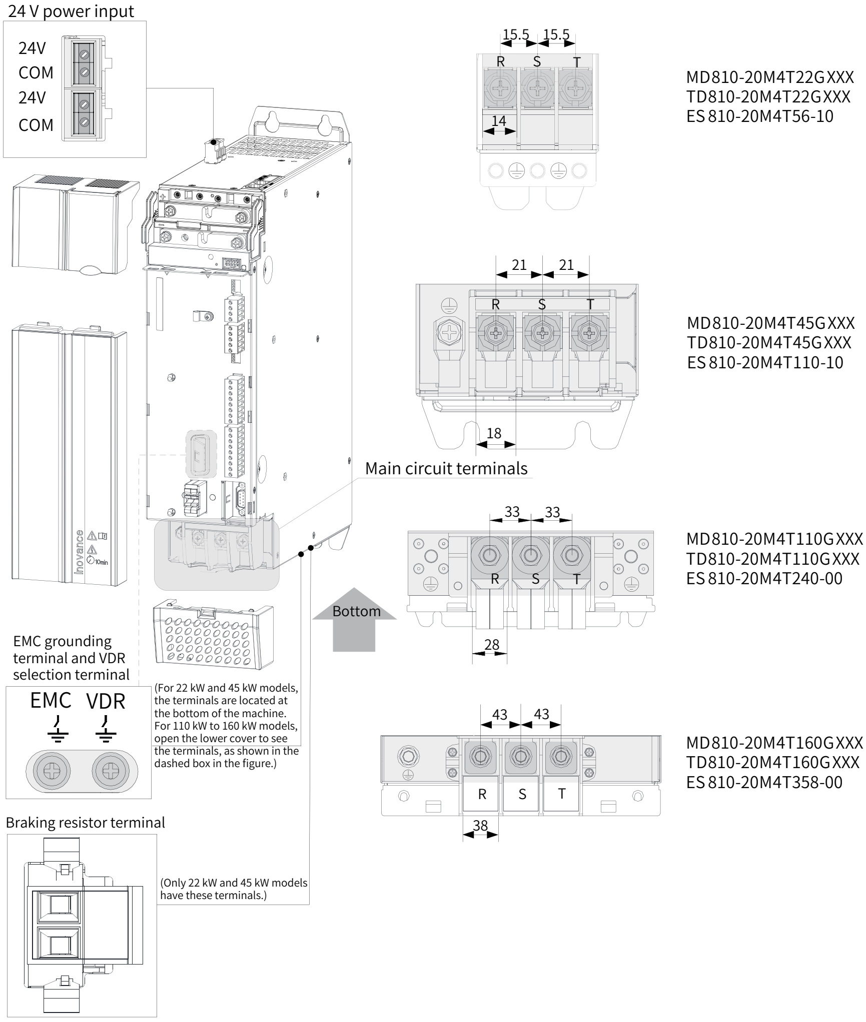


Figure 3-2 Terminal arrangement and size of the power supply unit (booksize, unit: mm)

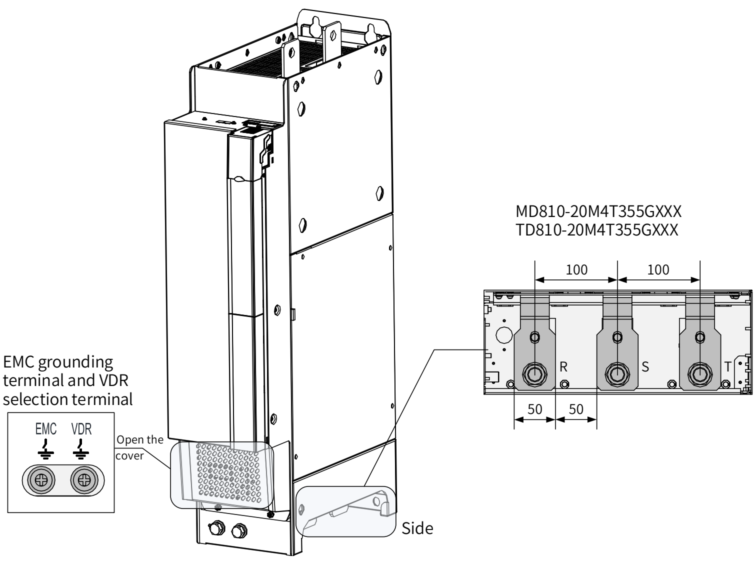


Figure 3-3 Terminal arrangement and size of the power supply unit (vertical tower, unit: mm)

2) Terminal arrangement of the drive unit

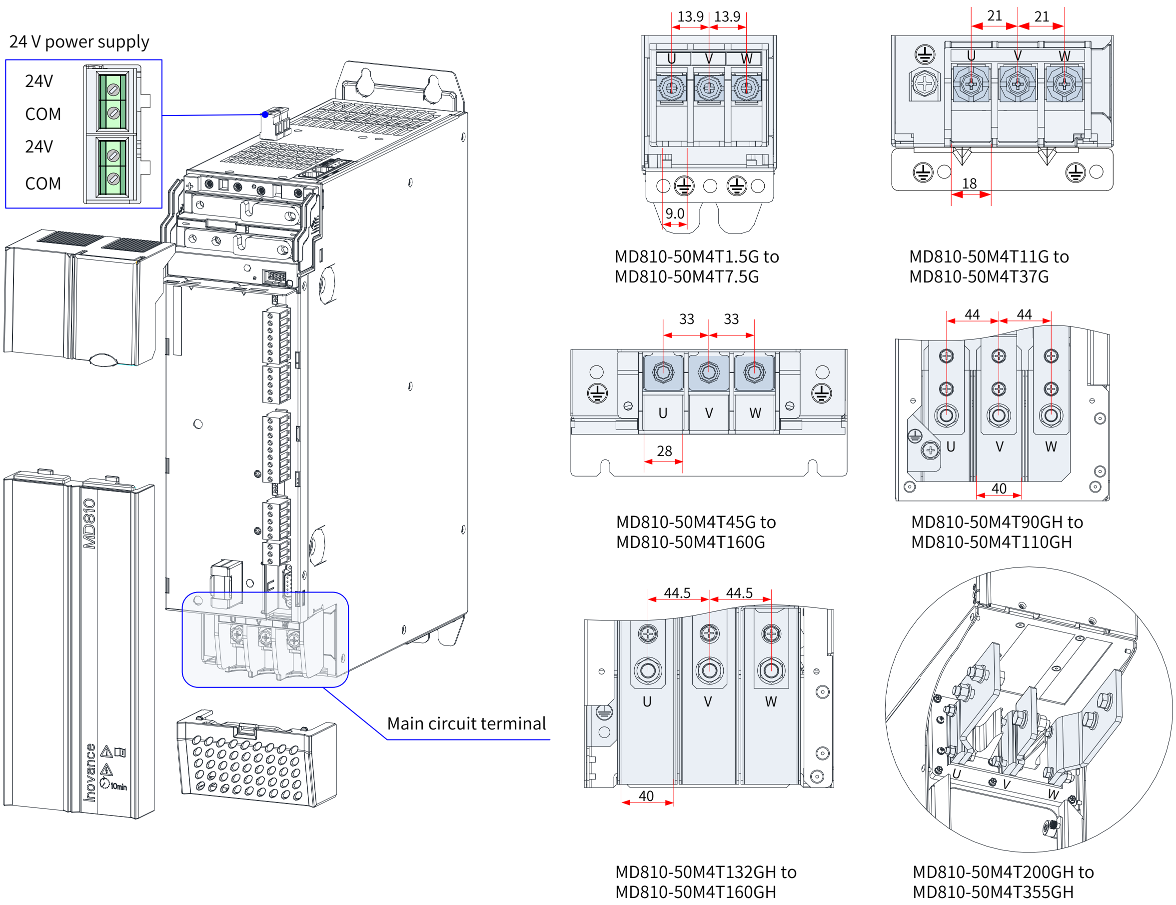


Figure 3-4 Power terminal arrangement and size of the drive unit (single-axis, unit: mm)

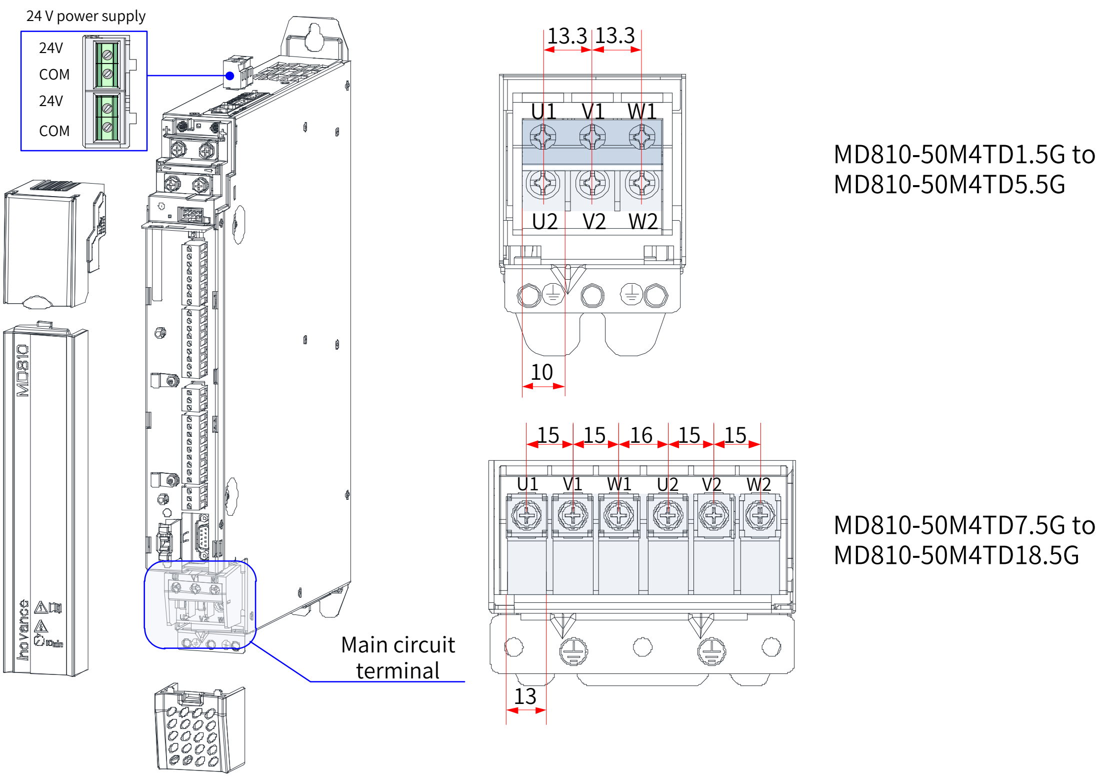


Figure 3-5 Power terminal arrangement and size of the drive unit (dual-axis, unit: mm)

Table 3-1 Descriptions of main circuit terminals of the drive unit

Terminal Symbol	Terminal Function
(+), (-)	DC bus terminals
U, V, W U1, V1, W1 U2, V2, W2	Three-phase AC output terminals
⏚	PE terminal

3.2.2 Main Circuit Terminal Description

1) Input power supply R, S, T

- The input wiring of the power supply unit has no phase sequence requirements.
- The specifications and installation method of external power cables must comply with local regulations and related IEC requirements.
- Use copper conductors of a proper size as power cable wirings according to the recommended values of power cable selection in "Table 3-2 Main circuit cable selection for the power supply unit".
- The filter must be installed near the input terminals of the power supply unit and the connecting cable must be shorter than 30 cm. The grounding terminals of the filter and power supply unit must be connected together. Ensure that the filter and power supply unit are installed on the same conductive installation surface. This conductive installation surface must be connected to the main grounding of the cabinet.

2) DC bus (+, –)

- Note that there is a residual voltage at the DC bus (+, –) terminals upon power-off. After the power is cut off, confirm that the CHARGE indicator is off and wait for at least 10 minutes, and then perform wiring. Otherwise, the residual voltage may cause an electric shock.
- When selecting an external braking component for the 110 kW, 160 kW, and 355 kW power supply unit, note that the polarity must be connected correctly. Failure to comply may result in damage to the power supply unit and braking component and even fire.
- The wire for the braking unit cannot exceed 100 m. Use the twisted pair wire or tight pair wires for parallel connection.
- Do not connect the braking resistor directly to the DC bus; otherwise, the AC drive may be damaged and even a fire may occur.

3) Drive unit output U, V, and W

- The specifications and installation of external power cables must comply with local regulations and IEC requirements.
- The output side of a drive unit cannot be connected to capacitor or surge absorber; otherwise, the AC drive will frequently activate the protection mechanism or even be damaged.
- If the motor cable is too long, electrical resonance may be generated due to the impact of the distributed capacitor. The electrical resonance will lead to damage to motor insulation or high leakage current, and trigger the overcurrent protection of drive. When the motor cable is longer than 100 m, install an AC output reactor close to the drive.
- It is recommended to use shielded cables as the motor output cables. The shield layer can be fixed by the cable support bracket (optional), as shown in "Figure 3-6 Cable support bracket installation". Alternatively, you can fix the shield layer on the cable support bracket with 360 degree, and crimp the drain wire of shield layer to the PE terminal, as shown in "Figure 3-7 Drain wire of motor cable shield layer".

- The drain wire of shield layer must be as short as possible, and the width is greater than 1/5 of the length, as shown in "Figure 3-7 Drain wire of motor cable shield layer".

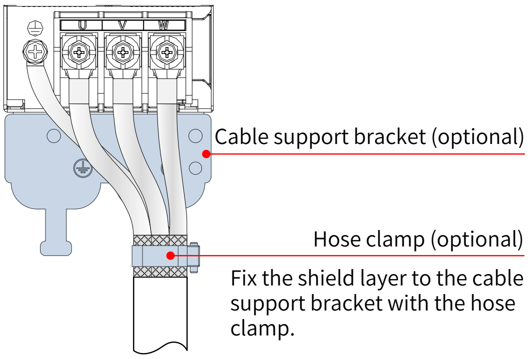


Figure 3-6 Cable support bracket installation

NOTE

- For details of cable support bracket selection, see "10.3.4 Shielded Bracket".

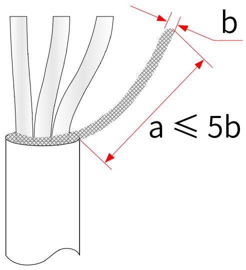
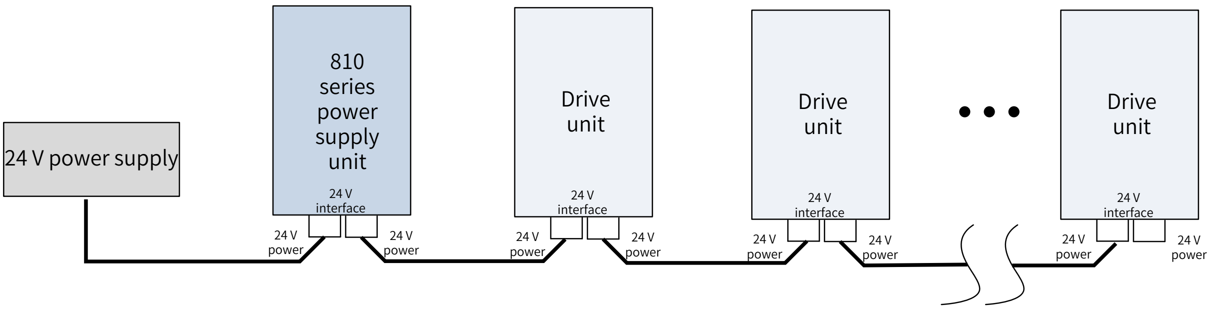


Figure 3-7 Drain wire of motor cable shield layer

4) 24 V external power system

An external 24 V auxiliary power supply can be connected to the 24V terminals of the power supply unit and all drive units in a daisy chain. After the 24 V external power supply system is connected, the control circuit operates properly and you can set parameters and query fault information when no main power supply is applied, which improves security greatly.



NOTE

- Principle of external 24 V power supply selection: 1 A per unit.
- The external 24 V power supply is optional.

5) Terminals BR and P for connecting the braking resistor (in case of built-in braking units of 22 kW and 45 kW power supply units)

- For the selection of braking resistors, refer to a recommended value and the wiring distance must be shorter than 5 m. Failure to comply may result in damage to the power supply unit.
- Note that no combustibles are allowed around the braking resistor. Avoid igniting the surrounding

components due to overheating of the braking resistor.

- After connecting the braking resistor, set the braking unit actuation start voltage parameter F9-08 according to actual load.

6) Ground terminal (⏚)

- The terminal must be reliably grounded; otherwise, the devices will work abnormally or even be damaged.
- Do not connect the ground terminal with the neutral wire (N) of the power supply.
- Select the size of protective ground conductors according to "Table 3-2 Main circuit cable selection for the power supply unit".
- Use the ground cables with yellow/green insulation layer for the protective ground conductor.
- It is recommended that the power supply unit and drive unit be installed on a conductive metal surface to ensure that the entire conductive bottom of the drive contacts with the installation surface.
- The filter and input reactor must be installed on the same installation surface as the power supply unit to ensure the performance of the filter and input reactor.

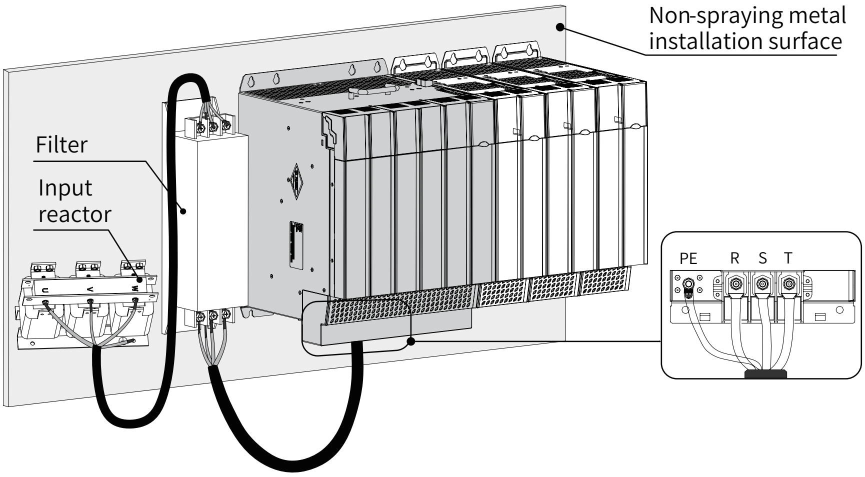


Figure 3-8 Protective grounding connection of main circuit terminals

7) VDR and safety capacitor (EMC) jumpers to ground

- The AC drive is applicable to power grid systems with neutral points grounded. If the AC drive is used in an IT power system (where the neutral point is not grounded), the VDR and EMC jumpers must be removed and the filter cannot be installed. Failure to comply may result in personal injury or damage to the AC drive.
- Where a leakage circuit breaker is installed, if leakage protection trips during startup, the screw of the safety capacitor (EMC) jumper to ground may be removed. For specific locations of the VDR and safety capacitor (EMC) jumpers to ground, see "Figure 3-2 Terminal arrangement and size of the power supply unit (booksize, unit: mm)" and "Figure 3-3 Terminal arrangement and size of the power supply unit (vertical tower, unit: mm)".

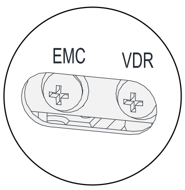


Figure 3-9 Locations of the VDR and safety capacitor (EMC) jumpers to ground

3.2.3 Main Circuit Cable Selection

Table 3-2 Main circuit cable selection for the power supply unit

Power Supply Unit Model	Rated Power (kW)	Rated AC Input Current (A)	Recommended Input IEC Cable Specification (mm^2)
MD810-20M4T22GXXX	22	49	10
MD810-20M4T45GXXX	45	89	25
MD810-20M4T110GXXX	110	196	95
MD810-20M4T160GXXX(W)	160	292	150
MD810-20M4T355GXXX	355	619	2×185

Table 3-3 Main circuit cable selection and tightening torque for the drive unit

Drive Unit Model	Output Terminals U, V, W			Grounding Terminal PE		
	Recommended IEC Cable (mm^2)	Screw	Tightening Torque (N·m)	Recommended IEC Cable (mm^2)	Screw	Tightening Torque (N·m)
MD810-50M4T1.5GXXX	0.75	M5	2.8	0.75	M5	2.8
MD810-50M4T2.2GXXX	0.75	M5	2.8	0.75	M5	2.8
MD810-50M4T3.7GXXX	1.0	M5	2.8	1.0	M5	2.8
MD810-50M4T5.5GXXX	1.5	M5	2.8	1.5	M5	2.8
MD810-50M4T7.5GXXX	2.5	M5	2.8	2.5	M5	2.8
MD810-50M4T11GXXX	4.0	M5	2.8	4.0	M6	4.8
MD810-50M4T15GXXX	6.0	M5	2.8	6.0	M6	4.8
MD810-50M4T18.5GXXX	10	M5	2.8	10	M6	4.8
MD810-50M4T22GXXX	10	M5	2.8	10	M6	4.8
MD810-50M4T30GXXX	16	M6	4.8	16	M6	4.8
MD810-50M4T37GXXX	25	M6	4.8	16	M6	4.8
MD810-50M4T45GXXX	35	M10	20.0	16	M10	20.0
MD810-50M4T55GXXX	50	M10	20.0	25	M10	20.0
MD810-50M4T75GXXX	70	M10	20.0	35	M10	20.0
MD810-50M4T90GXXX	95	M12	35.0	50	M10	20.0
MD810-50M4T110GXXX	120	M12	35.0	70	M10	20.0
MD810-50M4T132GXXX	150	M12	35.0	95	M10	20.0
MD810-50M4T160GXXX	185	M12	35.0	95	M10	20.0
MD810-50M4T200GXXXH	2*95	M10	20.0	95	M8	13.0
MD810-50M4T250GXXXH	2*120	M10	20.0	120	M8	13.0
MD810-50M4T315GXXXH	2*185	M10	20.0	185	M8	13.0
MD810-50M4T355GXXXH	2*185	M10	20.0	185	M8	13.0
MD810-50M4TD1.5GXXX	0.75	M5	2.8	0.75	M5	2.8
MD810-50M4TD2.2GXXX	0.75	M5	2.8	0.75	M5	2.8
MD810-50M4TD3.7GXXX	1.0	M5	2.8	1.0	M5	2.8
MD810-50M4TD5.5GXXX	1.5	M5	2.8	1.5	M5	2.8
MD810-50M4TD7.5GXXX	2.5	M5	2.8	2.5	M6	4.8
MD810-50M4TD11GXXX	4.0	M5	2.8	4.0	M6	4.8
MD810-50M4TD15GXXX	6.0	M5	2.8	6.0	M6	4.8
MD810-50M4TD18.5GXXX	10	M5	2.8	10	M6	4.8

1) Main circuit cable selection

It is recommended to use a symmetrical shielded cable as the input main circuit cable. Compared with a four-core cable, a symmetrical shielded cable can reduce electromagnetic radiation of the entire conducting system.

- Recommended power cable type — symmetrical shielded cable

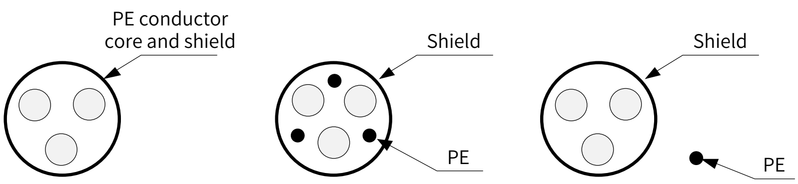


Figure 3-10 Recommended power cable type

- Non-recommended power cable type

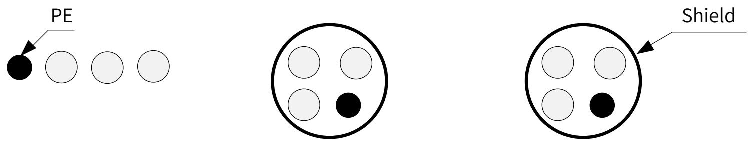


Figure 3-11 Non-recommended power cable type

- Recommended lug selection

Reference data for recommended lugs (Suzhou Yuanli Metal Enterprise Co., Ltd)

GTNR series

TNR series

TNS series

NOTE

- For details of lug selection, see "11.5.2 Lugs" of this guide.

3.2.4 System Grounding

Securely ground every device in the system. Connect the power supply unit, drive units, and components such as the input reactor and filter to the PE copper bar in the cabinet by star connection, as shown in the following figure:

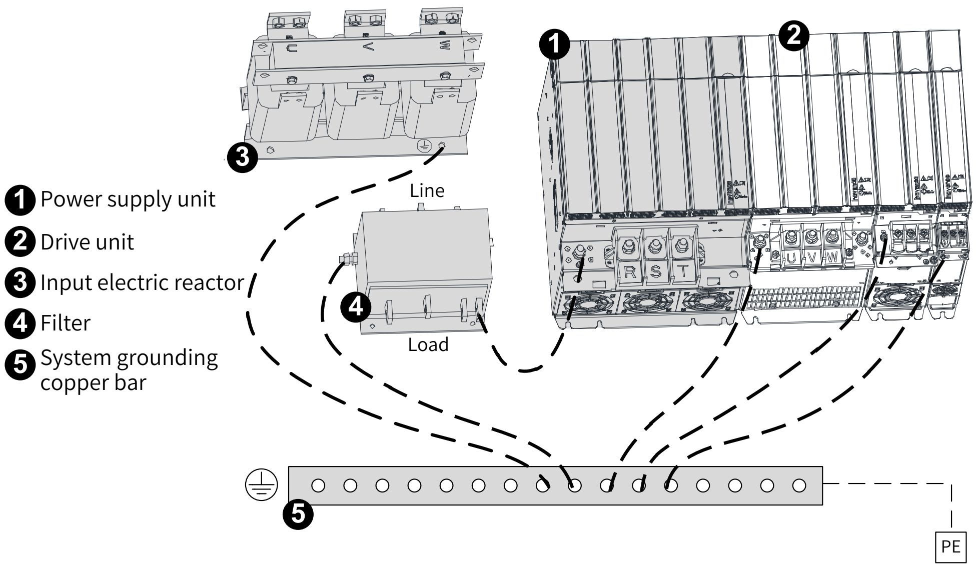


Figure 3-12 System grounding

3.3 Control Circuit Wiring

3.3.1 Control Terminals of the Power Supply Unit

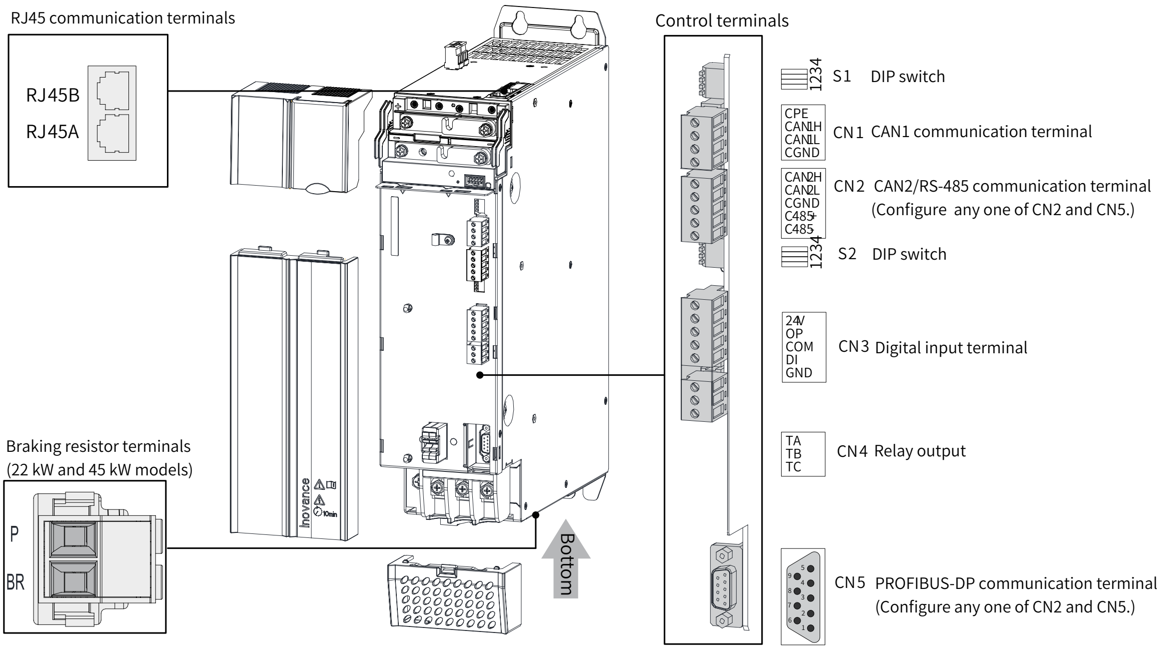
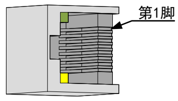
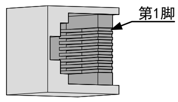


Figure 3-13 Control circuit terminal arrangement of the power supply unit

NOTE

- The PROFINET communication terminal is optional for all power supply units except the 355 kW model.
- Only one of CN2 (synchronous CAN and RS-485 communication terminal) and CN5 (PROFIBUS-DP communication terminal) needs to be configured.

Table 3-4 Description of control circuit terminals of the power supply unit

Terminal Type	Terminal Name		Terminal Function	Specifications	
PROFINET communication interfaces (ProfinetA/ProfinetB)	1	TX+	Data sending+	The yellow indicator indicates that the link connection is normal. The green indicator indicates that the signal is normal.	
	2	TX-	Data sending-		
	3	RX+	Data receiving+		
	6	RX-	Data receiving-		
RJ45 communication interfaces (RJ45A/ RJ45B)	1	CAN1H	CAN_H of CAN communication signal	CANopen/CANlink communication protocol supported.	
	2	CAN1L	CAN_L of CAN communication signal		
	3	CGND	Ground of CAN communication signal		
	4	RS485+	Positive of RS485 communication signal	Used for RS485 internal bus, external operating panel, and PC commissioning	
	5	RS485-	Negative of RS485 communication signal		
	6	CGND	Ground of RS485 communication signal		
	7	C7V	Power supply to an external LCD operating panel	Used to connect an external LCD operating panel. Note: not available in RJ45A	
CANopen/CANlink (CN1)	CAN1H		CAN_H of CAN communication signal	CANopen/CANlink communication protocol supported; CAN1 external terminal of RJ45	
	CAN1L		CAN_L of CAN communication signal		
	CGND		Common ground of communication		
	CPE		Network cable shield		
Synchronous CAN and RS485 communication (CN2)	C485+		Positive of external RS485 communication signal	Modbus communication protocol supported	
	C485-		Negative of external RS485 communication signal		
	CAN2H		CAN_H of CAN communication signal	Dedicated CAN and CANlink protocol for synchronous control	
	CAN2L		CAN_L of CAN communication signal		
	CGND		Common ground of communication		
Digital input (CN3)	DI		Ordinary multi-functional input terminal	Programmable terminal for isolated sink/source input Operating voltage range of 9 V to 30 V; ineffective voltage range below 5 V; input impedance of 3 kΩ; conformance of response time to the requirements for 100 Hz frequency input	
	OP		Common terminal for multi-functional input terminal	Internally isolated from COM and 24 V. Shorted to 24 V with a U jumper by default.	
	24V		Internal 24 V	24 V ± 10%, no-load voltage of 30 V or less, maximum output current of 200 mA, internally isolated from OP/ CNGD/GND.	
	COM		Internal 24 V ground	Internally isolated from CGND and GND.	
	GND		Reference ground of power supply		

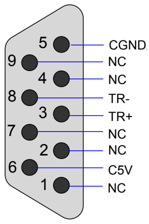
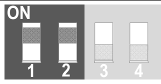
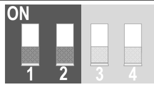
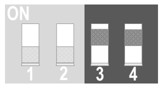
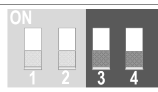
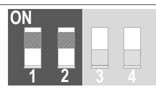
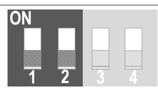
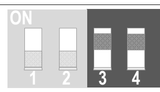
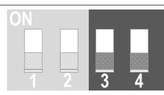
Terminal Type	Terminal Name	Terminal Function	Specifications
Relay output (CN4)	TA/TB/TC	TA-TB: normally closed (NC) TA-TC: normally open (NO)	Contact capacity: 250 VAC/3 A (COSφ = 0.4)
PROFIBUS-DP communication terminals (CN5)	Unconnected	/	
	Unconnected	/	
	TR+	PROFIBUS-DP bus plus	
	Unconnected	/	
	CGND2	Ground of PROFIBUS-DP bus power supply	
	C5V	PROFIBUS-DP bus power supply	
	Unconnected	/	
	TR-	PROFIBUS-DP bus minus	
	Unconnected	/	

Table 3-5 Definition of DIP switches of the power supply unit

Terminal Symbol	Terminal Name	Function Description	DIP Switch Position
S1	Selection of RS485 termination resistor	Connect the termination resistor when switches 1 and 2 are turned on.	
		Connect no termination resistor when switches 1 and 2 are turned off.	
	Selection of CAN1 termination resistor	Connect the termination resistor when switches 3 and 4 are turned on.	
		Connect no termination resistor when switches 3 and 4 are turned off.	
S2	Selection of C485 termination resistor	Connect the termination resistor when switches 1 and 2 are turned on.	
		Connect no termination resistor when switches 1 and 2 are turned off.	
	Selection of CAN2 termination resistor	Connect the termination resistor when switches 3 and 4 are turned on.	
		Connect no termination resistor when switches 3 and 4 are turned off.	

3.3.2 Control Terminals of the Drive Unit (Single-Axis)

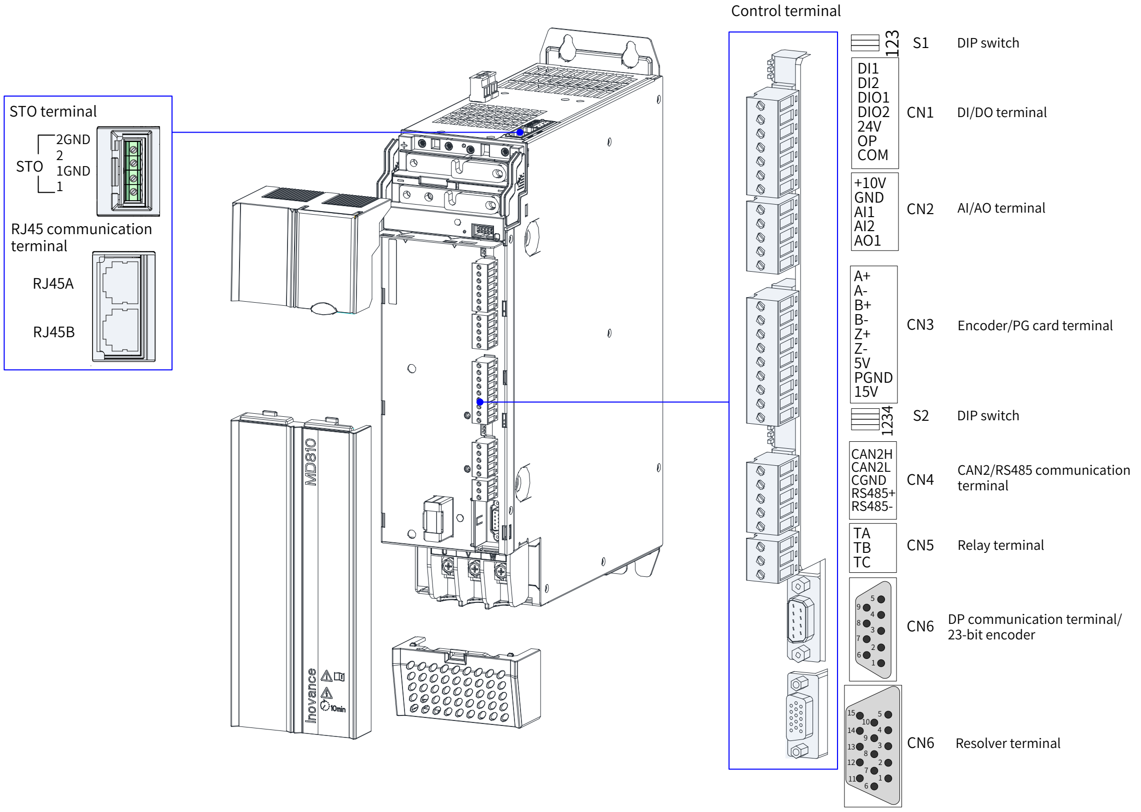


Figure 3-14 Control circuit terminal arrangement of the drive unit (single-axis booksize 1.5–160 kW)

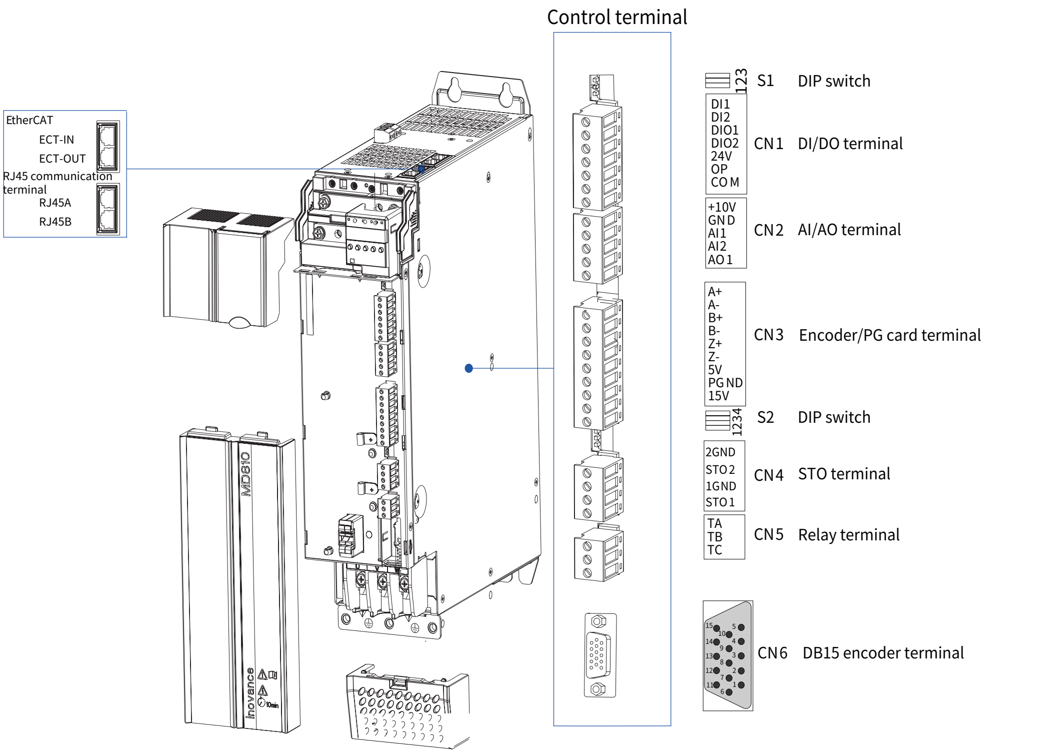


Figure 3-15 Control circuit terminal arrangement of the drive unit (single-axis vertical tower 200–350 kW)

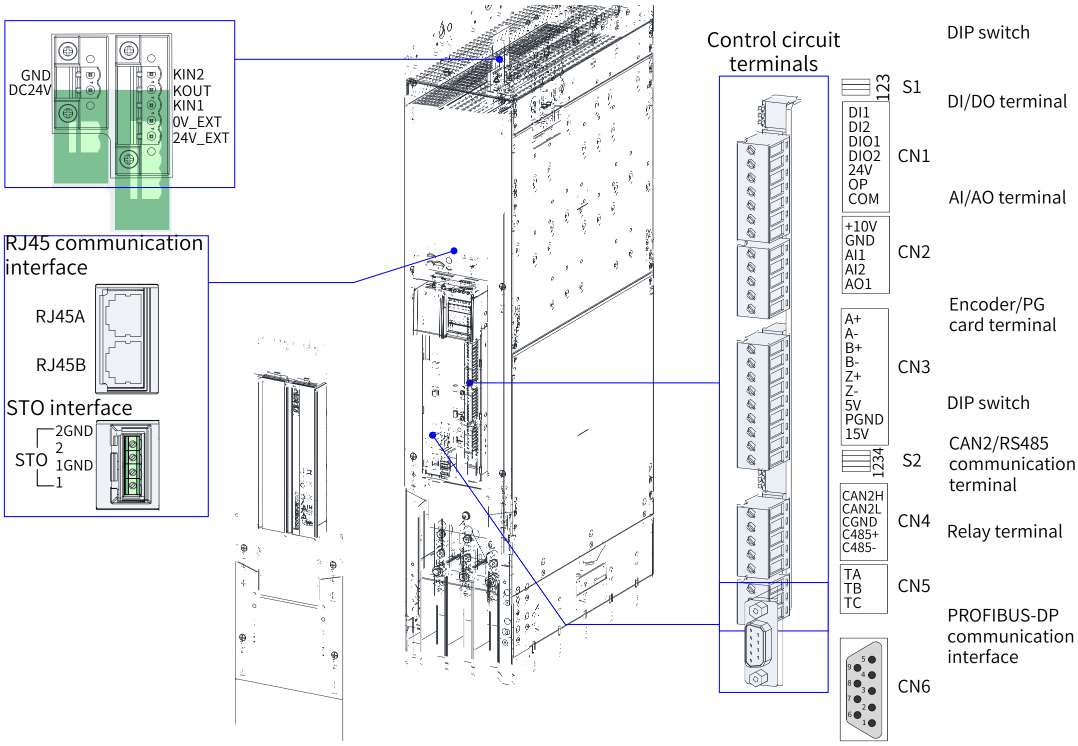
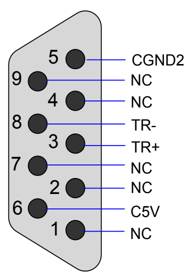


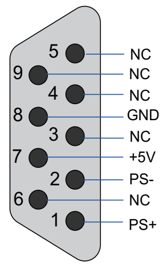
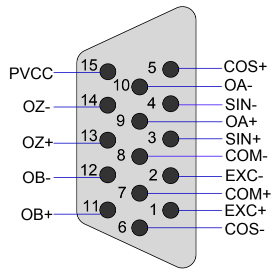
Figure 3-16 Control circuit terminal arrangement of the drive unit (single-axis vertical tower 90–355 kW)

Table 3-6 Description of control circuit terminals of the drive unit (single-axis)

Type	Terminal Name	Terminal Function	Specifications
STO terminals	1	STO channel 1 power positive	24 V power supply
	1GND	STO channel 1 power negative	
	2	STO channel 2 power positive	
	2GND	STO channel 2 power negative	
External 24 V power terminal	DC24 V	External power 24 V power positive	External power 24 V power input for the internal control module with the minimum required current of 1 A
	GND	External power 24 V power negative	
Connect with the DC soft charge unit terminals	24 V_EXT	External DC soft charge unit external power supply positive	External power 24 V power input for the DC soft charge unit with the minimum required current of 1 A
	OV_EXT	External DC soft charge unit external power supply negative	
	KIN1	DI input	Receiving response from the feedback module
	KOUT	DO output	Controlling the operation of relay and contactor
	KIN2	DI input	Reserved

Type	Terminal Name	Terminal Function	Specifications
Digital inputs/ Transistor outputs (CN1)	DI1-DI2	Ordinary multi-functional terminals	Programmable terminal for isolated sink/ source input Input frequency < 100 Hz Operating voltage range of 9 V to 30 V; ineffective voltage range below 5 V
	DIO1	High-speed pulse input terminal/ Ordinary multi-functional output terminal	Programmable terminal for input or output When used as DI, maximum input frequency 100 kHz When used as DO, maximum output capacity 24 VDC, 50 mA
	DIO2	Ordinary multi-functional input terminal/High-speed pulse output terminal	Programmable terminal for input or output When used as DI, maximum input frequency < 100 Hz When used as DO, maximum output frequency 100 kHz, capacity 24 VDC, 50 mA
	OP	Multi-functional input/output common end	Internally isolated from COM and 24V. Shorted to 24 V using a U jumper by default
	24V	Internal 24 V	24V±10%, no-load voltage not more than 30 V Maximum output current of 200 mA Internally isolated from OP/CGND and GND
	COM	Internal 24 V ground	Internally isolated from CGND and GND
Analog inpus/ Analog outputs (CN2)	AI1	AI1 Analog single-ended input channel 1	Programmable, 0 to 10 V or -10 to 10 V 12-bit resolution, correction accuracy 0.3%, input impedance 22.1 kΩ PT100/PT100 temperature sensor (switchover by DIP switch S1)
	AI2	Analog single-ended input channel 2	Programmable, 0 to 10 V or 0 to 20 mA 12-bit resolution, correction accuracy 0.3% Input impedance: In voltage mode: 22.1 kΩ In current mode: 500 Ω or 250 Ω
	AO	Analog output	Programmable, 0 to 10 V or 0 to 20 mA 12-bit resolution, correction accuracy 0.5% In voltage mode, maximum output load current 2 mA, load impedance > 5 kΩ; in current mode, load impedance < 500 Ω
	+10V	10 V analog voltage output	10 V±10%, maximum 10 mA
	GND	Analog ground	Internally isolated from COM and CGND

<table>
<tr><th>Type</th><th>Terminal Name</th><th>Terminal Function</th><th>Specifications</th></tr>
<tr><td rowspan="9">Encoder/PG card terminals (CN3)</td><td>A+</td><td>Differential encoder A signal positive</td><td rowspan="9">Three types of encoders supported:
Differential encoder, 5 V power supply
OC encoder, 15 V power supply
Push-pull encoder, 15 V power supply
Switchover between 5 V and 15 V by setting DIP switch 4 of S2
Note: CN3 is inactivated when CN6 is a 23-bit encoder interface</td></tr>
<tr><td>A-</td><td>Differential encoder A signal negative/ OC or push-pull encoder A signal</td></tr>
<tr><td>B+</td><td>Differential encoder B signal positive</td></tr>
<tr><td>B-</td><td>Differential encoder B signal negative/ OC or push-pull encoder B signal</td></tr>
<tr><td>Z+</td><td>Differential encoder Z signal positive</td></tr>
<tr><td>Z-</td><td>Differential encoder Z signal negative/ OC or push-pull encoder Z signal</td></tr>
<tr><td>5V</td><td>Encoder power supply</td></tr>
<tr><td>15V</td><td>Encoder power supply</td></tr>
<tr><td>PGND</td><td>Encoder power supply ground</td></tr>
<tr><td rowspan="8">RJ45A communication terminals</td><td>CAN1H</td><td>CAN_H of CAN communication signal</td><td rowspan="3">CANopen/CANlink supported</td></tr>
<tr><td>CAN1L</td><td>CAN_L of CAN communication signal</td></tr>
<tr><td>CGND</td><td>Communication signal ground</td></tr>
<tr><td>RS485+</td><td>RS485 communication signal positive</td><td rowspan="5">RS485 internal bus</td></tr>
<tr><td>RS485-</td><td>RS485 communication signal negative</td></tr>
<tr><td>Unconnected</td><td>/</td></tr>
<tr><td>Unconnected</td><td>/</td></tr>
<tr><td>CGND</td><td>Communication signal ground</td></tr>
<tr><td rowspan="8">RJ45B communication terminals</td><td>CAN1H</td><td>CAN_H of CAN communication signal</td><td rowspan="3">CANopen/CANlink supported</td></tr>
<tr><td>CAN1L</td><td>CAN_L of CAN communication signal</td></tr>
<tr><td>CGND</td><td>Communication signal ground</td></tr>
<tr><td>RS485+</td><td>RS485 communication signal positive</td><td rowspan="5">RS485 internal bus, used for external LCD operating panel and PC commissioning</td></tr>
<tr><td>RS485-</td><td>RS485 communication signal negative</td></tr>
<tr><td>C7V</td><td>Power supply of the external LCD operating panel</td></tr>
<tr><td>C7V</td><td>Power supply of the external LCD operating panel</td></tr>
<tr><td>CGND</td><td>Communication signal ground</td></tr>
<tr><td rowspan="3">CAN communication for synchronization control (CN4)</td><td>CAN2H</td><td>CAN_H of CAN communication signal</td><td rowspan="3">Dedicated CAN for synchronous control (CANlink protocol).</td></tr>
<tr><td>CAN2L</td><td>CAN_L of CAN communication signal</td></tr>
<tr><td>CGND</td><td>Ground of CAN communication signal</td></tr>
<tr><td>Relay output terminals (CN5)</td><td>TA/TB/TC</td><td>TA-TB: NC
TA-TC: NO</td><td>Contact capacity: 250 VAC/3 A (COSϕ = 0.4)</td></tr>
<tr><td rowspan="9">PROFIBUS-DP communication terminals (CN6)</td><td>Unconnected</td><td>/</td><td rowspan="9">
</td></tr>
<tr><td>Unconnected</td><td>/</td></tr>
<tr><td>TR+</td><td>DP bus positive</td></tr>
<tr><td>Unconnected</td><td>/</td></tr>
<tr><td>CGND2</td><td>Ground of DP bus power supply</td></tr>
<tr><td>C5V</td><td>DP bus power supply</td></tr>
<tr><td>Unconnected</td><td>/</td></tr>
<tr><td>TR-</td><td>DP bus negative</td></tr>
<tr><td>Unconnected</td><td></td></tr>
</table>

Type	Terminal Name	Terminal Function	Specifications
23-bit encoder terminals	PS+	Bus communication signal+	
	PS-	Bus communication signal-	
	Unconnected	/	
	Unconnected	/	
	Unconnected	/	
	Unconnected	/	
	+5 V	Encoder +5 V power supply	
	GND	Encoder +5 V power supply ground	Note: CN3 is invalid when CN6 is a 23-bit encoder interface
	Unconnected	/	
Resolver terminals (CN6)	EXC+	Excitation output signal positive	
	EXC-	Excitation output signal negative	
	SIN+	Feedback sine signal positive	
	SIN-	Feedback sine signal negative	
	COS+	Feedback cosine signal positive	
	COS-	Feedback cosine signal negative	
	COM	Power supply operating ground of the frequency dividing circuit	
	COM	Power supply operating ground of the frequency dividing circuit	
	OA+	Frequency dividing output signal A+	
	OA-	Frequency dividing output signal A-	
	OB+	Frequency dividing output signal B+	
	OB-	Frequency dividing output signal B-	
	OZ+	Frequency dividing output signal Z+	
	OZ-	Frequency dividing output signal Z-	
	PVCC	Power supply of the frequency dividing circuit (5–30 V)	

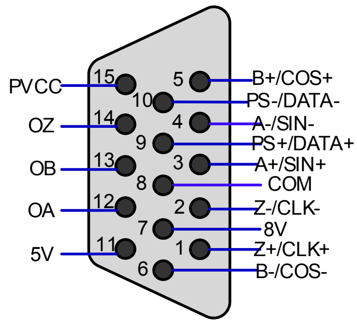
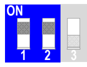
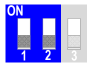
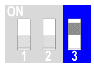
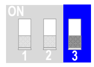
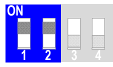
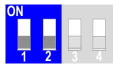
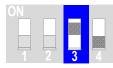
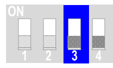
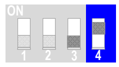
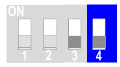
Type	Terminal Name	Terminal Function	Specifications
DB15 encoder terminals	Z+/CLK+	Z phase signal positive or SSI clock output signal positive of the incremental encoder/sin-cos encoder	
	Z-/CLK-	Z phase signal negative or SSI clock output signal negative of the incremental encoder/sin-cos encoder	
	A+/SIN+	A phase signal positive or sinusoidal input signal positive of the 5 V incremental encoder	
	A-/SIN-	A phase signal negative or sinusoidal input signal negative of the 5 V incremental encoder	
	B+/COS+	B phase signal positive or cosine input signal positive of the 5 V incremental encoder	
	B-/COS-	B phase signal negative or cosine input signal negative of the 5 V incremental encoder	
	12V	12 V power supply of the encoder	
	COM	Encoder power supply work ground	
	PS+/DATA+	Communication signal positive or SSI data signal positive of Inovance's 23-bit encoder	
	PS-/DATA-	Communication signal negative or SSI data signal negative of Inovance's 23-bit encoder	
	5V	5 V power supply of the encoder	
	OA	Frequency-division output A phase signal	
	OB	Frequency-division output B phase signal	
	OZ	Frequency-division output Z phase signal	
	PVCC	Frequency-division output power supply 5–30 V	

Table 3-7 Definition of DIP switches of the drive unit (single-axis)

Terminal Symbol	Terminal Name	Function Description	DIP Switch Position
S1	CAN1 termination resistor selection	Connect the termination resistor when switches 1 and 2 are turned on.	
		Connect no termination resistor when switches 1 and 2 are turned off.	
	AI1 function selection	PT100/PT1000 temperature detection when switch 3 is turned on.	
		Analog input when switch 3 is turned off.	
S2	C485 termination resistor selection	Connect the termination resistor when switches 1 and 2 are turned on.	
		Connect no termination resistor when switches 1 and 2 are turned off.	
	CAN2 termination resistor selection	Connect the termination resistor when switch 3 is turned on.	
		Connect no termination resistor when switch 3 is turned off.	
	PG interface 5 V and 15 V power supply selection	5 V power supply when switch 4 is turned on.	
		15 V power supply when switch 4 is turned off.	

3.3.2 Control Terminals of the Drive Unit (Dual-Axis)

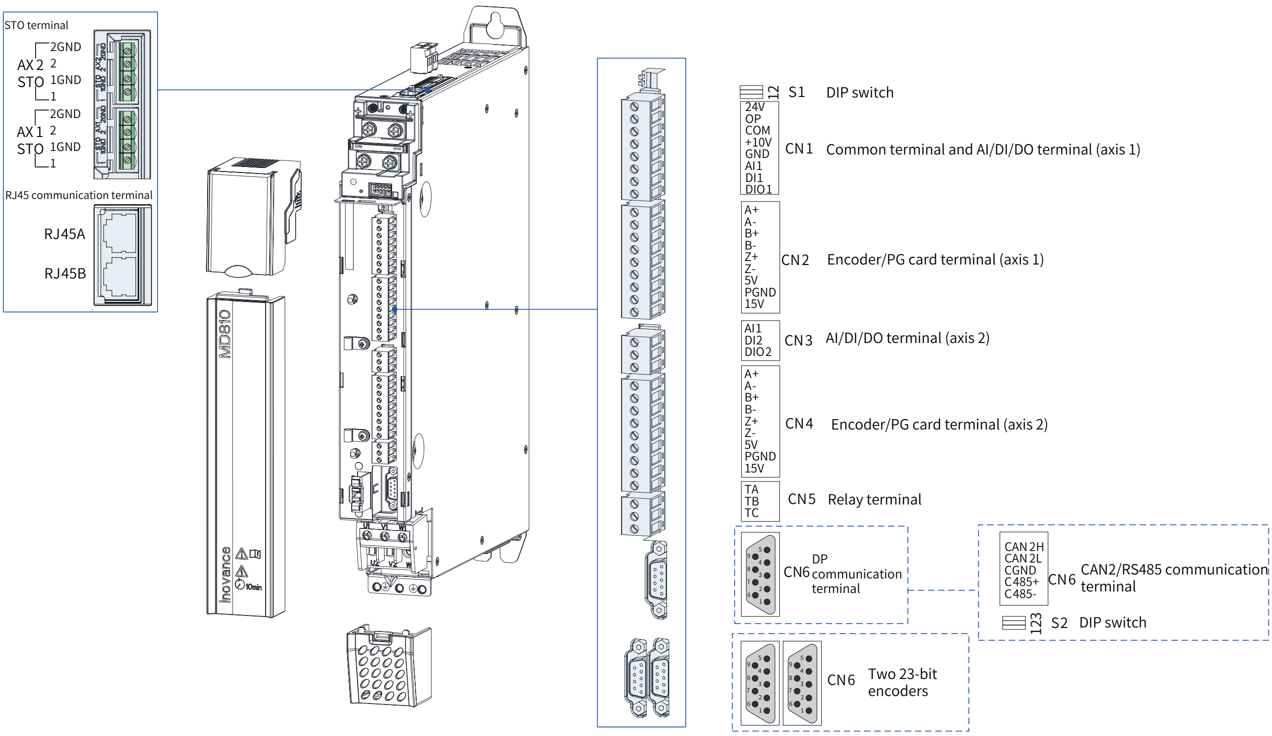


Figure 3-17 Control circuit terminal arrangement of the drive unit (dual-axis)

Table 3-8 Description of control circuit terminals of the drive unit (dual-axis)

Type	Terminal Symbol	Terminal Function	Specifications
STO terminals	1	STO channel 1 power positive	24 V power supply
	1GND	STO channel 1 power negative	
	2	STO channel 2 power positive	
	2GND	STO channel 2 power negative	
Digital inputs/ Transistor outputs	DI1	Ordinary multi-functional terminals	Programmable terminal for isolated sink/source input Input frequency < 100 Hz Operating voltage range of 9 V to 30 V; ineffective voltage range below 5 V.
	DIO1	High-speed pulse input terminal/ Ordinary multi-functional output terminal	Programmable terminal for input or output When used as DI, maximum input frequency 100 kHz When used as DO, maximum output capacity 24 VDC, 50 mA
	OP	Multi-functional input common terminal	Internally isolated from COM and 24V. Shorted to 24 V using a U jumper by default
	24V	Internal 24 V	24V±10%, no-load voltage not more than 30 V Maximum output current of 200 mA Internally isolated from OP/CGND and GND
	COM	Internal 24 V ground	Internally isolated from CGND and GND
Analog input	AI1	AI1 analog single-ended input channel 1	Programmable, 0 to 10 V / -10 to 10 V / 0 to 20 mA, 12-bit resolution, correction accuracy 0.3%, input impedance 22.1 kΩ at voltage mode, input impedance 250 Ω or 500 Ω at current mode, PT100/PT100 temperature sensor (by F9-56, Type of motor temperature sensor)
	+10V	10 V analog voltage output	10 V±10%, maximum 10 mA
	GND	Analog ground	Internally isolated from COM and CGND
Encoder/PG card terminal	A+	Differential encoder A signal positive	Three types of encoders supported: Differential encoder, 5 V power supply OC encoder, 15 V power supply Push-pull encoder, 15 V power supply Switchover between 5 V and 15 V by setting F1-25 (Encoder power supply selection)
	A-	Differential encoder A signal negative/ OC or push-pull encoder A signal	
	B+	Differential encoder B signal positive	
	B-	Differential encoder B signal negative/ OC or push-pull encoder B signal	
	Z+	Differential encoder Z signal positive	
	Z-	Differential encoder Z signal negative/ OC or push-pull encoder Z signal	
	5V	Encoder power supply	
	15V	Encoder power supply	
	PGND	Encoder power supply ground	

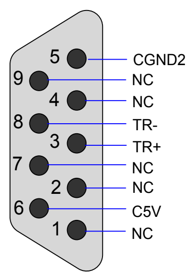
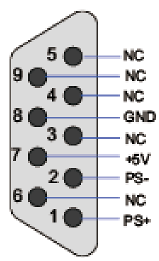
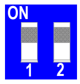
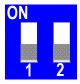
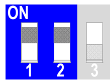
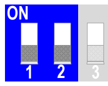
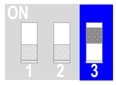
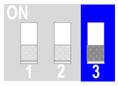
Type	Terminal Symbol	Terminal Function	Specifications
RJ45A communication interface	CAN1H	CAN_H of CAN communication signal	CANopen/CANlink supported
	CAN1L	CAN_L of CAN communication signal	
	CGND	Communication signal ground	
	RS485+	RS485 communication signal positive	RS485 internal bus
	RS485-	RS485 communication signal negative	
	Unconnected	/	
	Unconnected	/	
	CGND	Communication signal ground	
RJ45B communication interface	CAN1H	CAN_H of CAN communication signal	CANopen/CANlink supported
	CAN1L	CAN_L of CAN communication signal	
	CGND	Communication signal ground	
	RS485+	RS485 communication signal positive	RS485 internal bus, used for external LCD operating panel and PC commissioning
	RS485-	RS485 communication signal negative	
	C7V	Power supply of the external LCD operating panel	
	C7V	Power supply of the external LCD operating panel	
	CGND	Communication signal ground	
CAN communication for synchronization control (CN6)	CAN2H	CAN_H of CAN communication signal	Dedicated CAN for synchronous control (CANlink protocol).
	CAN2L	CAN_L of CAN communication signal	
	CGND	Ground of CAN communication signal	
Relay terminal	TA/TB/TC	TA-TB: NC TA-TC: NO Axis 1 and axis 2 are shared.	Contact capacity: 250 VAC/3 A (COSϕ = 0.4)
PROFIBUS-DP communication interface (CN6)	Unconnected	/	
	Unconnected	/	
	TR+	PROFIBUS-DP bus positive	
	Unconnected	/	
	CGND2	Ground of PROFIBUS-DP bus power supply	
	C5V	PROFIBUS-DP bus power supply	
	Unconnected	/	
	TR-	PROFIBUS-DP bus negative	
23-bit encoder interface (CN6)	PS+	Bus communication signal+	 Note: CN2 and CN4 are invalid when CN6 is a 23-bit encoder interface
	PS-	Bus communication signal-	
	Unconnected	/	
	Unconnected	/	
	Unconnected	/	
	Unconnected	/	
	+5 V	Encoder +5 V power supply	
	GND	Encoder +5 V power supply ground	
	Unconnected	/	

Table 3-9 Definition of DIP switches of the drive unit (dual-axis)

Terminal Symbol	Terminal Name	Function Description	DIP Switch Position
S1	CAN1 termination resistor selection	Connect the termination resistor when switches 1 and 2 are turned on.	
		Connect no termination resistor when switches 1 and 2 are turned off.	
S2	C485 termination resistor selection	Connect the termination resistor when switches 1 and 2 are turned on.	
		Connect no termination resistor when switches 1 and 2 are turned off.	
	CAN2 termination resistor selection	Connect the termination resistor when switch 3 is turned on.	
		Connect no termination resistor when switch 3 is turned off.	

3.3.3 Control Circuit Wiring Requirements

1) Control circuit cable selection

- All control cables must be shielded cables.
- It is recommended to use shielded twisted pairs (STPs) as digital signal cables.

STP

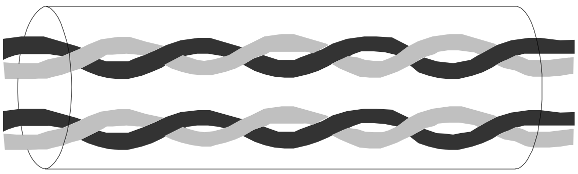


Figure 3-18 STP

2) Control circuit wiring requirements

- The motor cable must be laid far from all control cables.
- It is recommended that the motor cable, input power cable, and control circuit cables be located in different cable conduits. Avoid long-distant parallel routing of the motor cable and control circuit to prevent electromagnetic interference resulting from coupling.
- When the control circuit and the drive cable must be intersected, the intersection angle must be 90 degrees.

Recommended cabling diagram:

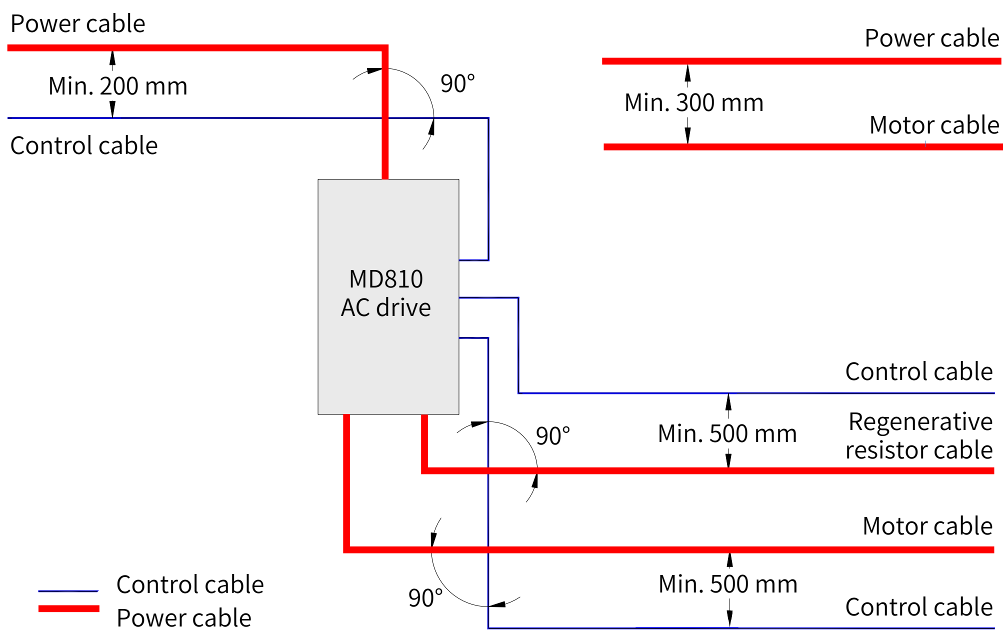


Figure 3-19 Wiring

3.3.4 Description of Control Circuit Wiring

1) DI terminals

Sink (NPN) and source (PNP) wiring methods are available for DI terminals.

■ Sink wiring method

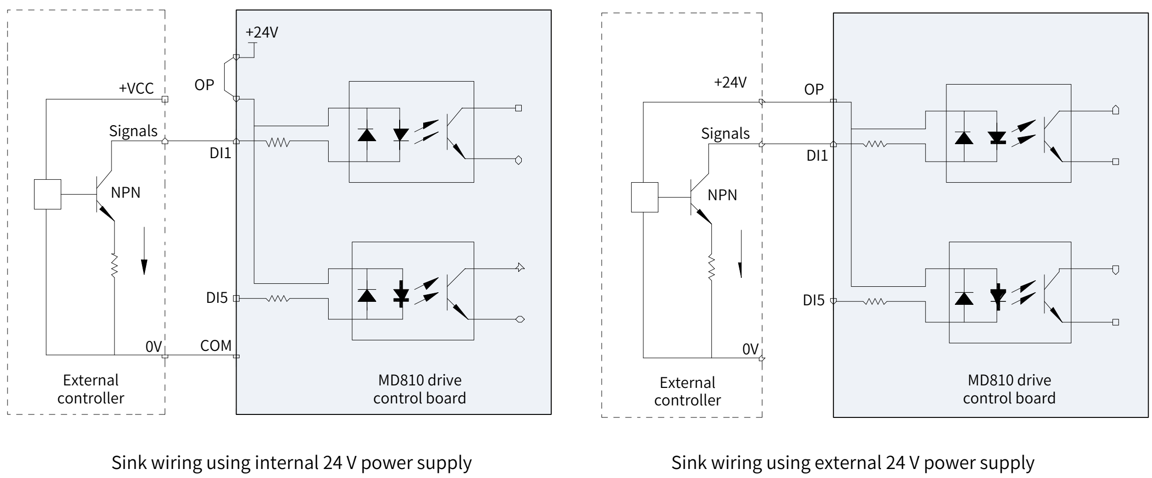


Figure 3-20 Sink wiring method

Using the internal 24 V power supply of the drive is the most commonly used wiring method, in which the OP of the drive is shorted to the 24 V terminal and the COM terminal of the drive is connected to the +VCC terminal of the external controller.

If an external 24 V power supply is used, the jumper between the +24 V and the OP must be removed, the 24 V positive electrode of the external power supply must be connected to the OP terminal, and the 0 V end of the external power supply is connected to a corresponding DI terminal through the controller contact (or switching device).

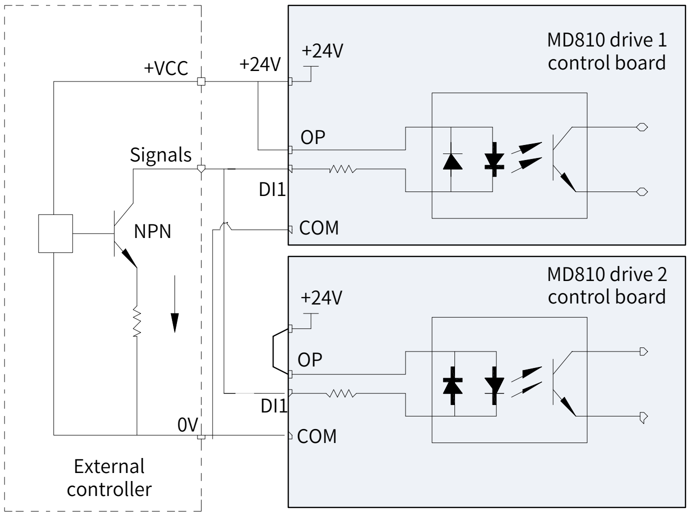


Figure 3-21 Sink wiring method for the DI terminals of multiple drives

■ Source wiring method

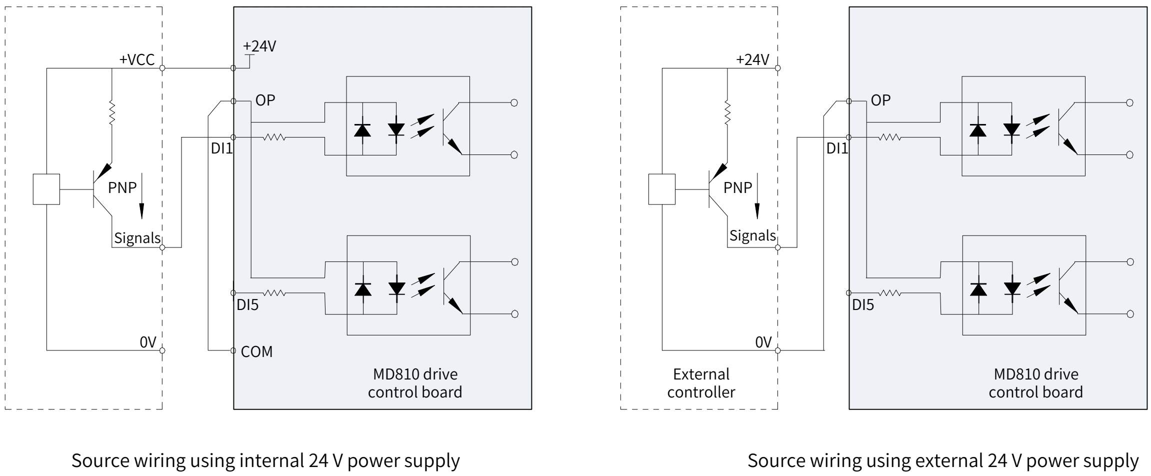


Figure 3-22 Source wiring method

If the internal 24 V power supply of the drive is used, the jumper between the +24 V and the OP must be removed, the OP must be connected to the COM, and +24 V must be connected to the common terminal of the external controller.

If an external power supply is used, the jumper between the +24 V and the OP must be removed, the OP must be connected to the 0 V of external power supply, and the 24 V positive electrode of the external power supply is connected to the DI terminal through the controller contact (or switching device).

2) Relay output terminals

The inductive load (relay, contactor, and motor) causes voltage spikes after the current is removed. A piezoresistor must be used for protection at the relay contact and absorption circuits such as piezoresistors, RC absorption circuits and diodes must be installed on inductive loads to ensure minimum interference during cutoff.

When a contactor and an intermediate relay are connected to 220 VAC, a piezoresistor must be paralleled at both ends of the drive coil of the contactor and intermediate relay and have a withstand voltage of more than 275 VAC. When a contactor and an intermediate relay are connected to 24 V DC, a freewheel diode must be inversely paralleled at both ends of the coil of the contactor and intermediate relay, that is, the cathode and anode of the freewheel diode are connected to the 24 V side and non-24 V side of the coil respectively.

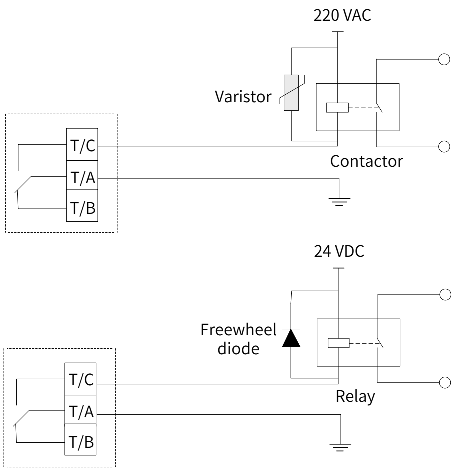


Figure 3-23 Anti-interference measures of relay output terminals

> **WARNING**
>
> ◆ If relay output terminals are connected to 220 V dangerous voltage, pay attention to distinguishing them from the surrounding safety extra-low voltage circuit terminals to prevent misconnection. Wiring requirements for reinforced insulation must be considered.
>
> ◆ The external 220 V power supply connected to the relay must be used in an environment with overvoltage class II (OVC II).
>
> ◆ The modification to the relay output takes effect only when high voltage is applied.

3) DI/DO terminals

DIO1 and DIO2 can be used as DI or DO terminals. The input/output function depends on the settings of F4-41 (DIO terminal type). DIO1 and DIO2 are DI terminals by default. Note that DIO1 and DIO2 cannot be used as DI and DO terminals at the same time.

When they are used as DI terminals, the wiring method is consistent with the preceding DI1-DI2. When DIO is used as a DO, the DO common terminal is COM and only the sink wiring method is supported, as shown in the following figure. It is recommended that the DI common terminal OP of DIO be connected to 24 V; otherwise, when OP is connected to COM, the user devices may become active before the DIO becomes active.

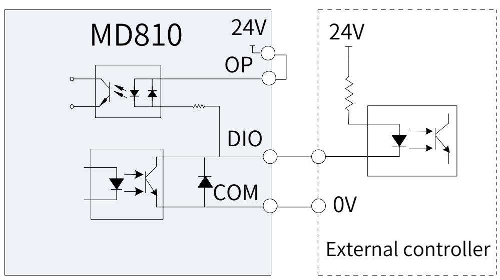


Figure 3-24 DO terminal wiring

4) AI terminal

■ AI1

AI1 supports 0 to 10 V input, -10 V-10 V input, and PT100/PT1000 temperature sensor input. When temperature sensor input is used, turn switch 3 of S1 to ON, switching AI1 from analog-circuit to PT100/PT1000 temperature sensor detection circuit, and set F9-56 (Type of motor temperature sensor) to the corresponding sensor type.

Since weak analog voltage signals are prone to interference, shield cables are required and the distance must be as short as possible (within 20 m), as shown in "Figure 3-25 AI1 terminal wiring" and "Figure 3-26

Wiring when AI1 is used as temperature sensor input". If there is a strong interference in analog signals, install a filter capacitor or ferrite magnetic core on the analog signal source side, as shown in "Figure 3-27 Shield layer grounding of analog terminal".

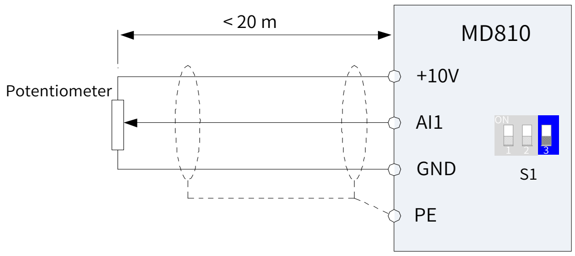


Figure 3-25 AI1 terminal wiring

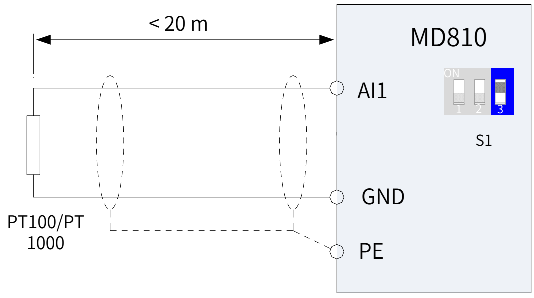


Figure 3-26 Wiring when AI1 is used as temperature sensor input

The shield layer drain wire of the analog terminal must be connected to PE on the drive side.

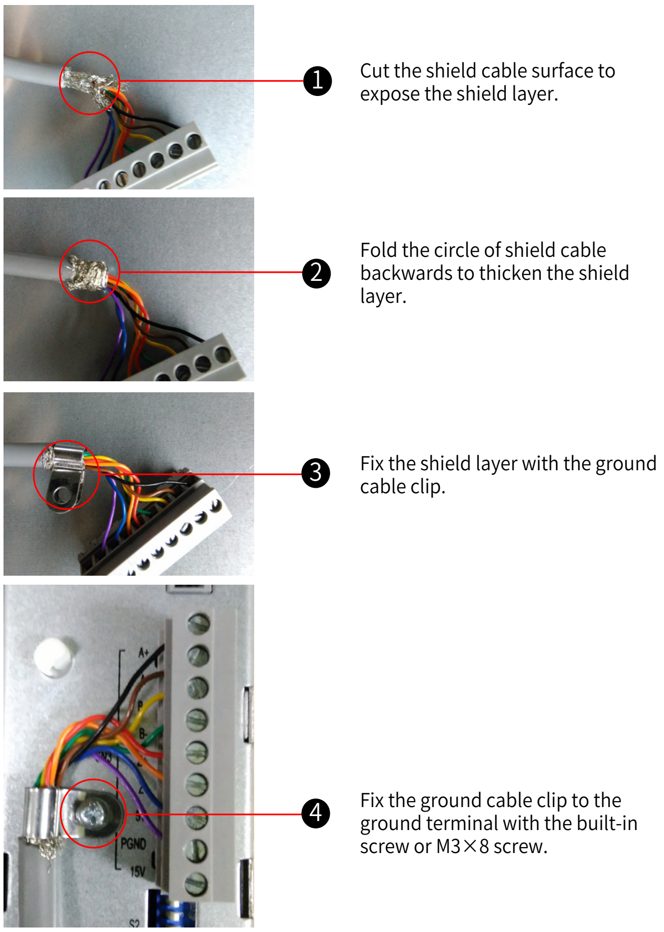


Figure 3-27 Shield layer grounding of analog terminal

■ AI2

AI2 supports 0 to 10 V input and 0 to 20 mA input. To use the voltage input mode, set F4-40 (AI2 input type) to 0 (Voltage input). The wiring is the same as the wiring of AI1.

To use the current input mode (AI2 is the current input direction and GND is the current output direction), set F4-40 (AI2 input type) to 1 (Current input). This parameter indicates the current input module, and "F4-40 = 1" indicates that the current loading resistance is 500 Ω.

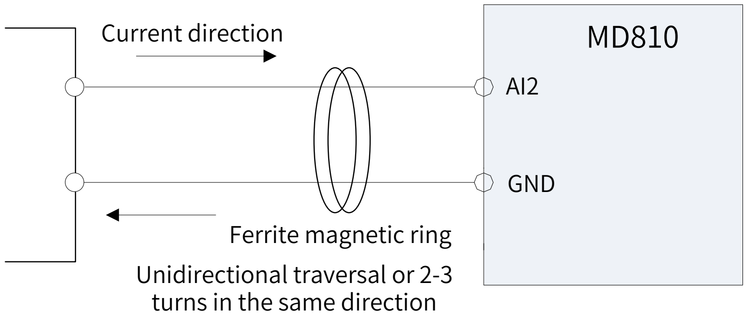


Figure 3-28 AI2 terminal wiring

5) AO terminal

The AO supports 0-10 V and 0-20 mA output modes, which can be set by using F5-23 (AO mode selection).

If the AO uses voltage output mode, the loading resistance cannot be smaller than 5 kΩ. That is, the drive current of AO must be smaller than 2 mA. If the AO uses the current output mode, the loading resistance must be smaller than or equal to 500 Ω; otherwise, the linearity of AO output will distort.

Since weak analog voltage signals are prone to interference, shield cables are required and the wiring distance must be as short as possible (within 20 m), as shown in the following figure. If there is a strong interference in analog signals, install the filter capacitor or ferrite magnetic core on the analog signal source side.

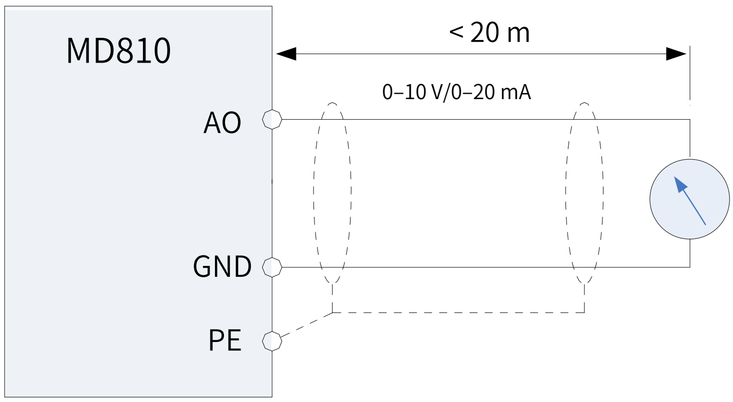


Figure 3-29 AO terminal wiring

6) Wiring of PG encoder signal feedback interface

The PG interface is compatible with differential input, collector input, and push-pull input, so it supports various interfaces such as encoder interfaces and host controller A/B phase input interfaces. In addition, the PG interface provides the adaptive filter, automatic interlock, and differential disconnection detection functions. These functions can apply to the scenarios with low host controller input frequency, strong interference, and signal edge jitter.

■ PG interface specifications

Table 3-10 PG interface specifications (frequency dividing resolver)

Resolution	12 bits
Exicitation Frequency	10 kHz
Excitation Output Voltage	7 vrms
Sin/Cos Voltage	3.5 vpp
Transformation Ratio	0.5
Maximum Motor Speed	60000 rpm
Frequency Dividing Coefficient	1:N
Frequency Dividing Output Resolution	1024/N
Frequency Dividing Interface	Differential/OC/Push-pull
Resolver Input Terminal	DB15 female connector
Frequency Dividing Output Terminal	

Table 3-11 PG interface specifications (differential encoder)

Encoder Power Supply	5 V/200 mA, 15 V/100 mA
Highest Input Frequency of PG Interface	Differential input: 500 kHz, open collector input: 50 kHz, push-pull input: 100 kHz
Encoder Interface Type	Differential input, open collector input, and push-pull input supported
Wire Gauge	16-26 AWG
Terminal Interval	5.08 mm
Terminal Screw	Phillips screw
Terminal Type	Male connector

■ Filter mode selection

F1-29 (PG signal filter) is used to set the filter mode of PG interface. The modes include non-adaptive filter, adaptive filter, fixed interlock, and automatic interlock. The mode descriptions are as follows:

Non-adaptive filter: The PG card filtering coefficient is fixed at a very small value. This mode is suitable for the scenarios with no interference, low interference, high-speed transmission, or high frequency jumps.

Adaptive filter: With an automatically adjusted filtering coefficient, the PG card has a strong interference-resistant capability, especially when the encoder feedback frequency is lower than 100 kHz. This mode is suitable for the scenarios with high interference. This is the default mode.

Fixed interlock: On the basis of adaptive filter, the function of eliminating the encoder feedback signal edge jitter is added. This mode is suitable for the scenarios where encoder feedback signal edge jitter exists.

Automatic interlock: The mode is automatically switched between the adaptive filter and fixed interlock. This mode is suitable for the scenarios where the system alternates between zero-speed operation and non-zero-speed operation. It prevents the fixed interlock function from eliminating the valid signals as boundary jitter during zero-speed operation.

■ Relationship between encoder cable lengths and wire gauge

The longer the encoder cable is, the higher the cable resistance is. Therefore, if the encoder cable is long, the voltage drop of the encoder power supply and the encoder signals due to cable resistance are high. If the wire gauge is improper for long distance transmission, the cable resistance will lead to signal attenuation, and the encoder and PG card may work abnormally. See the following table to select appropriate wire gauge based on the onsite cable length. (Wire gauge: A standard used to identify the conductor diameter. Here, the wire gauge complies with the AWG standard.)

Table 3-12 Relationship between encoder cable lengths and wire gauge

Cable Length (m)	American Wire Gauge (AWG)
10	⩽ 26
20	
30	⩽ 24
40	
50	⩽ 22
60	
70	⩽ 21
80	
90	⩽ 20
100	

■ Wiring method

① Wiring for differential input

Step 1: Connect the encoder output signals to input terminals A+/A-, B+/B-, Z+/Z-, 5 V, and PGND of the PG card.

Step 2: Set the power supply mode for the encoder to 5 V. (Turn switch 4 of S2 to ON.)

Step 3: Connect the shield layer of the encoder cable to the PE terminal of the PG interface.

Step 4: Select a filter mode based on the field requirement by setting F1-29 (PG signal filter).

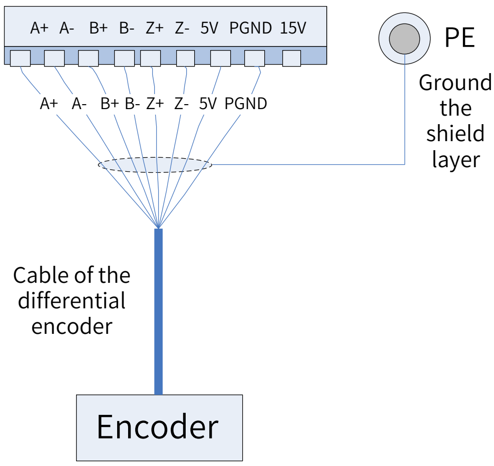
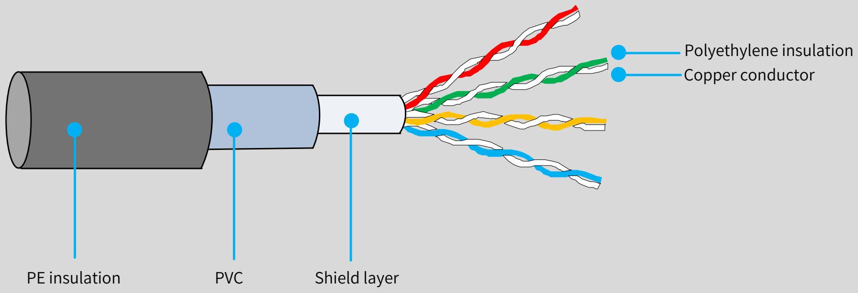


Figure 3-30 Differential encoder input connections

NOTE

- The encoder of the PG interface supports 5 V and 15 V power supply modes (selected by setting switch 4 of S2), so check whether the jumper is set to 5 V output before power-on. If the jumper is not correctly set, a high voltage will damage the encoder.
- It is strongly recommended to use the shield twisted-pair cables (as shown in the following figure). Connect the cables by strictly following the differential input requirements (the differential frequency divider must be processed in the same way).



② Wiring for open collector input 1

Step 1: Connect the output A/B/Z phases of the encoder to input terminals A-/B-/Z- of the PG card, and connect the power cable of encoder to the 15 V and PGND terminals.

Step 2: Set the power supply mode for the PG card encoder to 15 V. (Turn switch 4 of S2 to OFF.)

Step 3: Connect the shield layer of the encoder cable to the PE terminal of the PG interface.

Step 4: Select a filter mode based on the field requirement by setting F1-29 (PG signal filter).

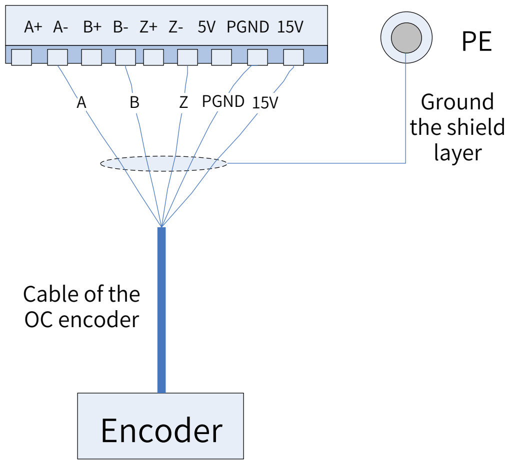


Figure 3-31 Open collector encoder input connections 1

NOTE

- Due to the electrical characteristics of the open collector, signal rising edge is slow and signals are transmitted within a limited distance. Therefore, the open collector output encoder is not recommended if the cable length is longer than 50 m or the frequency is higher than 50 kHz. In such a scenario, the push-pull or differential output encoder is recommended.

③ Wiring for open collector input 2

When the encoder wiring distance is longer than 20 m, the encoder signal frequency is higher than 50 kHz, or closed loop vector control is used, the motor operates abnormally if the running frequency exceeds a certain value. In this situation, connect the cables as follows:

Step 1: Connect the output A/B/Z phases of the encoder to input terminals A+/B+/Z+ of the PG card, short A-/B-/Z- to PGND, and connect the power cable of the encoder to the 15 V and PGND terminals.

Step 2: Set the power supply mode for the PG card encoder to 15 V. (Turn switch 4 of S2 to OFF.)

Step 3: Connect the shield layer of the encoder cable to the PE terminal of the PG interface.

Step 4: Select a filter mode based on the field requirement by setting F1-29 (PG signal filter).

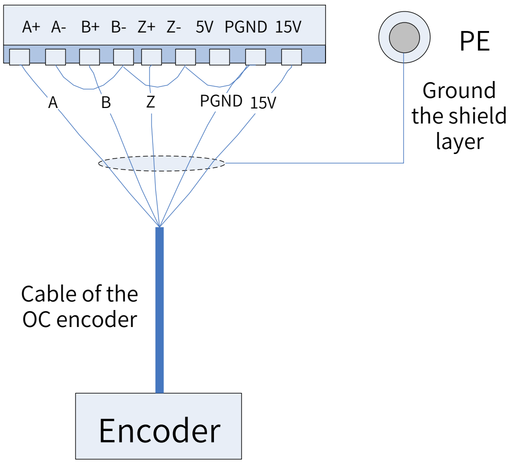


Figure 3-32 Open collector encoder input connections 2

④ Wiring for push-pull input

Step 1: For a push-pull encoder of the complementary output type, connect outputs A-/B-/Z- of the encoder to input terminals A-/B-/Z- of the PG card, respectively. Do not connect the outputs A+/B+/Z+ phases of the encoder. For a push-pull encoder of the single-ended signal output type, connect the A/B/Z phases to input terminals A-/B-/Z- of the PG card. Then connect the power cable of the encoder to 5 V/15 V and PGND (15 V is used as an example in the following figure).

Step 2: Select a power supply mode (5 V or 15 V) for the PG interface encoder according to the encoder power supply voltage. (Select 5 V by turning switch 4 of S2 to ON or 15 V by turning the switch to OFF.)

Step 3: Connect the shield layer of the encoder cable to the PE terminal of the PG interface.

Step 4: Select a filter mode based on the field requirement by setting F1-29 (PG signal filter).

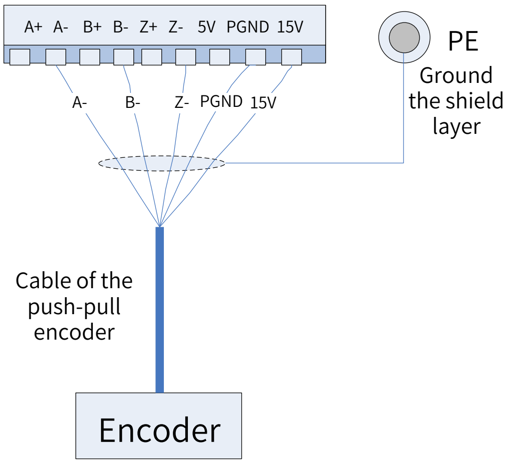
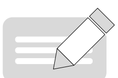


Figure 3-33 Push-pull encoder input connections



NOTE

◆ For the push-pull encoder of the complementary output type (with positive and negative signals such as A+/A-), you must connect either of A+/B+/Z+ or A-/B-/Z- to A-/B-/Z- of the PG card terminal. The A+/B+/Z+ terminals of the PG card cannot be connected; otherwise, the circuits on the PG card may be damaged.

⑤ How to quickly differentiate open collector output encoder and push-pull output encoder

Use this method if you cannot differentiate the encoder type during field commissioning:

Connect the power cable of the encoder to the power terminal of the PG interface to power the encoder. Do not connect A/B/Z signal cables to the PG interface terminal.

Switch multimeter mode to DC voltage. Connect the black probe to the 0 V terminal of the PG interface and the red probe to the output signal A or B of the encoder.

Rotate the motor shaft slowly. If the multimeter shows a voltage jump, it is a push-pull output encoder. If the multimeter shows a stable voltage of 0 V, it is an open collector output encoder.

7) Wiring of the DB15 encoder interface (This section is available only for G5XX models. For details about the related parameters, see "Appendix C Parameter Table of the Drive Unit".)

The DB15 encoder interface can be connected to multiple types of encoders, such as the 5 V differential encoder, sin-cos encoder, Inovance's 23-bit communication encoder, and SSI encoder. This terminal also supports the incremental frequency-division output.

■ Wiring of the 5 V differential encoder

Table 3-13 PG card specifications

Encoder 5 V power supply	5 V/300 mA
Supported encoder type	5 V differential encoder
Maximum encoder input signal frequency	300 kHz
Encoder disconnection detection time	Supported

The cable used for connecting the encoder must be shielded twisted pair (STP). Select a proper cable diameter according to the distance between the encoder and AC drive, as described in the following table.

Table 3-14 Encoder cable length and diameter

Cable Length (Unit: m)	Wire Gauge (AWG)
10	⩽ 26
20	
30	⩽ 24
40	
50	⩽ 22
60	
70	⩽ 21
80	
90	⩽ 20
100	

Connct the signal cable of the 5 V differential encoder to the DB15 encoder interface by following "Figure 3-34 5 V differential encoder connections".

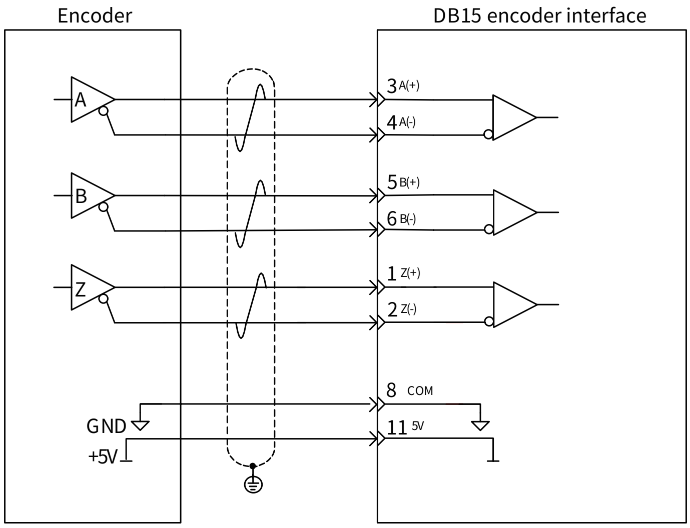


Figure 3-34 5 V differential encoder connections

NOTE

◆ If the encoder does not have the Z+/Z- signal, connect Z+ and Z- of the DB15 encoder interface to 5V and COM respectively. Otherwise, an encoder disconnection fault will be reported.

Related parameters are as follows:

Set F1-23 (PG2 encoder type) to 0 (ABZ incremental encoder) to set the encoder type of the second group to ABZ incremental encoder.

Set F1-43 (PG2 signal filter) as required to select a proper filter mode for the second group of ABZ incremental encoder.

1) Non-adaptive filter: The filter coefficient of the PG card is fixed and small. This mode is suitable for applications with no or low interference, high speed, or large frequency hopping.

2) Adaptive filter: The filter coefficient of the PG card is adjusted automatically, enabling higher anti-interference capacity (especially when the encoder feedback speed is lower than 100 kHz). This mode is suitable for applications with high interference and is used by default upon delivery.

3) Fixed interlock: An encoder feedback signal edge jittering elimination function is added based on the "adaptive filter" mode. This mode is suitable for applications with encoder feedback signal edge jittering.

4) Automatic interlock: Switchover between the "adaptive filter" mode and "fixed interlock" mode is implemented automatically based on the "fixed interlock" mode to adapt to applications running at zero speed or non-zero speed. This mode avoids the situation that a valid signal is mistakenly eliminated as edge jittering during zero-speed running in the "fixed interlock" mode.

■ Wiring of the sin-cos encoder

Table 3-15 PG card specifications

Encoder 5 V power supply	5 V/300 mA
Sin-cos signal	Differential voltage: 06–1.2 Vpp 1.0 Vpp (Typ)
	Common mode voltage: 3 V (max.)
	Band width: 300 kHz

The cable used for connecting the encoder must be shielded twisted pair (STP). The cable length shall be shorter than 10 m.

Connect the 5 V differential encoder signal cable to the DB15 encoder interface, as shown in "Figure 3-35 Sin-cos encoder connections". Note that a pair of STPs must be connected to a pair of differential signals.

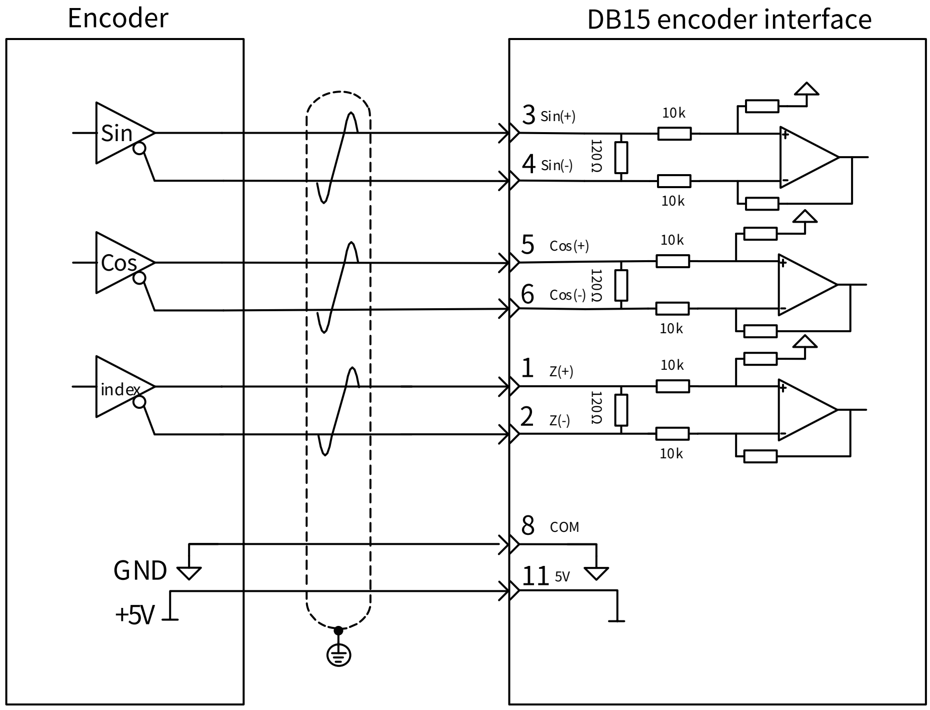


Figure 3-35 Sin-cos encoder connections

Related parameters are as follows:

Set F1-23 (PG2 encoder type) to 2 (Sin-cos encoder).

Set F1-21 (Sin-cos encoder wave quantity per resolution) according to the actual wave quantity per resolution of the sin-cos encoder.

■ Wiring of Inovance's 23-bit communication encoder

Table 3-16 PG card specifications

Encoder 5 V power supply	5 V/300 mA
Encoder resolution	23 bit
Encoder data refreshing frequency	16 kHz
RS485 communication rate	Maximum: 4 Mbps

The cable used for connecting the encoder must be shielded twisted pair (STP). Select a proper cable diameter according to the distance between the encoder and AC drive, as described in the following table.

Table 3-17 Encoder cable length and diameter

Cable Length (Unit: m)	Wire Gauge (AWG)
10	⩽ 20
20	
30	
40	
50	⩽ 18
60	

Connect the signal cable of Inovance's 23-bit communication encoder to the DB15 encoder interface, as shown in "Figure 3-36 Inovance's 23-bit communication encoder connections".

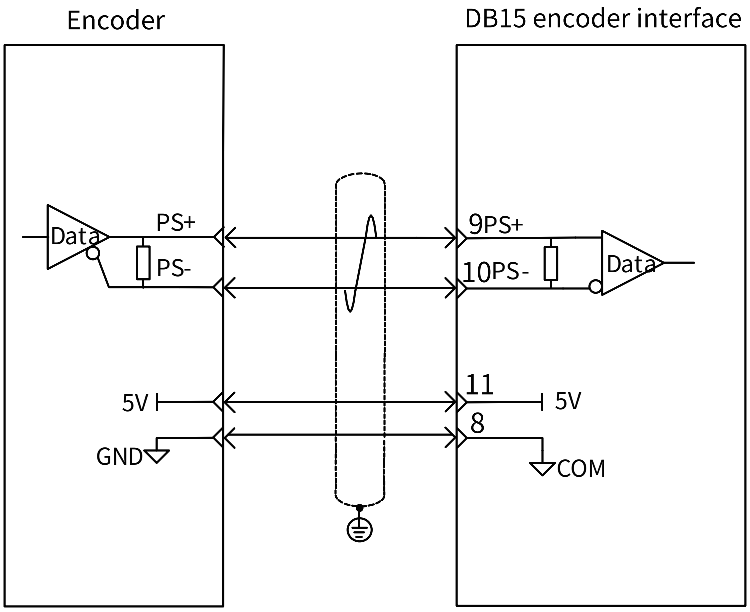


Figure 3-36 Inovance's 23-bit communication encoder connections

The related parameter is as follows:

Set F1-23 (PG2 encoder type) to 1 (23-bit encoder) to select Inovance's 23-bit communication encoder.

■ SSI type encoder

Table 3-18 PG card specifications

Encoder power supply	5 V/300 mA, 12 V/200 mA
Encoder resolution	32 bit
SSI communication rate	Maximum: 1 Mbps

NOTE

◆ The sum of multi-turn bits + single-turn bits + error bits in the SSI data must be less than 36 bits. The resolution upper limit of the multi-turn bits and single-turn bits must be less than 24 bits.

The cable used for connecting the encoder must be shielded twisted pair (STP). Select a proper cable diameter according to the distance between the encoder and AC drive, as described in the following table.

Table 3-19 Encoder cable length and diameter

Cable Length (Unit: m)	Wire Gauge (AWG)
10	⩽ 20
20	
30	
40	
50	⩽ 18
60	

Connect the signal cable of SSI encoder to the DB15 encoder interface, as shown in "Figure 3-37 SSI encoder connections".

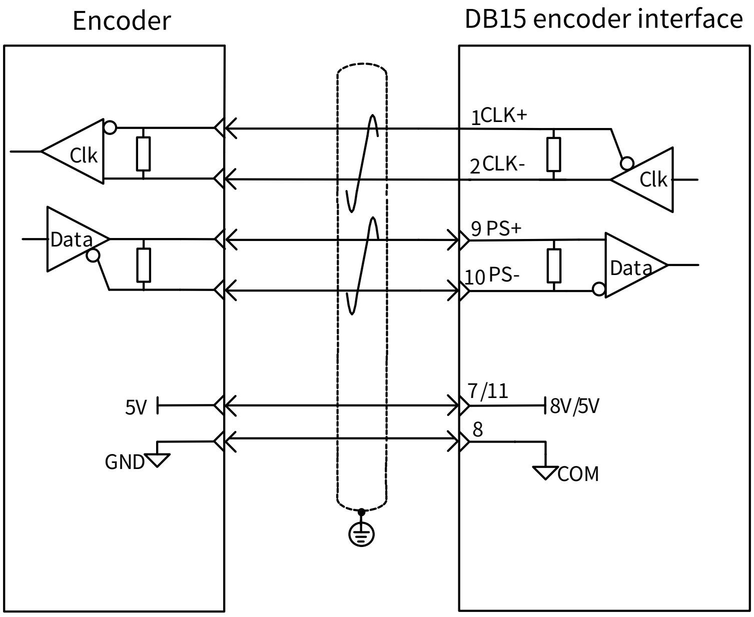


Figure 3-37 SSI encoder connections

NOTE

◆ Select a proper power supply according to the requirements of the encoder power supply.

The related parameters are as follows:

Set F1-23 (PG2 encoder type) to 3 (SSI encoder) and F1-47 (SSI encoder type) to 0 (Common SSI) to select the SSI rotary encoder.

Set F1-23 (PG2 encoder type) to 3 (SSI encoder) and F1-47 (SSI encoder type) to 1 (Laser ranging SSI) to select the SSI laser encoder.

Set F1-38 (SSI encoder baud rate) according to the encoder specifications and cable length. Generally, as listed in "Table 3-20 SSI baud rate and cable length", the higher the bard rate is, the shorter the data transmission time is and the shorter the cable length is required, and vice versa.

Set F1-39 (SSI encoder single-turn bits) according to the encoder specifications. The upper limit is 24 bits.

Set F1-40 (SSI encoder multi-turn bits) according to the encoder specifications. The upper limit is 24 bits.

Set F1-44 (SSI encoder error bits), F1-45 (SSI encoder fully closed loop), and F1-47 (SSI encoder type).

Table 3-20 SSI baud rate and cable length

Baud Rate (kbps)	Cable Length (m)
1000	10
500	25
400	50
250	150
125	300

■ Frequency-division output

Table 3-21 Frequency-division output specifications

Frequency-division output power supply	5–30 V
Frequency-division output type	ABZ incremental
Frequency-division output interface	Push-pull output

Maximum drive capacity of frequency-division output	50 mA
Frequency-division frequency upper limit	500 kHz

As shown in "Figure 3-38 Frequency-division output connections", connect the frequency-division signal to the PLC or PG card with power supplied to the frequency-division.

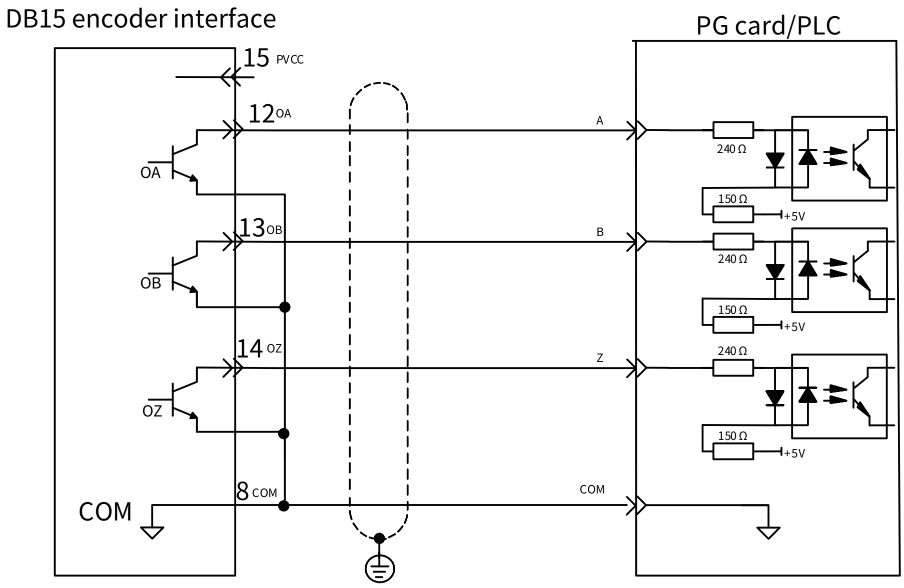


Figure 3-38 Frequency-division output connections

The related parameters are as follows:

Set F1-20 (Frequency-division signal source).

If the frequency-division source is the ABZ incremental encoder, set F1-35 [Resolver frequency-division coefficient/ABZ ecnoder frequency-division coefficient (G5xx series)] to set the ABZ incremental frequency-division coefficient.

If the the frequency-division source is not the ABZ incremental encoder, set F1-46 (Absolute encoder frequency-division coefficient) to set the frequency-division coefficient of communication encoder.

8) Cable selection for the 23-bit absolute encoder

The high-speed RS-485 bus is adopted for the 23-bit absolute encoder. The cable selection is based on the communication distance. The requirements for cable selection are as follows:

- Cable diameter larger than or equal to 22 AWG
- Cable resistance less than 2.5 Ω
- Cable distribution capacitance less than 4.8 nF
- STP required

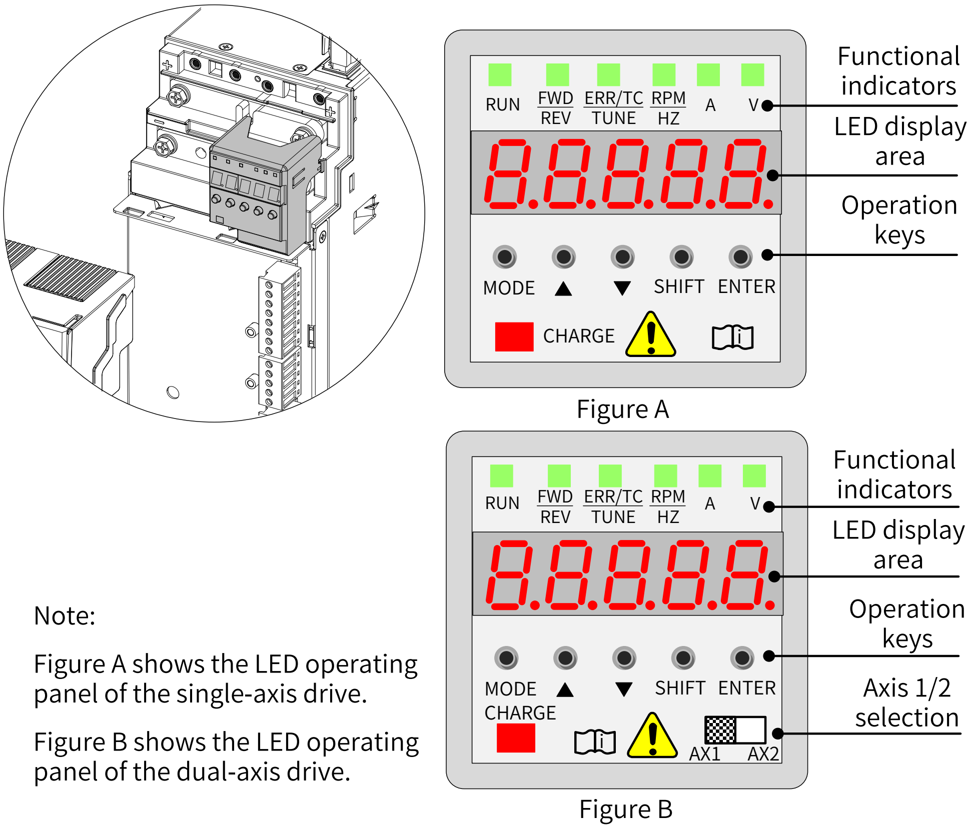
Recommended cable: LEONI L45467-J17-B15

4 Commissioning Tools

The commissioning software of the MD810 mainly include the LED operating panel, the external LCD operating panel, and the software tool.

4.1 LED Operating Panel

You can perform operations such as parameter setting/modification, operating status monitoring, and motor parameter auto-tuning on the power supply unit and drive unit using this LED operating panel. The following figure shows the appearance and operation key names of the LED operating panel.



Note:

Figure A shows the LED operating panel of the single-axis drive.

Figure B shows the LED operating panel of the dual-axis drive.

Figure 4-1 LED operating panel

4.1.1 Functional Indicators

in the following table indicates ON; indicates OFF; indicates flash.

Table 4-1 Description of indicators on the LED operating panel

Indicator State		State Description
RUN indicator	RUN (off)	Off: Stop
	RUN (on)	On: Running
FWD/REV indicator	FWD/REV (off)	Off: Forward running
	FWD/REV (on)	On: Reverse running

Indicator State		State Description
ERR/TC/TUNE Fault/Torque control/Auto-tuning indicator	ERR/TC/TUNE	Off: Speed mode
	ERR/TC/TUNE	ON (green): Torque control mode
	ERR/TC/TUNE	Slow flash (green): Auto-tuning state (1 time/s)
	ERR/TC/TUNE	Quick flash (red): fault state (4 times/s)
RPM/HZ A V		Speed/Frequency unit: RPM/Hz
Hz A V		Current unit: A
Hz A V		Voltage unit: V
Hz A V		Parameter unit: %

4.1.2 LED Display Area

There are 5-digit LEDs on the LED operating panel to display the set frequency, output frequency, various monitoring data, and alarm codes.

Table 4-2 LED display and actual data

LED Display	Actual Data	LED Display	Actual Data	LED Display	Actual Data	LED Display	Actual Data
0	0	7	7	d	D	o	o
1	1	8	8	E	E	P	P
2	2	9	9, g	F	F	r	R
3	3	A	A	H	H	T	T
4	4	b	B	J	J	U	U
5	5, S	C	C	L	L	u	u
6	6	c	c	N	N		

4.1.3 Key Functions

Table 4-3 Key functions

Key	Key Name	Function Description
MODE	Programming	Enter or exit a menu, and perform parameter query mode switchover.
▲	Up	Data or parameter increment
▼	Down	Data or parameter decrement
SHIFT	Shift	◆ Select the displayed parameter in the STOP or RUNNING status. ◆ Select the digit to be modified when modifying a parameter value.
ENTER	ENTER	◆ Enter each level of menu interface. ◆ Confirm displayed parameter setting.
AX1 AX2	AX1/AX2 selection	Select axis 1/2 as the main axis. By default, AX1 is selected.

4.1.4 Parameter Modification

The LED operating panel uses a three-level menu structure to perform operations such as parameter settings. After entering a menu at every level, press ▲ and ▼ to perform modification when a display bit flashes. The following figure shows the operation flow.

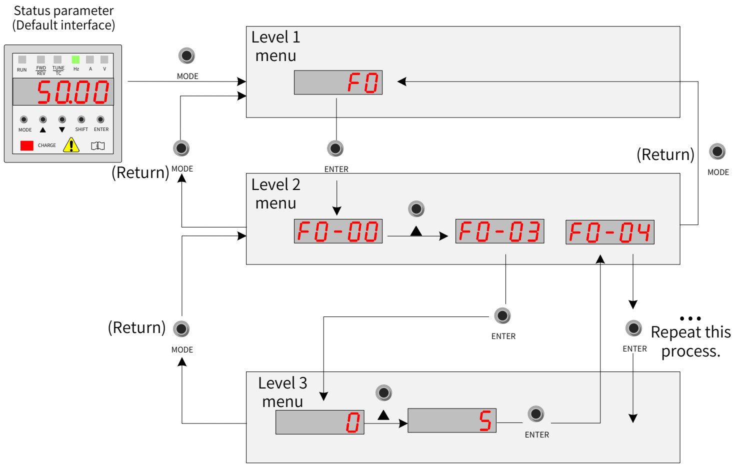


Figure 4-2 Operation flowchart for the 3-level menu structure

Example of changing F3-02 (Cut-off frequency of torque boost) from 10.00 Hz to 15.00 Hz.

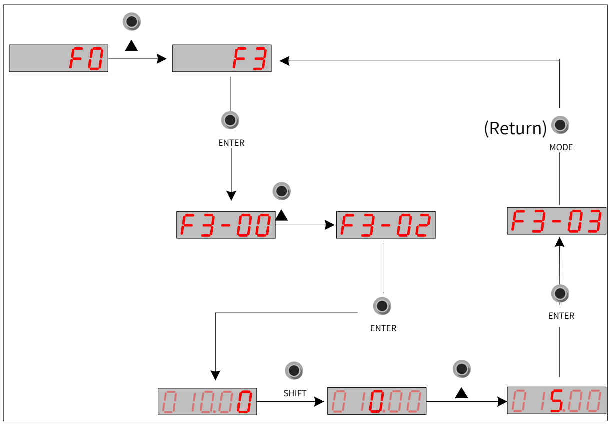


Figure 4-3 Parameter modification

■ You can press MODE or ENTER to return to a level-2 menu when performing level-3 menu operations. The difference between both keys is as follows:

Pressing ENTER is to save a set parameter and then return to a level-2 menu and automatically transfer to the next parameter. Pressing MODE is to give up the current parameter modification and directly back to a level-2 menu with the current parameter No.

■ If a parameter does not include a flashing digit in level-3 menu state, the parameter cannot be modified. Two possible reasons are:

1) The parameter is an unmodifiable parameter such as the drive type, actual detection parameter, and running record parameter.

2) The parameter cannot be modified while the AC drive is in RUNNING status. You can modify these types of parameters only when the AC drive is in the STOP status.

4.1.5 Parameter Viewing

The operating panel provides three viewing modes, as listed in the following table.

Parameter Display Method	Display	Description
User-defined parameter display	-USEr	View user-defined parameters.
User-modified parameter display	--C--	View parameters different from defaults.
Function parameter display	-bASE	View all parameters.

Three parameter viewing methods are provided. The default is the basic viewing method (to view all parameter groups). By parameter setting (FP- 03, Selection of individualized parameter display), two quick parameter viewing methods are also provided.

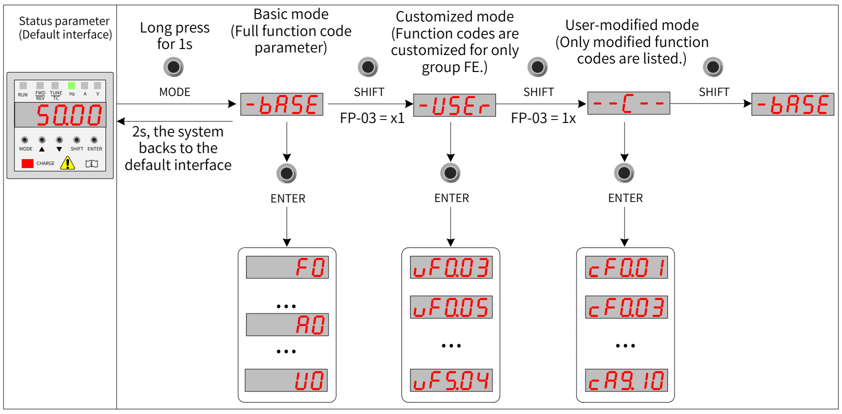


Figure 4-4 Parameter viewing methods

As shown in the preceding figure, the parameter display form such as uF3.02 in the customized mode menu indicates F3-02 (Cut-off frequency of torque boost). The operation method of modifying parameters in the customized menu is the same as that of modifying corresponding parameters in ordinary programming state.

1 Basic viewing method

The basic parameter group, i.e. all parameters of the drive, can be queried or modified by the operation method described in "4.1.4 Parameter Modification". Three parameter display modes can be switched over by pressing MODE on the panel. After entering group parameters, the viewing or modification methods are the same as operation methods described in "4.2 External LCD Operating Panel".

2 Quick viewing methods

If you want to display user-defined groups and user-modified parameter groups, set FP-03 (Selection of individualized parameter display) to 11.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FP-03	Selection of individualized parameter display	11	Ones position: Selection of -USEr group display 0: Disabled; 1: Enabled Tens position: Selection of --C-- group display 0: Disabled; 1: Enabled	Determine whether to display user-defined groups and user-modified parameter groups.

■ Viewing user-defined parameter groups

Long press MODE on the panel to enter the "user-defined parameter" mode -USEr and view user-defined parameters.

Method of defining parameters by users: You can define up to 32 commonly used parameters in group FE

(FE-00 to FE-31). There are 16 user-defined parameters (FE-00 to FE-15) in group FE by default. You can modify these default parameters as required. If a parameter in group FE is set to F0.00, no user-defined parameter is defined.

If uNULL is displayed when you long press MODE to enter a menu, the customized menu is empty. The following table shows the default parameters in a customized menu:

Table 4-4 Commonly used parameters in a customized menu

Parameter No.	User-defined Parameter No.	Parameter Name	Parameter No.	User-defined Parameter No.	Parameter Name
FE-00	F0-01	1st motor control mode	FE-01	F0-02	Command source selection
FE-02	F0-03	Main frequency source X selection	FE-03	F0-07	Final frequency reference setting selection
FE-04	F0-08	Preset frequency	FE-05	F0-17	Acceleration time 1
FE-06	F0-18	Deceleration time 1	FE-07	F3-00	V/F curve setting
FE-08	F3-01	Torque boost	FE-09	F4-00	DI1 function selection
FE-10	F4-01	DI2 function selection	FE-11	F4-03	DIO1 function selection
FE-12	F5-04	DO1 function selection	FE-13	F5-07	AO function selection
FE-14	F6-00	Start mode	FE-15	F6-10	Stop mode

■ Viewing user-modified parameters

Long press MODE on the panel to enter the "user-modified parameter" mode --C-- and view parameters different from defaults.

This mode facilitates your access to modified parameters. User-modified parameters are listed in user-modified parameter groups, i.e. the current setting values are different from defaults. These parameters are in a list that is automatically generated by the drive.

3 State parameter query

In stop or running state, multiple state parameters can be displayed by pressing SHIFT on the operating panel to switch over every byte of F7-03 (LED display running parameter 1), F7-04 (LED display running parameter 2), and F7-05 (LED display stop parameters).

32 running state parameters are available in running state. Select whether to display a parameter corresponding to every bit according to binary bits of F7-03 (LED display running parameter 1) and F7-04 (LED display running parameter 2). 13 stop state parameters are available in stop state. Select whether to display a parameter corresponding to every bit according to binary bits of F7-05 (LED display stop parameters).

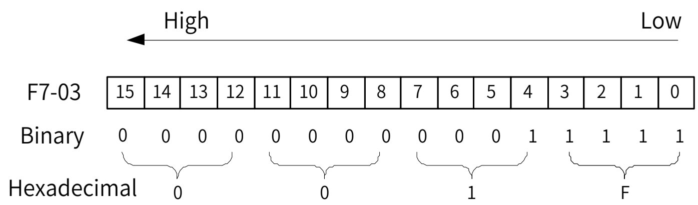
Example:

Viewing parameters in running state using the panel: (Running frequency, bus voltage, output voltage, output current, output power, and PID settings)

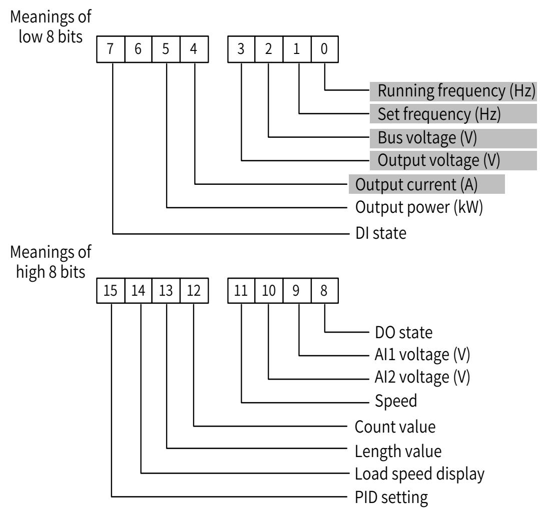
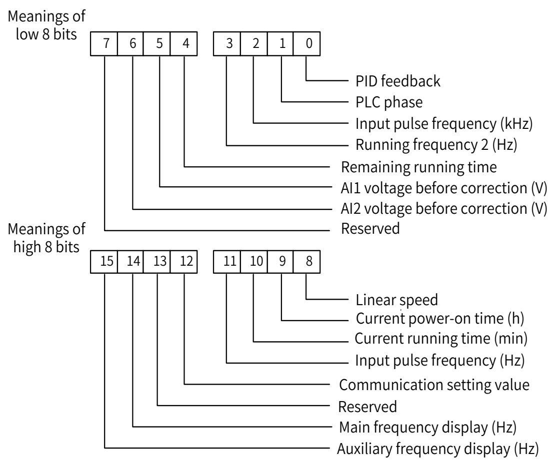
1) Set a corresponding bit to 1 according to the corresponding relation between every byte in F7-03 (LED display running parameter 1) and the preceding parameters.

2) After converting this binary number to a hexadecimal number, set it in F7-03 (LED display running parameter 1). Use the keypad to set the value that is displayed as H.001F .

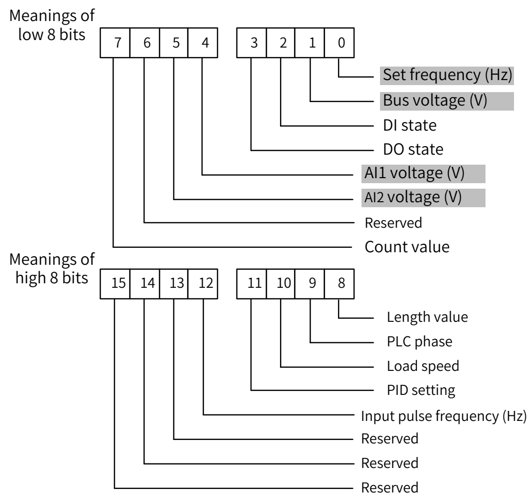
3) View values of related parameters by pressing SHIFT on the operating panel to switch over every byte of F7-03 (LED display running parameter 1). The following figure shows the setting:



The method of viewing other state parameters is the same as F7-03 (LED display running parameter 1). The corresponding relation between the state parameters and every byte of F7-03 (LED display running parameter 1), F7-04 (LED display running parameter 2), and F7-05 (LED display stop parameters) is as follows:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F7-03	LED display running parameter 1	1F	0000 to FFFF	If the following parameters need to be displayed in running, set their corresponding positions to 1. After converting this binary number to a hexadecimal number, set it in F7-03.  Note: The part with shading is default display.
F7-04	LED display running parameter 2	0	0000 to FFFF	If the following parameters need to be displayed in running, set their corresponding positions to 1. After converting this binary number to a hexadecimal number, set it in F7-04. 

<table>
<tr><th>Parameter No.</th><th>Parameter Name</th><th>Default</th><th>Setting Range</th><th>Parameter Description</th></tr>
<tr><td>F7-05</td><td>LED display stop parameters</td><td>0</td><td>0000 to FFFF</td><td>If the following parameters need to be displayed upon stop, set their corresponding positions to 1. After converting this binary number to a hexadecimal number, set it in F7-05.



Note: The part with shading is default display.</td></tr>
</table>

NOTE

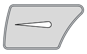
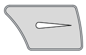
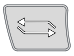
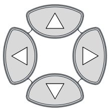
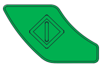
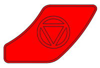
- If the AC drive is repowered on, the displayed parameter is the parameter selected before power-off by default

4.2 External LCD Operating Panel

The external LCD operating panel (model SOP-20) is Inovance's new-generation commissioning aid of frequency control system. The external LCD operating panel has a wide power supply range and LCD display, supports multibus and applies to the single-drive/multidrive system. The operating panel provides the functions such as parameter setting, state monitoring, simple oscilloscope, parameter copy, fault analysis and locating, program download, and USB connection.

4.2.1 Appearance and Display

Figure 4-5 Appearance of external LCD operating panel

Name	Legend	Function Description
Left soft key		Used to execute the display function at the bottom left of the screen.
Right soft key		Used to execute the display function at the bottom right of the screen.
Toggle key		Used to quickly enter the equipment list page. In some pages where operations cannot be interrupted, the quick model toggle function is disabled and this key is invalid.
Arrow keys		The up and down arrow keys are used to select options in a display menu and list, scroll up and down a text page and adjust a value (e.g. setting time, entering a password or changing a parameter value). The left and right arrow keys are used to move the cursor left and right.
Help key		Used to open a help page. A help page depends on the context, i.e. the contents of this page are related to a corresponding menu or view. For more information about a help page, see "Help".
RUN key		Used to start up the drive in local control mode.
Stop key		Used to stop the drive in local control mode. When the equipment is faulty, the stop key is used to reset the equipment.
Loc/Rem toggle key		Used to switch control between the control panel (local) and the remote connection (remote).

Main interface display:

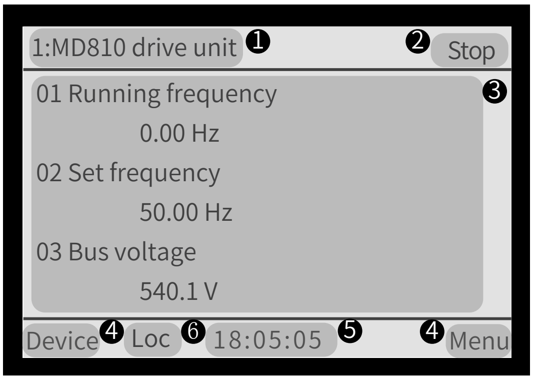


Figure 4-6 Main interface of the external LCD operating panel

❶ Current equipment information: The value in the front is station No. The value in the rear is a specific equipment name.

❷ Equipment status and fault information: Displays the running status information of the current equipment. When the equipment fails, fault information is displayed by flashing and the running status is not displayed.

❸ Content area: Displays actual contents of a view in this area. Contents of every view are different. The preceding example view is a homepage.

❹ Soft key selection: Displays the soft key function in the given context.

❺ Clock: Displays the current time.

❻ Control position (drive unit):

Loc: Local control by the external LCD operating panel is enabled.

Rem: Remote control by I/O or bus is enabled.

Blank: This function is unavailable on the equipment.

4.2.2 Wiring

The commissioning operation can be performed by connecting the RJ45 interface at the back of the external LCD operating panel to the RJ45B interface at the top of the MD810 drive unit or power supply unit using a standard network cable. The following figure shows the interface of the MD810 drive unit or power supply unit.

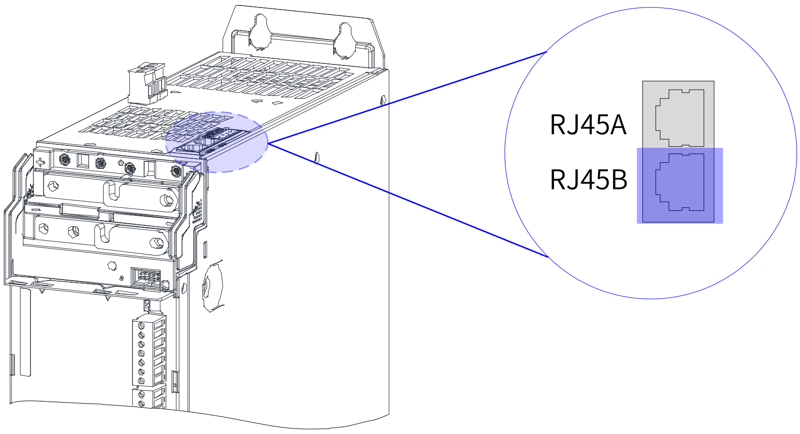
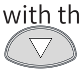


Figure 4-7 Connection between the LCD operating panel and unit

NOTE

◆ In Figure 4-7, the single-axis unit (100 mm width) is used as an example. The RJ45 interface position may vary depending on models.

4.2.3 Status Viewing

After the external LCD operating panel wiring is completed, the status information interface of the drive with the current default station No. is displayed, as shown in the following figure. Press  and  to view more status information.

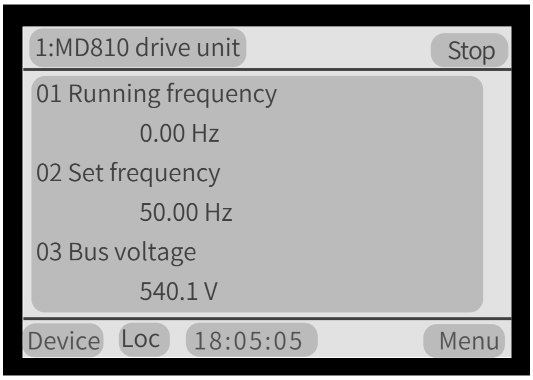
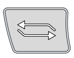
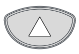
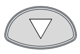
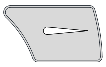


Figure 4-8 Status page

Press  to enter the equipment list page. Press  and  to move the cursor. After selecting a machine to be viewed, press  to enter the status information page of this machine.

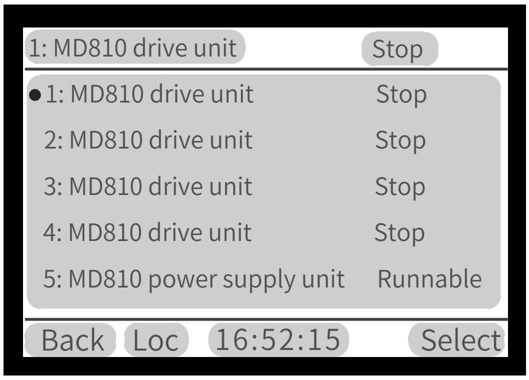
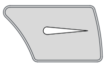


Figure 4-9 Equipment list page

4.2.4 Parameter Setting

Press  on the main page to enter the parameter setting interface. The following figure shows the setting procedure.

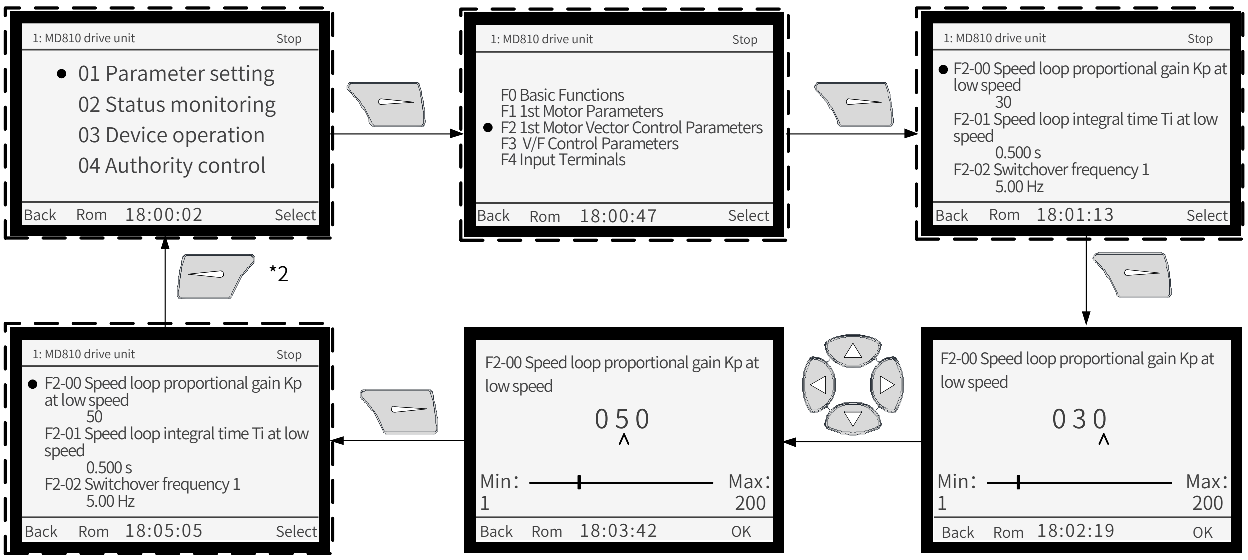
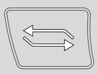


Figure 4-10 Parameter setting

NOTE

- Press  in the page with a box to enter the equipment list page and select the parameter setting of other machines.

4.2.5 Auto-tuning (Drive Unit)

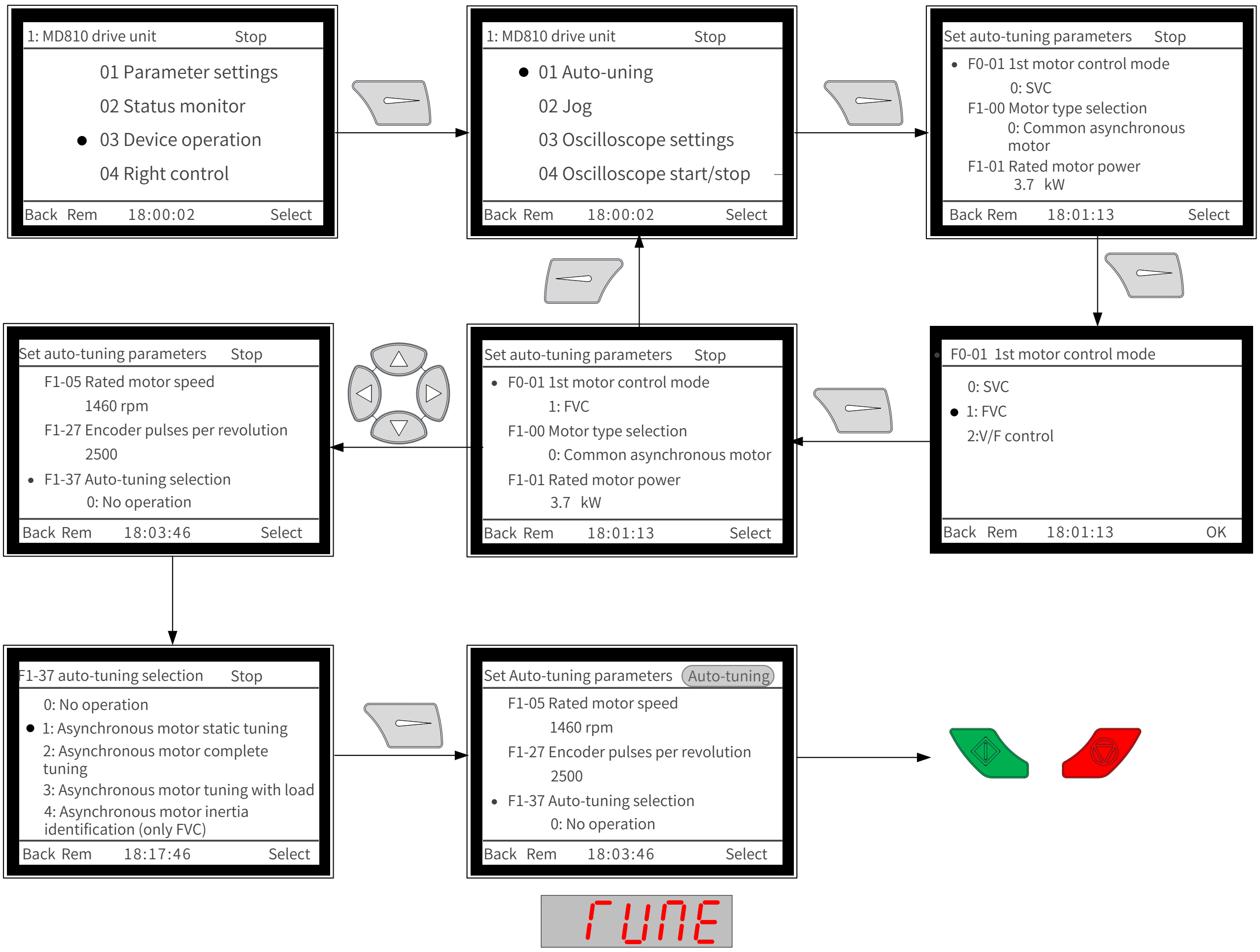
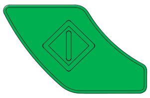
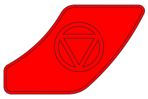


Figure 4-11 Auto-tuning process

NOTE

◆ Press [key] in the page with a box [ ] to enter the equipment list page and perform auto-tuning for other machines.

4.2.6 Jog (Drive Unit)

You can press  and  to enable the jog function of the motor only when the motor is in the local control status.

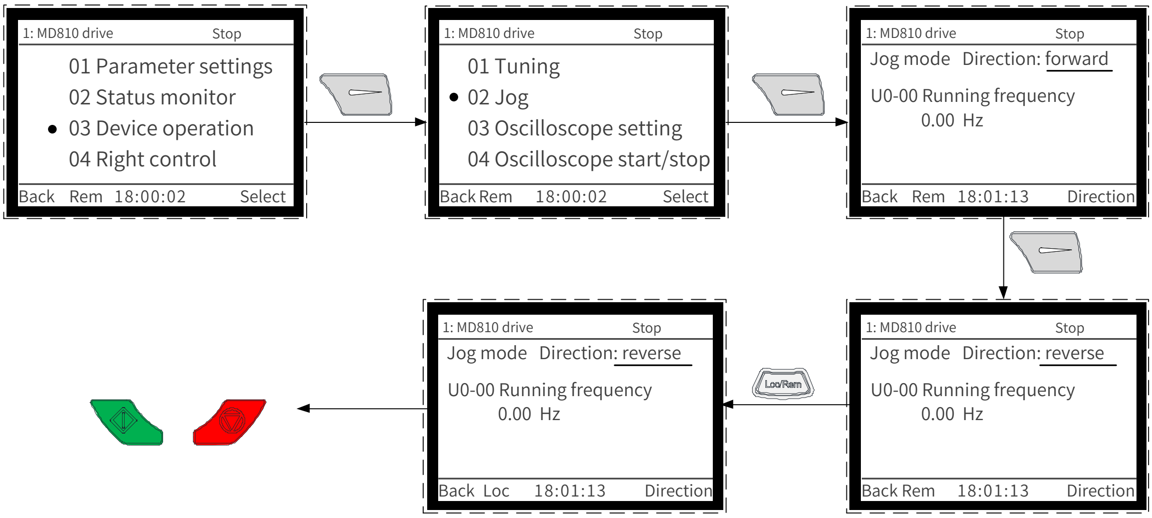
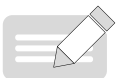
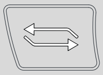


Figure 4-12 Jog function


NOTE

◆ Press  in the page with a box to enter the equipment list page and perform auto-tuning for other machines.

4.2.7 Parameter Copy

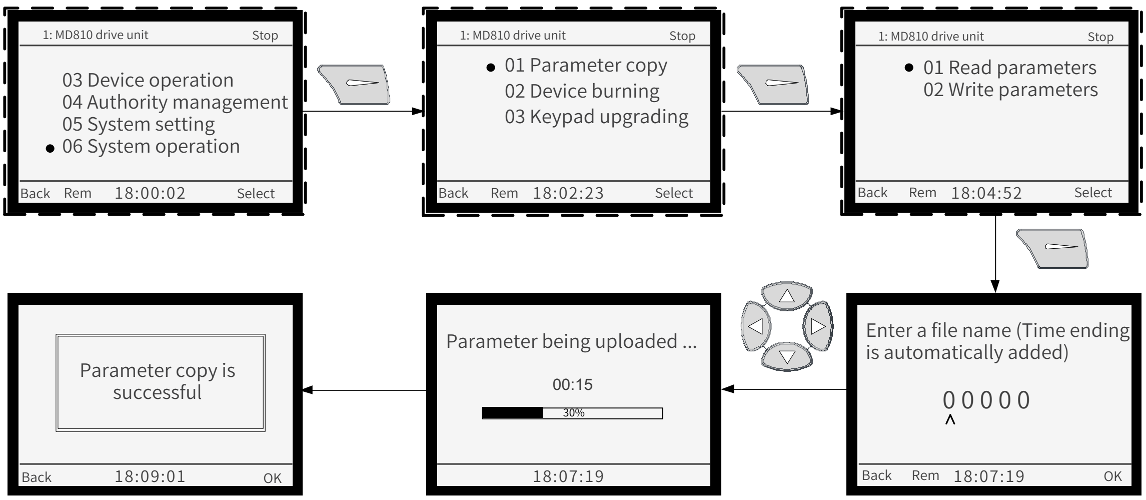


Figure 4-13 Parameter uploading

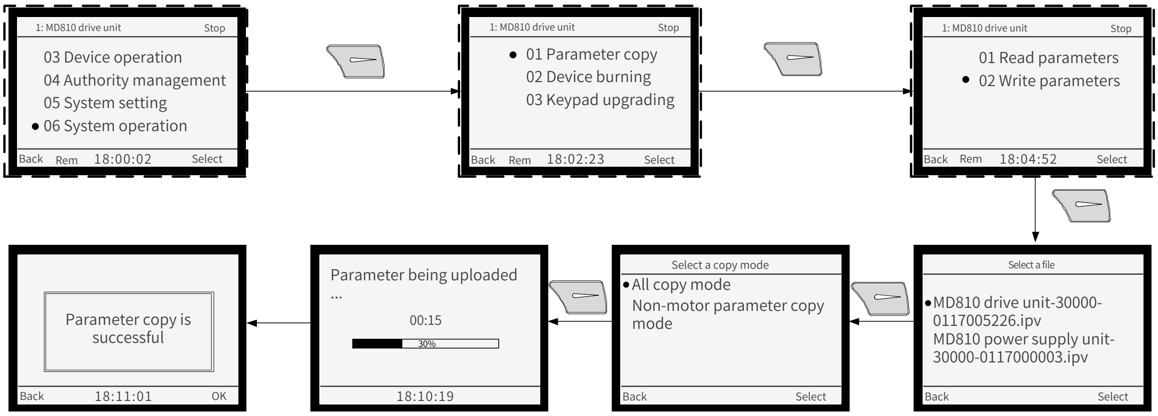


Figure 4-14 Parameter downloading

NOTE

◆ Press in the page with a box to enter the equipment list page and select the fault state query of other machines in the station.

4.2.8 Fault Query

Figure 4-15 Fault query

NOTE

◆ The current fault information description is displayed in Fault Status. The historical fault information list is displayed in Historical Fault.

◆ Press in the page with a box to enter the equipment list page and select the fault status query of other machines in the station.

4.3 InoDriveShop Commissioning Software

InoDriveShop is a commissioning software developed for MD810. By using the InoDriveShop, you can monitor the drive in real time, set parameters, configure the oscilloscope, and use the emergency stop function on the PC. The operation process is as follows:

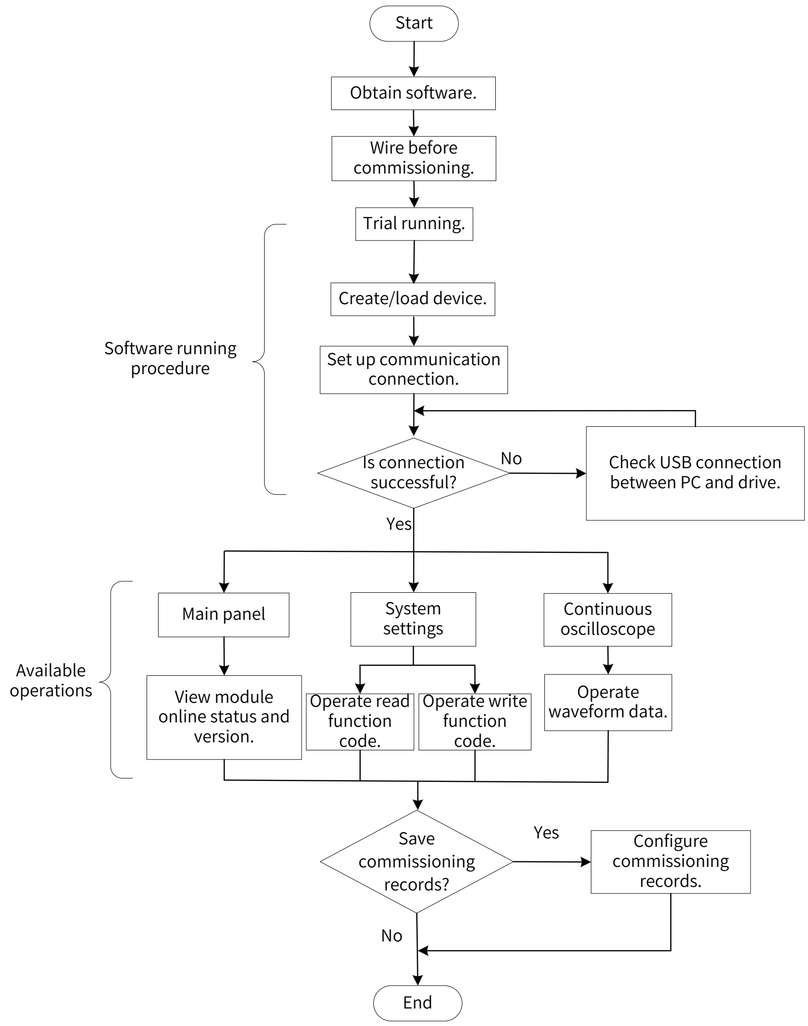


Figure 4-16 Software commissioning process

4.3.1 Obtaining Software

InoDriveShop is free. You can obtain the software in the following ways:

- From the agents of Inovance
- From the Download > Software page on www.inovance.com

NOTE

◆ Inovance's products and documents are subject to change without notice. Upgrade your software version if necessary.

4.3.2 Wiring Before Commissioning

Before running InoDriveShop, ensure that the communication between the drive and PC is normal. The connection is as follows:

■ Connecting the SOP-20 external operating panel

Connect the SOP-20 external operating panel (optional) with a USB cable. The end connected to the SOP-20 external operating panel is a Mini USB interface. The SOP-20 external operating panel is connected to the power supply unit (or drive unit) through an RJ45 terminal, as shown below:

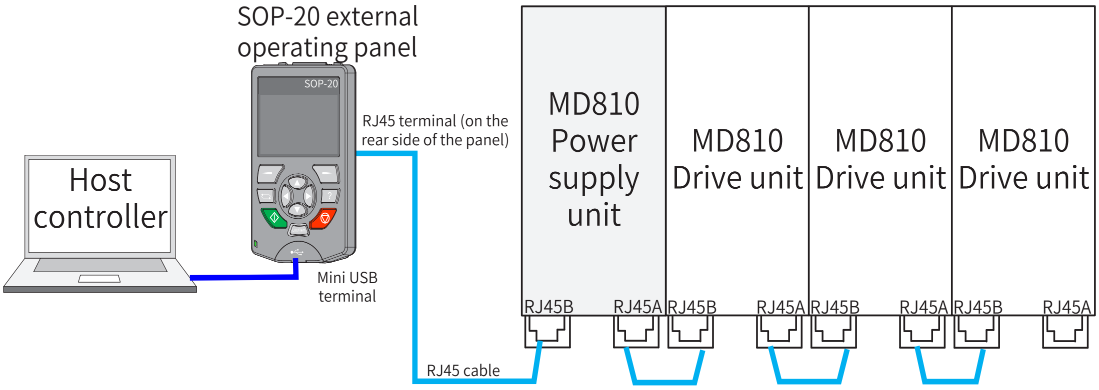


Figure 4-17 Connection for software commissioning (SOP-20 external operating panel)

■ Connecting the Inolink

Connect the Inolink (optional) with a USB cable. The end connected to the Inolink is a mini USB interface. The Inolink is connected to the power supply unit (or drive unit) through an RJ45 terminal, as shown below:

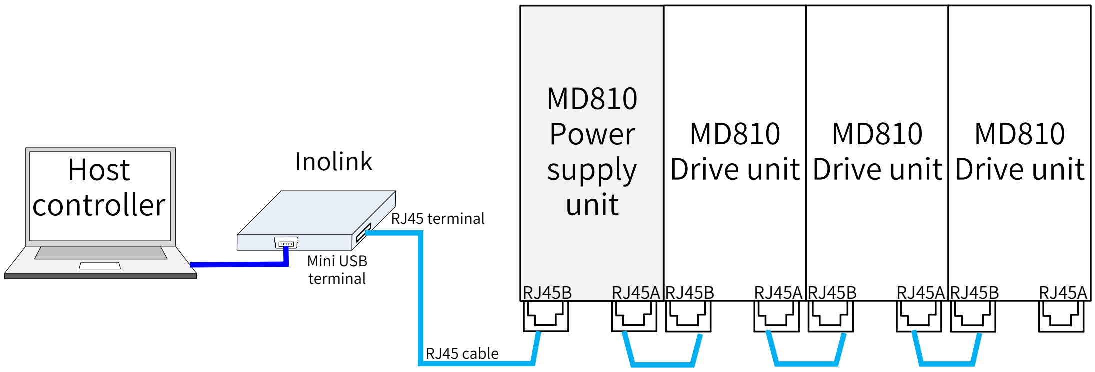


Figure 4-18 Connection for software commissioning (Inolink)

4.3.3 Software Running Procedure

The InoDriveShop software is installation free. To use it, double-click the InoDriveShop icon on the desktop or the executable file in the installation directory.

1) Software Running

■ PC Requirements

A desktop computer or laptop meeting the following conditions:

Operating system: Windows XP, Windows 7, Windows 8, or Windows 10

CPU frequency: 2 GHz or higher

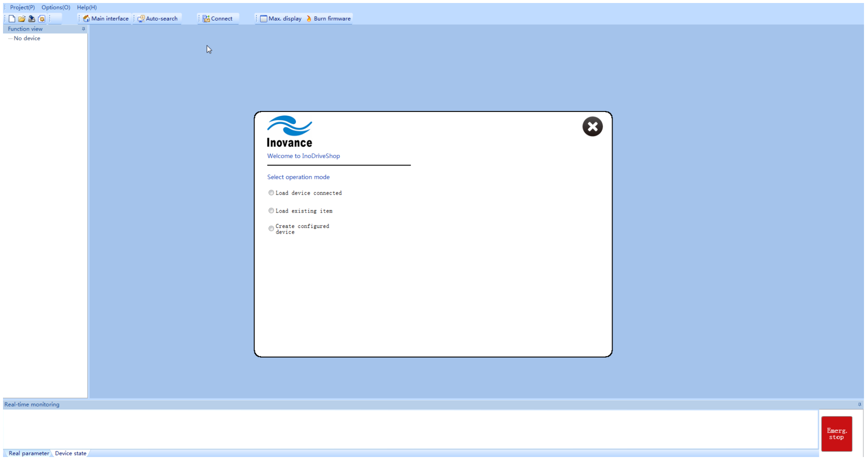
Memory size: 2 GB or higher

■ Procedure

Double-click 

on the desktop or the executable file in the installation directory.

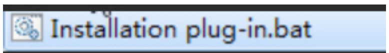
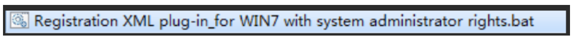
When the software is running, the following dialog box is displayed.



NOTE

◆ If you need to upgrade the InoDriveShop software, back up the existing working files, and delete the InoDriveShop software package of the earlier version. Restart the computer to run the software of the target version.

■ Troubleshooting for First Running

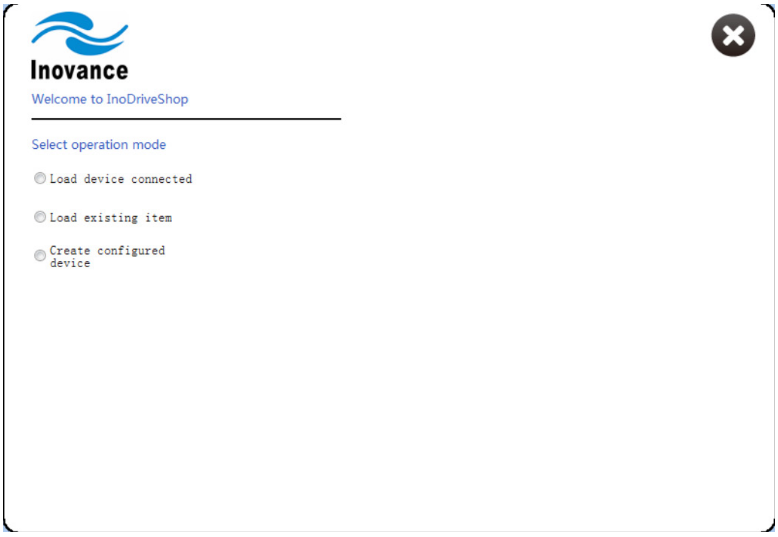
Fault	Cause	Solution
The first running fails.	There is a lack of VS library.	Double-click the following file in the software folder to install it: 
	There is a lack of XML DLL.	Double-click the following file in the software folder to install it manually: 

2) Creating or Loading Project

Double-click 

on the desktop or the executable file in the software folder.

When the software is running, the following dialog box is displayed.

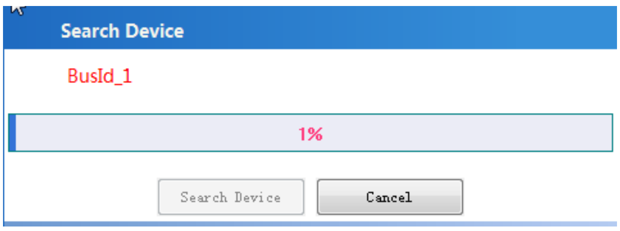


NOTE

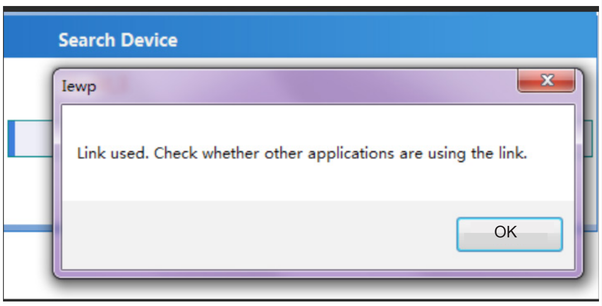
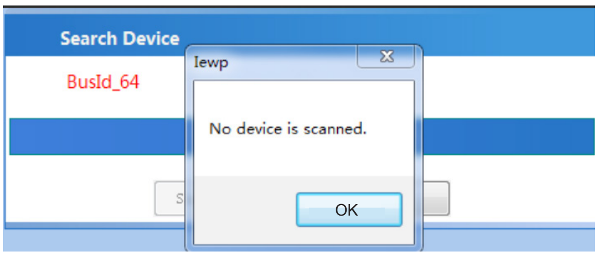
- If a power supply unit (or drive unit) is connected, you are suggested to select **Load device connected**, so that the unit information in the software can be consistent with the onsite information.
- If you select **Load existing item**, ensure that the unit information recorded in the historical project is consistent with the onsite information.

■ Loading a Connected Device

Select **Load device connected**. The software automatically creates a project and scans/loads the connected units. When the scanning is successful, the main interface is displayed. For details about the main interface, see "4.3.4 Software Functions".

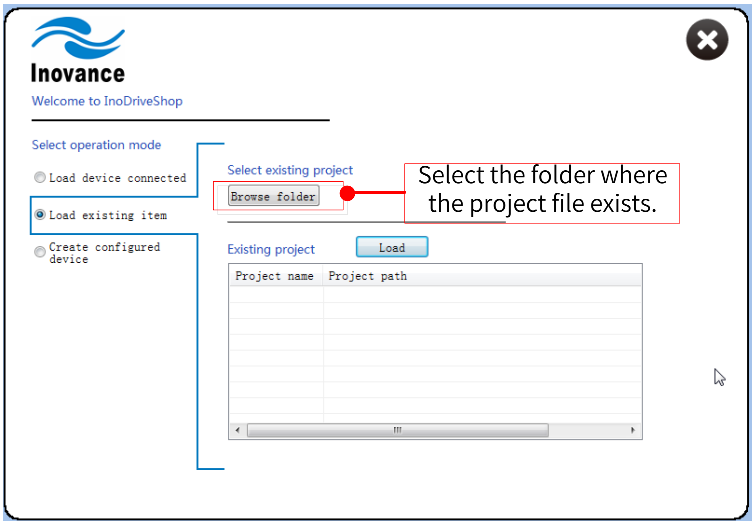


Troubleshooting:

Symptom	Solution
	Check whether the USB communication between the computer and Inolink or SOP-20 external panel is normal. You are advised to remove and reconnect the Mini USB connector. Figure 4-17 and Figure 4-18 show the commissioning connections.
	Check whether the RJ45 communication between the unit and Inolink or SOP-20 external panel is normal. You are advised to remove and reconnect the RJ45 terminal. Figure 4-17 and Figure 4-18 show the commissioning connections.

■ Loading an Existing Project

Select **Load existing item**. Then the saved historical project is loaded manually. When the load is successful, the main interface is displayed. For details about the main interface, see "4.3.4 Software Functions".

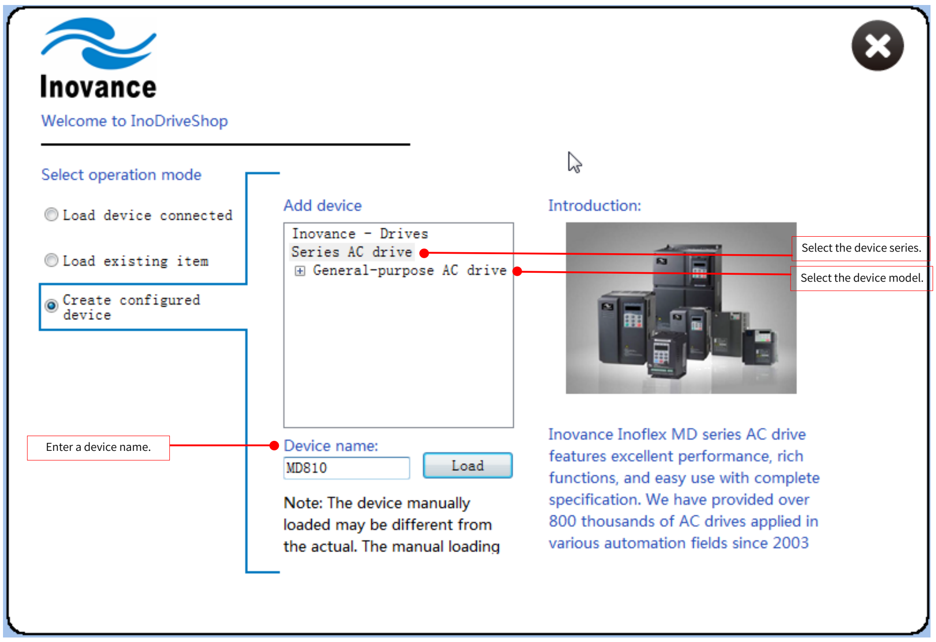


■ Creating Configured Device

Select **Create configured device**. Then a simulated device (with a built-in power supply unit and a drive unit) for demonstration is created. When the load is successful, the main interface is displayed. For details about the main interface, see "4.3.4 Software Functions".

NOTE

◆ This function is used for offline project creation.



Procedure:

1. Enter a device name.
   - Enter the device name in the box

2. Select a device model.
   - Select a model of the device to be added, for example, MD810.

3. Click Load.
   - A project is created and the selected device model is added offline.

4. Load is successful.
   - The main page is displayed after successful load.

3) Communication Connection

■ Setting Up a Connection

After you select to create or load a project, the system automatically sets up the communication connection, or you can click Auto-search in the toolbar to create a connection with the drive. In this situation, the status displayed on the main interface is online, as shown in Figure 4-19.

If you need to manually set up a communication connection, click Connect in the toolbar. Alternatively, you can right-click a node in the function view and select Connect from the shortcut menu. Then the status displayed on the main page is online, as shown in Figure 4-19.

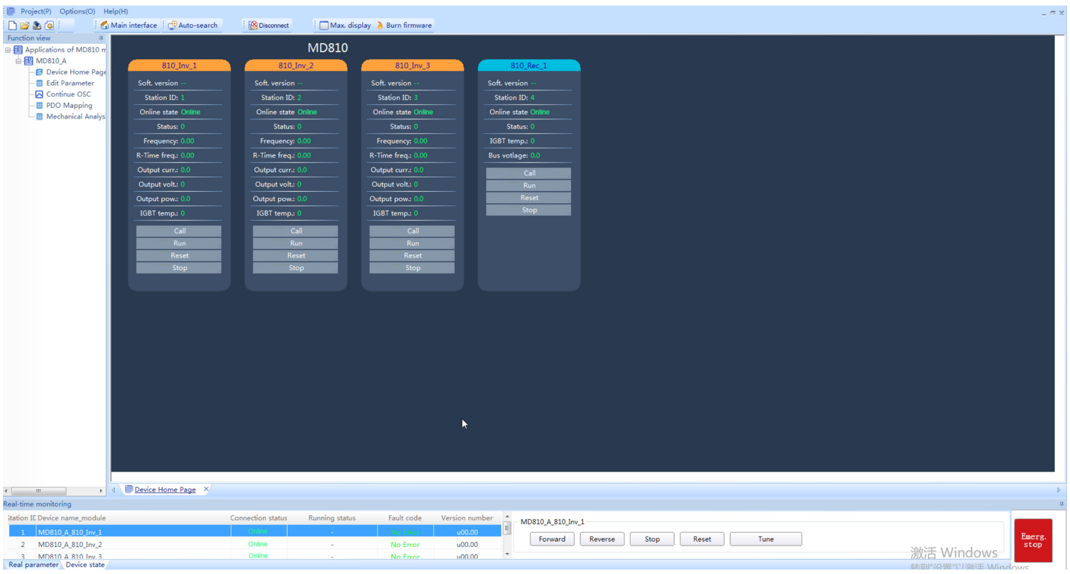


Figure 4-19 Communication connection setup (loading a connected device)

Troubleshooting:

Symptom	Solution
A drive is always disconnected during connection setup. That is, its status stays at offline.	◆ Check whether the RJ45 connection between drives is normal, and whether the control terminal DIP switches S1 and S2 are correctly set, and whether the termination resistor is correctly configured. For details about DIP switches, see "3.3 Control Circuit Wiring". ◆ Check whether the station addresses of online drives conflict by examining the setting of FD-02 (Modbus local address).

■ Closing the Connection

To close a communication connection, click Disconnect in the toolbar. Alternatively, you can right-click a node in the function view and select **Disconnect** from the shortcut menu. Then the status displayed on the main interface is offline, as shown in Figure 4-20.

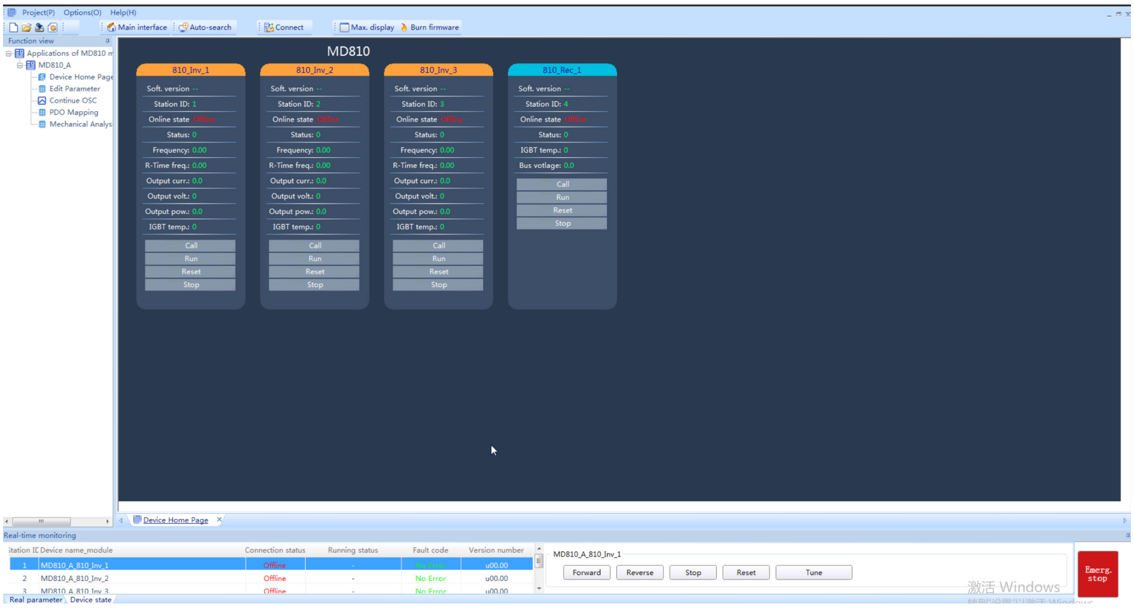
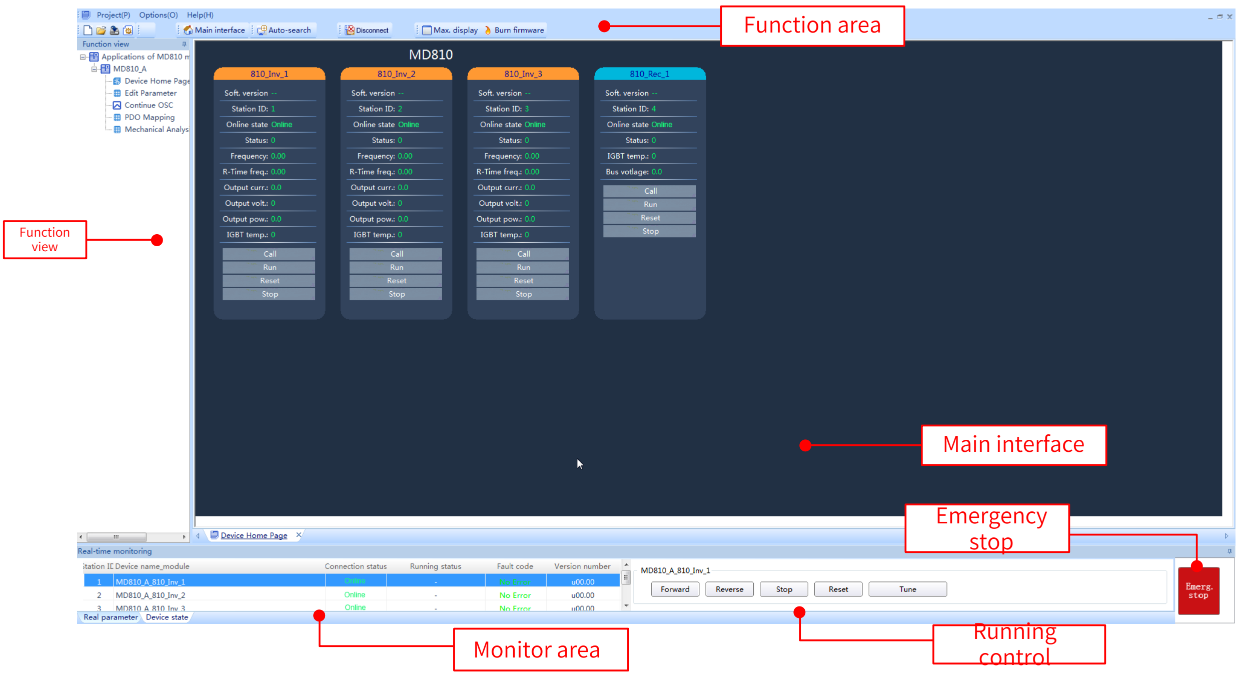


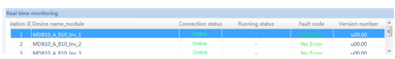
Figure 4-20 Communication disconnection (loading a connected device)

4.3.4 Software Functions

1) Main Interface

Click Main interface in the toolbar or double-click Device Home Page in the function view.



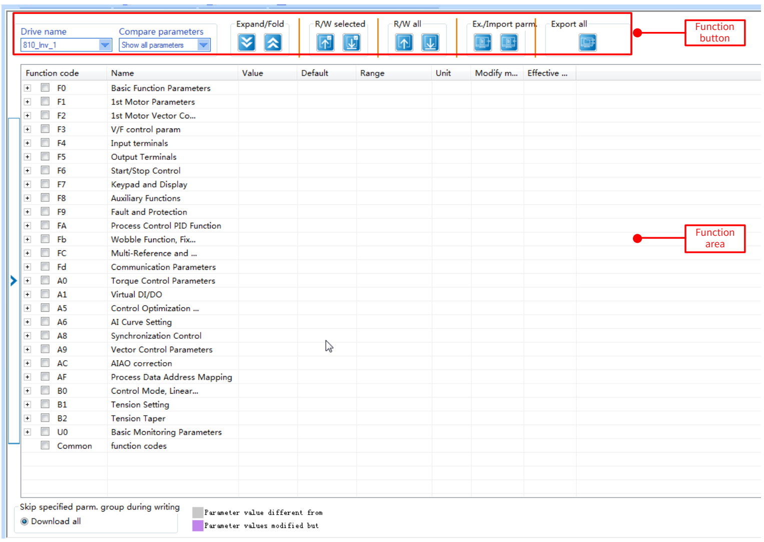
Type	Option	Icon	Function Description
Function view	Function selection	Applications of MD810 multi-drive system MD810_A Device Home Page Edit Parameter Continue OSC PDO Mapping Mechanical Analysis	Displays the functional operations on the device.
Function area	Communication settings		Modifies CAN communication settings.
	System settings		System settings: user management and language settings.
	Main interface	Main interface	Goes to the main interface.
	Automatic search	Auto-search	Scans and loads the connected devices.
	Disconnection	Disconnect	Disconnects/connects the device.
	Maximize	Max. display	Maximizes the page.
	Firmware burning	Burn firmware	Upgrades drive software online using the commissioning software.
Main interface	Sort (by power supply and drive units)		Displays all connected drives and their structures.
	Call	Call	After a click, the module LED blinks, so that you can locate the drive.
	Run	Run	Running upon fault
	Reset	Reset	Reset upon fault
	Stop	Stop	Stop upon fault
	Click the top of drive unit	123_1	Click the top of power supply or drive unit to change the module name.
	Click the bottom of main interface	Device Home Page Edit Parameter Continue OSC	◆ Goes to the parameter settings page. ◆ Goes to the continuous OSC page.
Monitor area	Real-time monitor		Displays the online status, running status, fault code, and version of each module.
Running control	Running mode selection	MD810_A_810_Inv_1 Forward Reverse Stop Reset Tune	Controls the start and stop of each module's motor.
Emergency stop	Emergency stop	Emerg. stop	Stops the motors of all drives with one click.

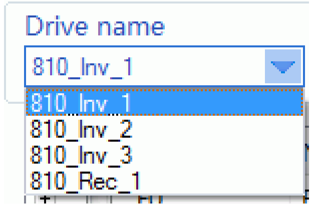
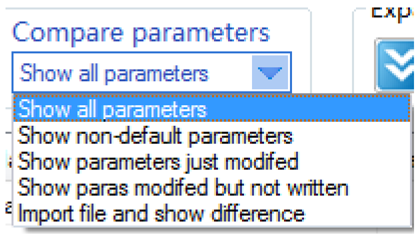
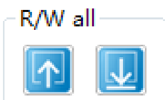
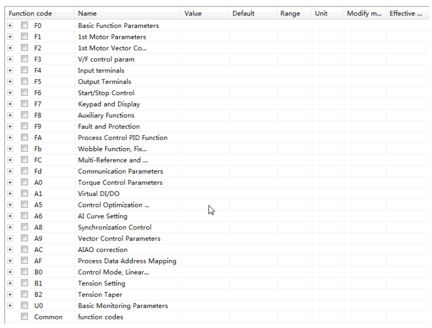
NOTE

◆ The drive status and parameters of drives displayed on the main interface are updated in real time.

2) Parameter Settings

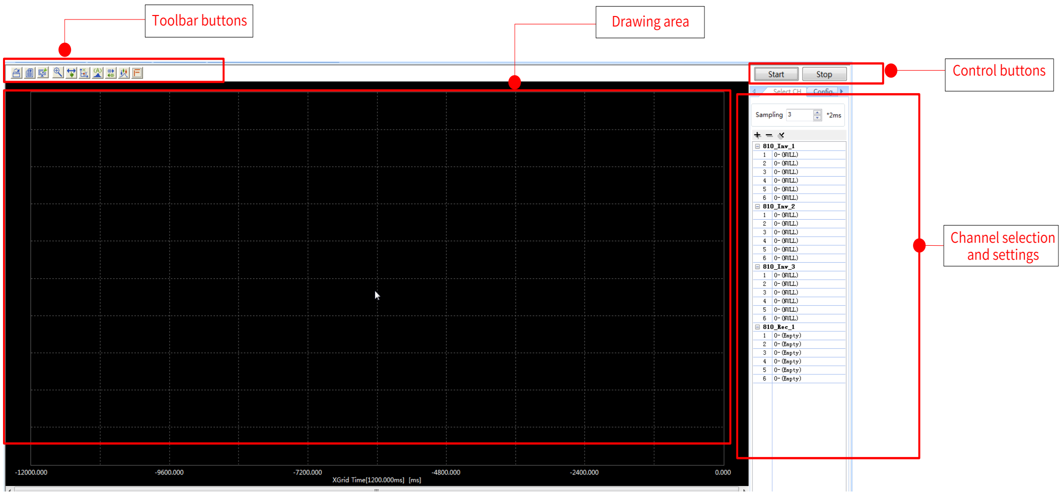
Double-click **Edit Parameter** in the function view.

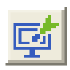
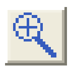
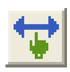
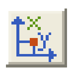
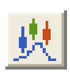


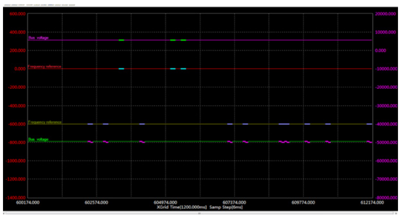
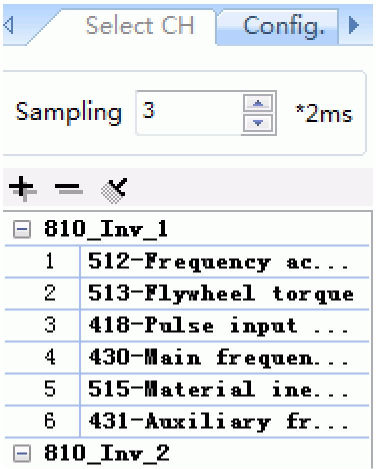
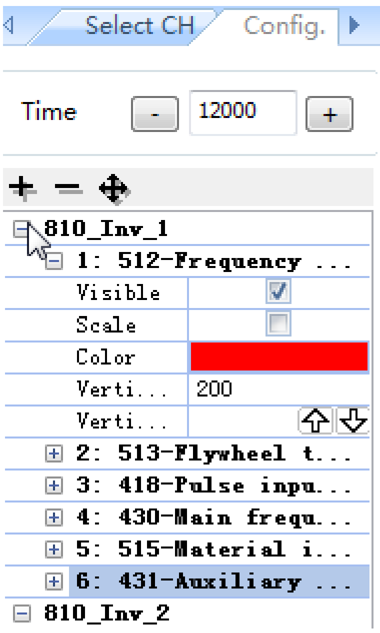
Type	Option	Icon	Function Description
Function buttons	Drive selection		Selects the drive corresponding to the display parameters.
	Parameter comparison		Selects the display parameter type from the drop-down list.
	Expand/Fold		Expands/Fold parameter No. to facilitate one-click operation.
	Reading/writing of the selected parameter		Reads/writes the modified value of the selected parameter No. to the device.
	Read/write all parameters		Reads/writes all parameter values of the selected drive.
	Import/export parameters		Imports the historical parameter file or exports the parameters in the drive to a file in .xls or .csv format.
	Export parameters of all drives		Exports the parameters of all connected drives to files in .xls or .csv format. Each drive has a parameter table.
Function area	Parameter display		Displays the parameter information of the device, including parameter No., name, current value, factory settings, value range, unit, modification method, and effective method.
	Colors		The current value of the parameter is different from the factory settings.
			The parameter values are modified, but not written into the drives.

3) Continuous oscilloscope

Double-click **Continue OSC** in the function view.



Type	Option	Icon	Function Description
Toolbar buttons	Open		Opens a historical data file (.csv).
	Save		Saves the current sampled data or waveform in .csv or .xls format.
	Screenshot		Saves the current sampling waveform in .bmp format.
	Zoom in		Zooms in the waveform in the specified area. To restore the waveform, right-click in the waveform area. This function conflicts with the drag function.
	Drag		Enables the horizontal/vertical cursor move function. This function conflicts with the zoom in function.
	Coordinate		Enables the coordinate prompt function of the sampling points. The prompt is displayed when the cursor is moved onto the waveform area, and hidden when the cursor is moved out.
	Curve name		Displays the curve name (channel name) in the waveform area or on the left of the waveform.
	Cursor		Displays the horizontal and vertical cursors (A and B) on the cursor window. You can set the distance between cursors. The cursor window shows the sampled point information of the channels corresponding to cursors A and B.
	Sampled point mark		Displays a dot for the sampled point on the waveform curve.
	Spectrum analysis		Converts time domain signals into frequency domain signals for spectrum analysis.

Type	Option	Icon	Function Description
Drawing area	Scaling area		The X axis (time) is displayed on the bottom. The Y axis is displayed on the side (depending on parameter settings).
	Waveform display area		Draws a curve for the sampled point.
Control button	Start		Starts continuous sampling.
	Stop		Stops continuous sampling.
Channel selection	Expand/ Fold/Clear all		Expands, folds, or clears the sampling channels of all modules by one click.
	Sampling interval		Sets the sampling interval. The value ranges from 1 to 100. Sampling interval = Sampling coefficient x 2 ms. The default sampling interval is 3. If you are prompted that the sampling interval is short, increase it.
	Channel selection		Selects sampling channels for each drive. A maximum of six channels can be selected for each drive.
Channel settings	Time axis		Sets the time length that can be represented by the X axis. The value ranges from 600 to 60000, in ms.
	Visibility		Sets whether the channel is visible.
	Scale		Sets whether to display the scale of Y axis.
	Color		Selects the colors of curves and scales from the drop-down list.
	Vertical scale		Selects a scale from the Y axis. The value ranges from 0.01 to 100000.
	Vertical moving		Moves the waveform upwards and downwards by clicking .

4.3.5 Example of Using Typical Software Functions

1) Copying Parameter Settings in Batches

To quickly synchronize the parameter settings among multiple drives, perform the following operations (in this example, the parameter settings on drive 2 and drive 3 are changed to be the same as those on drive 1):

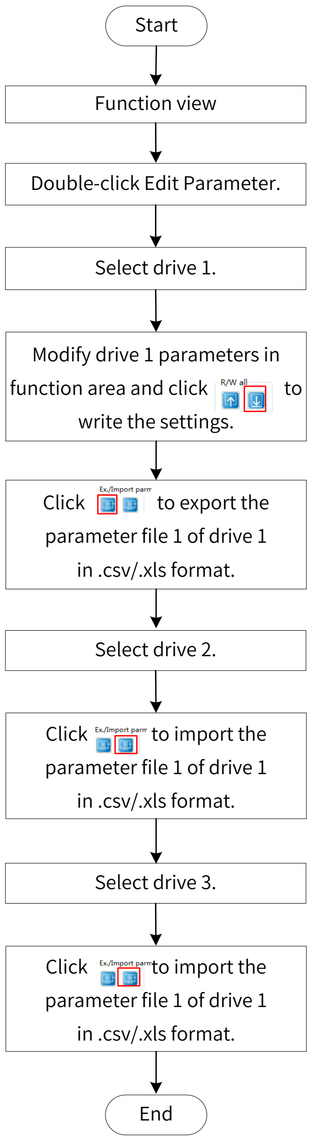


Figure 4-21 Batch copying of parameter settings

2) Downloading Parameter Settings in Batches

To quickly download the parameter settings from multiple drives, perform the following operations:

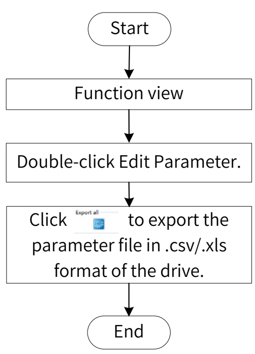


Figure 4-22 Batch downloading of parameter settings

NOTE

◆ The parameter files exported from drives are in the .csv or .xls format, and each drive has an independent file with the drive name as the file name.

3) Configuring the oscilloscope to Display the Waveforms of Multiple Drives by Parameters

To display the waveforms of multiple drives by parameters, as shown in Figure 4-24, perform the operations in Figure 4-23.

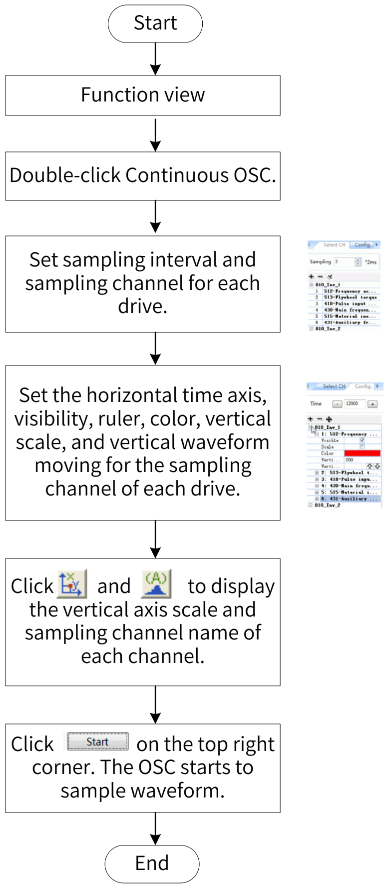


Figure 4-24 Procedure for displaying the waveforms of multiple drives by parameters

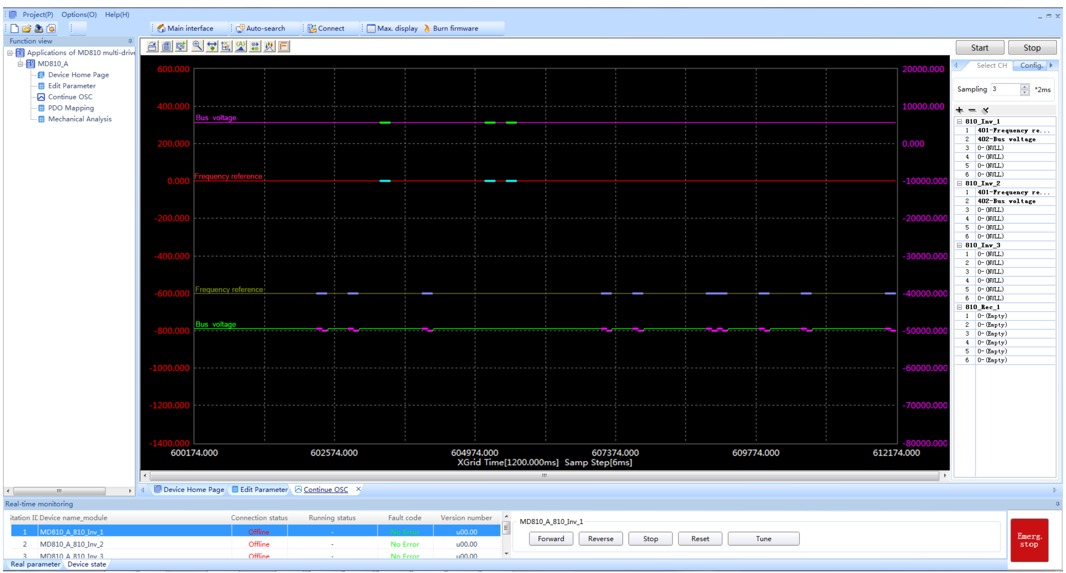


Figure 4-25 Oscilloscope display interface (displaying waveforms of multiple drives by parameters)

4) Checking the Abnormality at One Sampling Point

To check the abnormal waveform of a sampling channel on the oscilloscope display interface, perform the following operations:

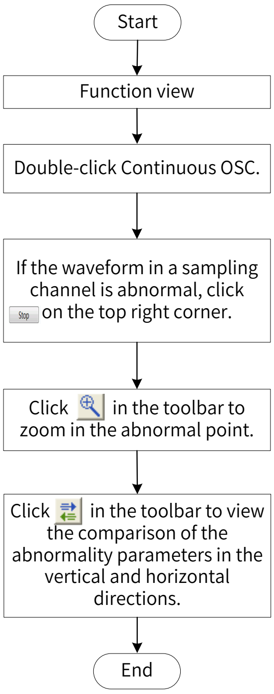


Figure 4-26 Checking the abnormality at one sampling point

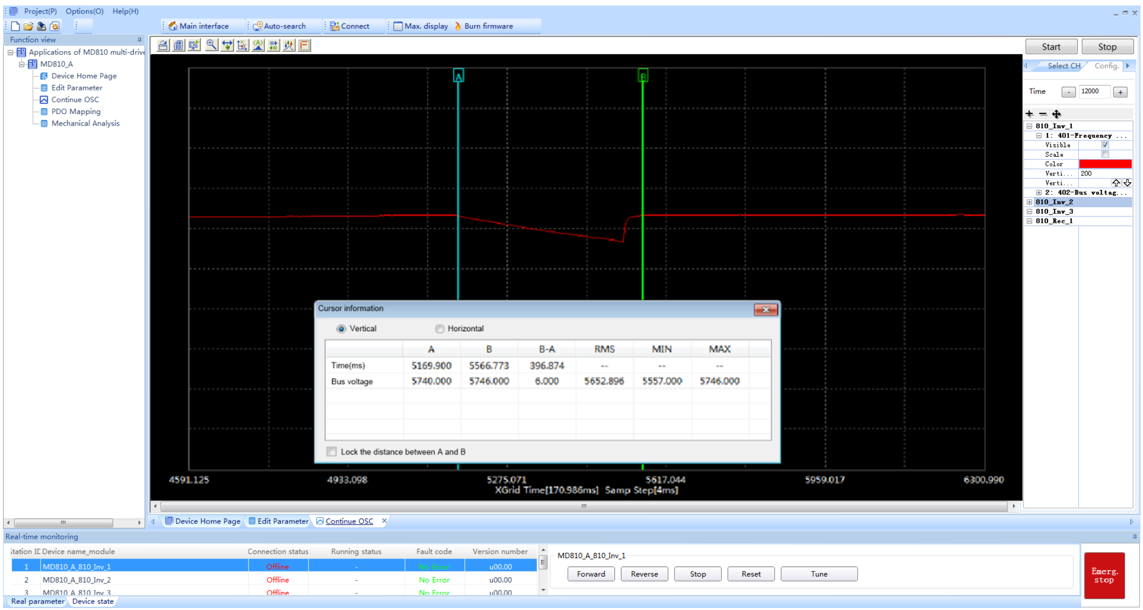


Figure 4-27 Abnormality analysis in the vertical axis

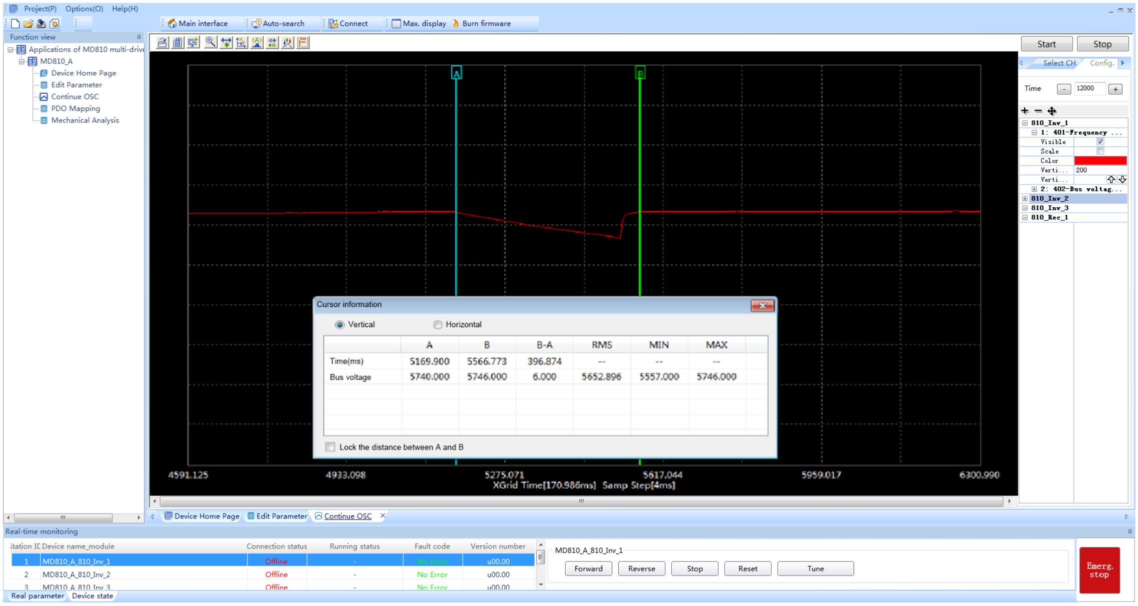


Figure 4-28 Abnormality analysis in the horizontal axis

5 Basic Operation and Trial Run

This chapter describes the basic commissioning procedure of the MD810 series drive unit, including the frequency reference settings and start/stop control. Following this chapter, you can implement trial running for the drive unit to control the motors.

5.1 Quick Commissioning

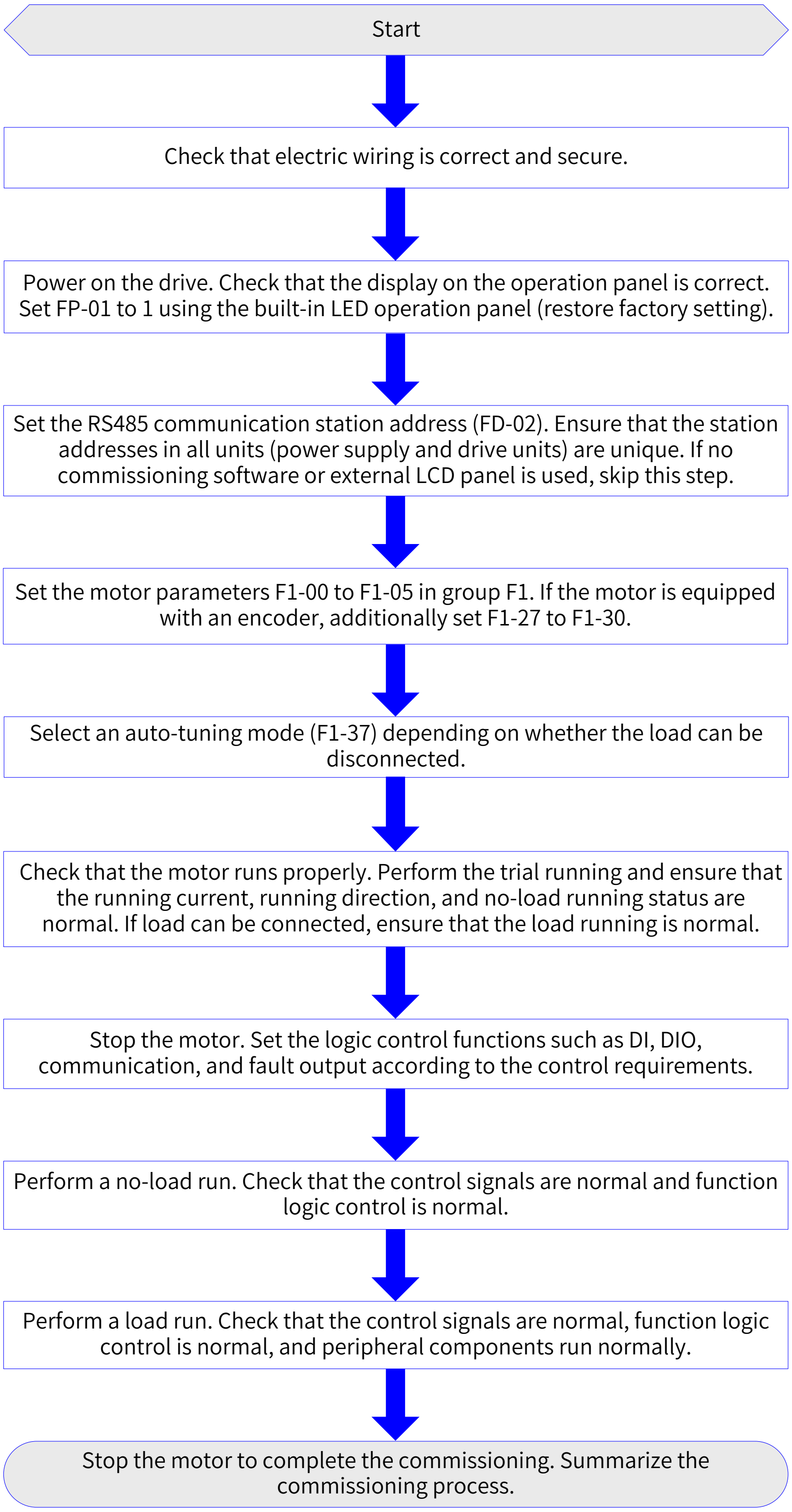


Figure 5-1 Quick commissioning procedure

5.2 Drive Commissioning Process

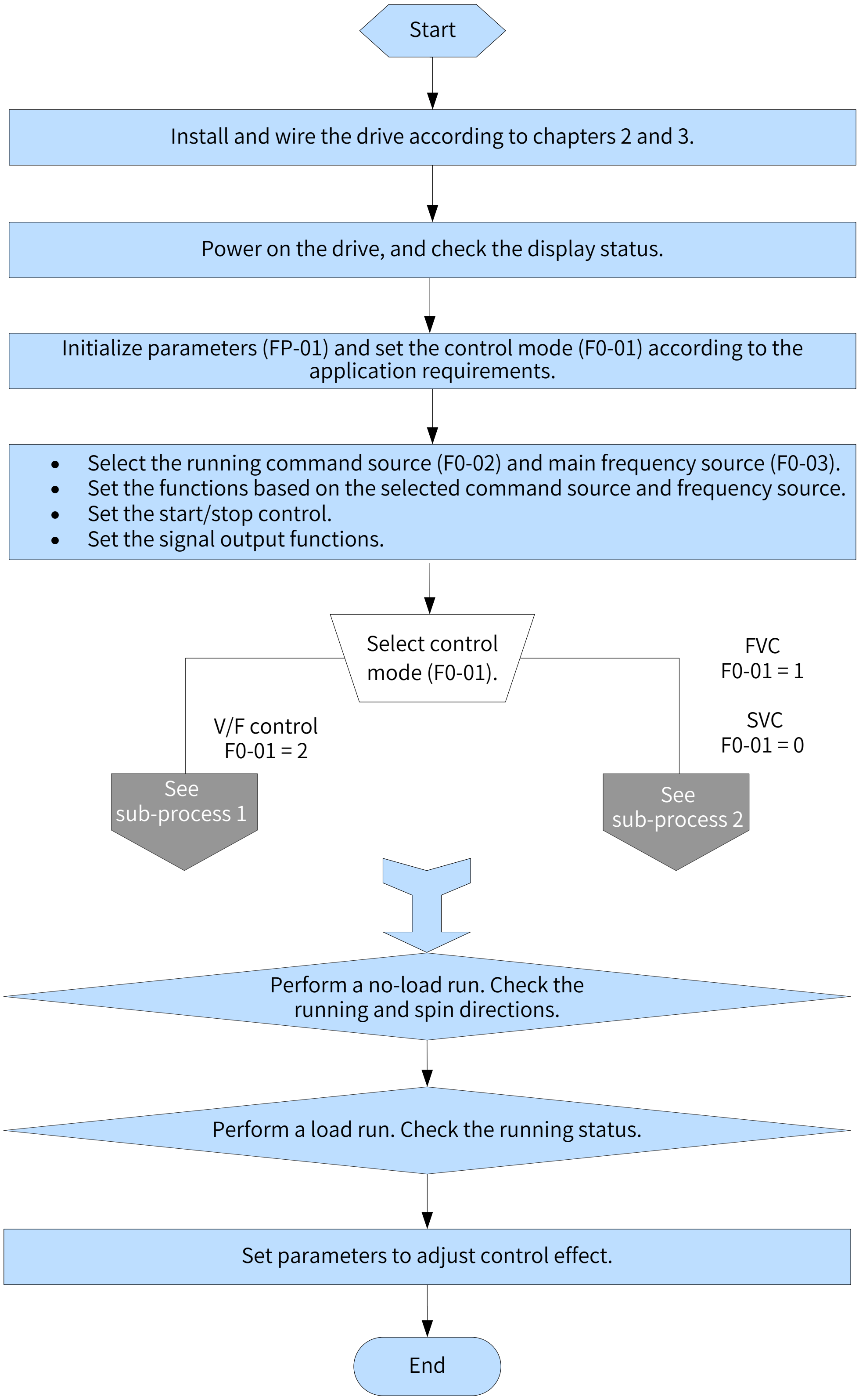


Figure 5-2 Drive commissioning process

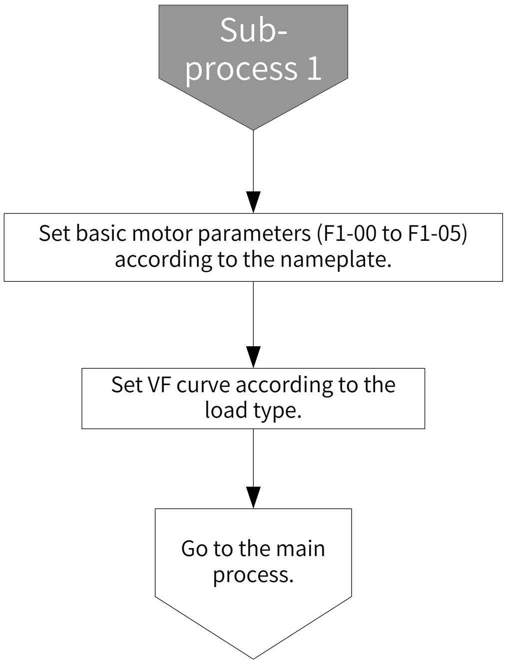


Figure 5-3 Drive commissioning sub-process 1 (V/F control)

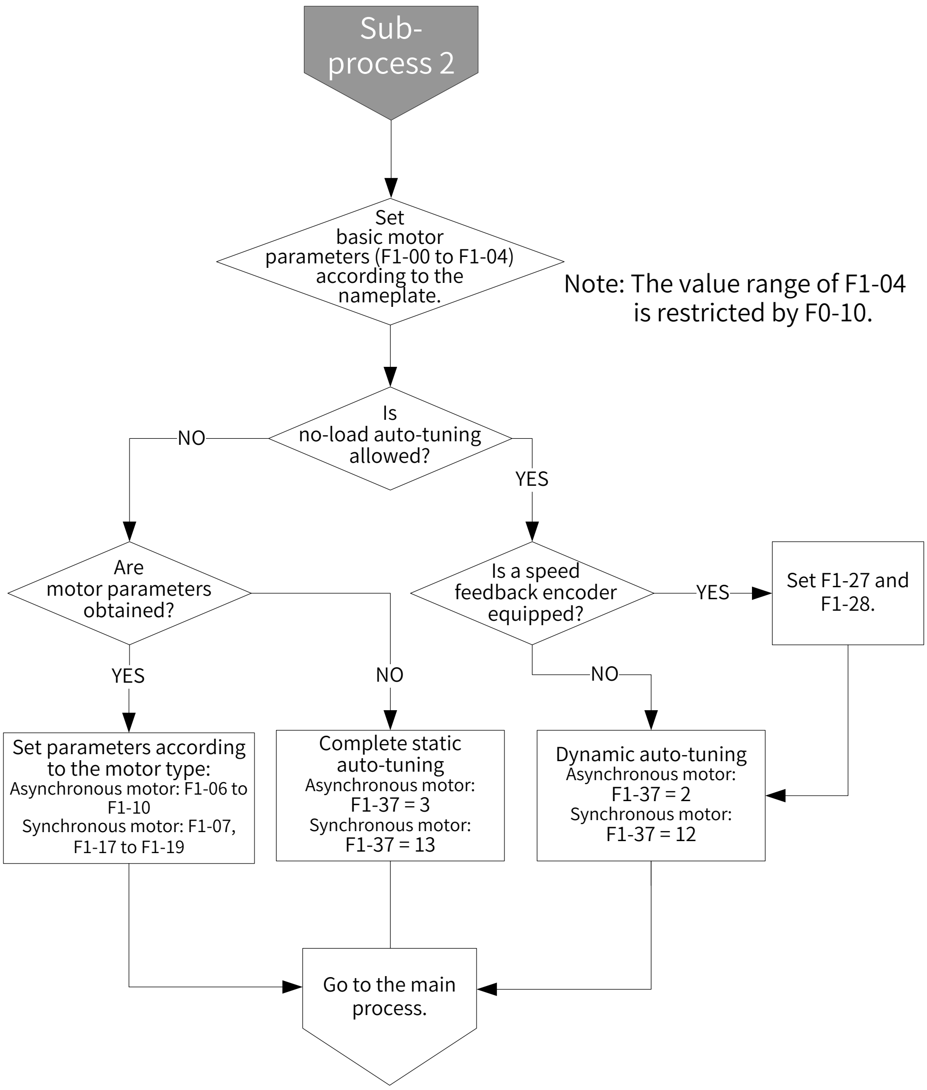


Figure 5-4 Drive commissioning sub-process 2 (vector control)

5.3 Precautions Before Power-on

Perform the following checks before powering on the device.

Item	Description
Check the power voltage.	The power voltage ranges from 380 VAC to 480 VAC 50/60 Hz (47–63 Hz).
	The power input terminals (R/S/T) are reliably connected.
	The drive and motor are properly grounded.
Check the connection between the drive output terminals and the motor terminals.	The drive output terminals (U/V/W) and motor terminals are properly connected.
Check the connection with the control circuit terminals of the drive.	The control circuit terminals of the drive are properly connected to other control devices.
Check the status of drive control terminals.	The control circuit terminals of the drive are in OFF state (the drive stops running).
Check the load.	The motor is running without load and is not connected to any mechanical system.

5.4 Status Display After Power-on

After power-on, the operating panel display in normal status is as follows.

Status	Display	Description
Normal	50.00	The factory setting 50.00 Hz is displayed.
Faulty	Err02	When a fault occurs, the drive stops and displays the fault type.
Warning	A16.13	If the drive fault is not promptly handled, a warning is triggered.

5.5 Parameter Initialization

You can restore the factory settings of the drive. After the initialization, FP-01 (Parameter initialization) is automatically set to 0 (No operation).

Parameter No.	Parameter Name	Setting Range	Default
FP-01	Parameter initialization	0: No operation 01: Restore factory parameters except motor parameters, encoder parameters, and F0-10 (Maximum frequency) 02: Clear records 04: Back up current user parameters 501: Restore backup user parameters 502: Restore to factory setting (except FD group and AF group parameters)	0

1: Restore to factory parameter mode 1

After FP-01 (Parameter initialization) is set to 1, most functional parameters of the drive are restored to the default settings, except the following parameters: motor parameters, F0-22 (Frequency reference resolution), F0-10 (Maximum frequency), fault records, F7-09 (Accumulative running time), F7-13 (Accumulative power-on time), F7-14 (Accumulative power consumption), and F7-07 (Heatsink temperature of IGBT).

2: Clear records

The cleared information includes the fault records, F7-09 (Accumulative running time), F7-13 (Accumulative power-on time), and F7-14 (Accumulative power consumption).

4: Back up current user parameters

This selection backs up the settings to all parameters, allowing to restore the parameters upon incorrect settings.

501: Recover backup user parameters

The previous backup parameters (backed up by setting FP-01 to 4) are restored.

5.6 Motor Control Mode Selection Basis

Parameter No.	Parameter Name	Description	Application
F0-01	1st motor control mode	0: Sensorless vector control (SVC)	This is an open-loop vector control applied to high-performance control scenarios. A drive can control only one motor. It is applicable to the loads such as machine tool, centrifuge, wire drawing machine, and injection molding machine.
		1: Feedback vector control (FVC)	This is a closed-loop vector control. The motor must be equipped with an encoder (MD810 supports ABZ incremental encoders and Weton's 23-bit absolute encoder). This mode is applicable to the scenarios requiring high-precision speed control and torque control. A drive can control only one motor. It is applicable to the loads such as high-speed paper machine, lifting machine, and elevator.
		2: Voltage/Frequency control (V/F control)	This mode is applicable to the scenarios where the load is light, such as cooling blowers or pumps. This mode is applicable to the scenarios where a drive controls multiple motors.

5.7 Frequency Reference Selection

Parameter No.	Parameter Name	Setting Range	Default
F0-03	Main frequency source selection	0: Digital setting (initial value F0-08 can be modified by keypad or terminal UP/DOWN, non-retentive at power failure) 1: Digital setting (initial value F0-08 can be modified by keypad or terminal UP/DOWN, retentive at power failure) 2: AI1 3: AI2 4: (Reserved) 5: Pulse reference (DIO1) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication setting 10: Synchronization control	0

5.7.1 LED Operating Panel Settings

Setting F0-03 (Main frequency source X selection) to 0: digital setting, non-retentive at power failure.

Set the initial frequency to F0-08 (Preset frequency). The preset frequency value can be changed by pressing ▲ and ▼ on the keypad (or using the multifunctional terminals UP/DOWN). After a power cycle, the frequency value is restored to F0-08 (Preset frequency).

Setting F0-03 (Main frequency source X selection) to 1: digital setting, retentive at power failure.

After a power cycle, the frequency is the frequency set before power-off. The frequency value set by using ▲ and ▼ on the keypad or terminals UP/DOWN is retained.

5.7.2 Analog Input

The MD810 control board provides two analog input terminals AI1 and AI2.

Table 5-1 AI feature description

<table>
<tr><th>Terminal</th><th>Name</th><th>Type</th><th>Input Range</th><th>Input Impedance</th></tr>
<tr><td>AI1-GND[1]</td><td>Control board AI terminal 1</td><td>Voltage input</td><td>DC -10 V to +10 V</td><td>22 kΩ</td></tr>
<tr><td rowspan="2">AI2-GND[1]</td><td rowspan="2">Control board AI terminal 2</td><td>Voltage input[2]</td><td>DC 0 V to 10 V</td><td>22 kΩ</td></tr>
<tr><td>Current input[2]</td><td>0 mA to 20 mA</td><td>500 Ω (F4-40 = 1)
250 Ω (F4-40 = 2)</td></tr>
</table>

[1] For the terminal wiring, see "3 Electrical Installation".

[2] Select the voltage or current input by setting F4-40 (AI2 input type).

Table 5-2 Configuration procedure for setting AI as frequency reference

<table>
<tr><th>Procedure</th><th>Parameter</th><th colspan="2">Description</th></tr>
<tr><td rowspan="2">AI terminal selection: Select an AI terminal as the source of frequency reference based on terminal features.</td><td rowspan="2">F0-03 (Main frequency source X selection)</td><td>F0-03 = 2</td><td>AI1 as the source</td></tr>
<tr><td>F0-03 = 3</td><td>AI2 as the source</td></tr>
<tr><td>AI voltage[1] and frequency curve selection: select one from the five curves</td><td>F4-33 (AI curve selection)</td><td colspan="2">Generally, retain the default value 321 for F4-33, indicating curve 1 for AI1 and curve 2 for AI2.</td></tr>
<tr><td rowspan="6">Mapping curve of AI voltage[1] and frequency:
Set the mappings between voltage inputs on the AI terminals and the preset values.</td><td>F4-13 (AI curve 1 minimum input) to F4-16 (Corresponding percentage of AI curve 1 maximum input) [2]</td><td>Setting of curve 1</td><td>Typical setting curve[3]</td></tr>
<tr><td>F4-18 (AI curve 2 minimum input) to F4-21 (Corresponding percentage of AI curve 2 maximum input)</td><td>Setting of curve 2</td><td>Typical setting curve[4]</td></tr>
<tr><td>A6-00 (AI curve 4 minimum input) to A6-07 (Corresponding percentage of AI curve 4 maximum input)</td><td>Setting of curve 4</td><td rowspan="2">-</td></tr>
<tr><td>A6-08 (AI curve 5 minimum input) to A6-15 (Corresponding percentage of AI curve 5 maximum input)</td><td>Setting of curve 5</td></tr>
<tr><td>F4-34 (Setting for AI less than minimum input)</td><td colspan="2">Setting for AI less than the minimum input[2]</td></tr>
<tr><td>F0-10 (Maximum frequency)</td><td colspan="2">When an AI terminal is used as the main frequency source, the 100% of the voltage/current input is F0-10 (Maximum frequency).</td></tr>
<tr><td>AI filter time</td><td>F4-17 (AI1 filter time)</td><td colspan="2">The default value is 0.1s. This parameter is set by evaluating the response speed requirement and onsite signal interference. If quick response is required, reduce the parameter value. If the onsite interference is high, increase the parameter value.</td></tr>
</table>

[1] When the current AI curve is set, 1 mA is equivalent to 0.5 V voltage, that is 20 mA is equivalent to 10 V.

[2] When the AI voltage is higher than F4-15 (AI curve 1 maximum input), the analog voltage is calculated by the maximum input. Similarly, when the AI voltage is lower than F4-13 (AI curve 1 minimum input), the analog voltage is calculated by F4-34 (Setting for AI less than minimum input) or 0.0%.

[3] The typical curve of AI1 is as follows:

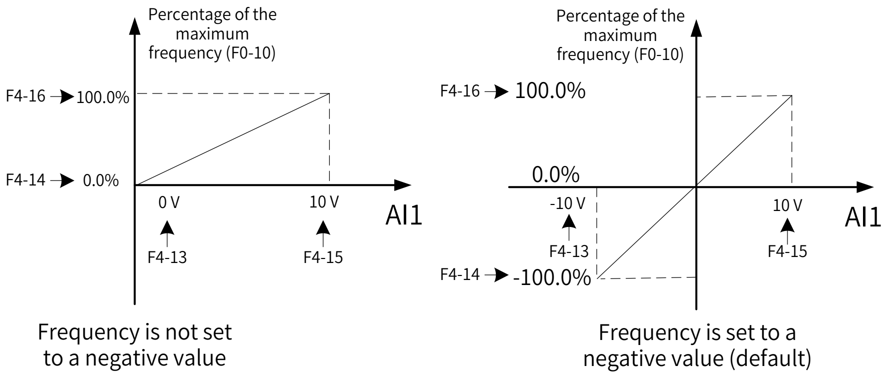


Figure 5-5 Typical curve of AI1

[4] When AI2 is used as voltage input, the typical curve is the same as that of AI1. When AI2 is used as current input, set 4 to 20 mA to match 0 to 50 Hz or -50 to +50 Hz.

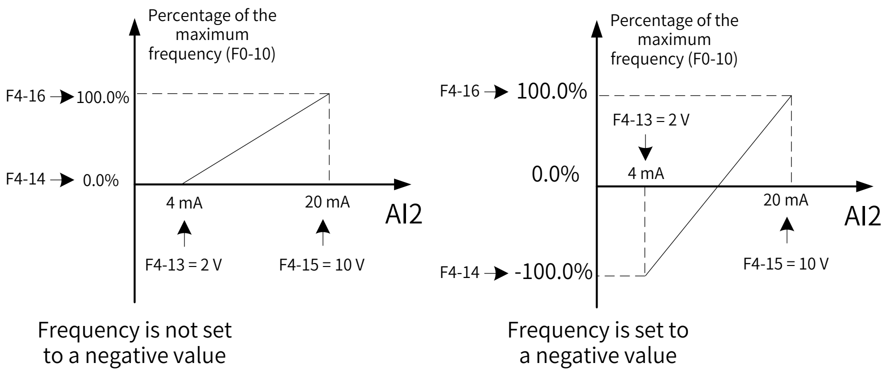


Figure 5-6 Typical curve of AI2

5.7.3 Digital Pulse Input

Frequency is set by the high-speed pulse of terminal DIO1.

The pulse reference signal specifications are: voltage of 9 V to 30 V and frequency of 0 kHz to 100 kHz.

Table 5-3 Procedure for using digital pulse input (DIO1) as frequency reference

Procedure	Parameter	Description
Select digital pulse input (DIO1) as frequency reference.	F0-03 (Main frequency source X selection) F4-03 (DIO1 function selection)	Set the ones position of F4-41 (DIO terminal type) to 0 to set DIO1 as input (default). Set F0-03 (Main frequency source X selection) to 5. That is, set the main frequency reference to pulse setting (DIO1).
Set the mapping curve for the pulse frequency and the set frequency.	F4-28 (Pulse minimum input) to F4-31 (Corresponding percentage of pulse maximum input)	Typical setting curve[1]
	F0-10 (Maximum frequency)	When the digital pulse is used as the frequency source, the 100% of the value corresponds to F0-10 (Maximum frequency).
Set the filter time of the set frequency.	F4-32 (Pulse filter time)	Set the filter time of the set frequency.

[1] The following figure shows the typical curve when the digital pulse input is used as frequency reference:

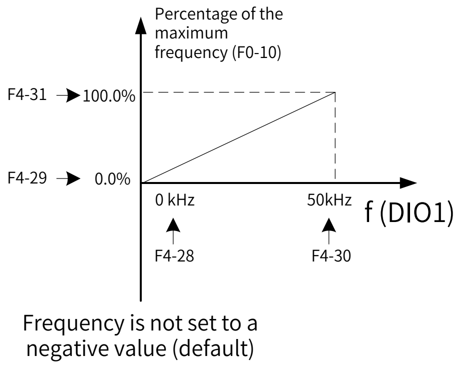


Figure 5-7 DIO1 used as frequency reference

5.7.4 Main Frequency Communication Settings

MD810 supports four methods to communicate with the host controller: Modbus, PROFIBUS-DP, CANopen, and CANlink. You can configure main frequency communication by setting F0-03 (Main frequency source X selection), as listed in the following table.

Procedure	Parameter	Description
Set the frequency reference setting channel to communication setting.	F0-03	F0-03 = 9

5.7.5 Multi-reference

When multi-reference is configured, you can set different frequency values by flexibly combining DI terminal status.

Table 5-4 Configuration procedure for multi-reference as frequency reference

Procedure	Parameter	Description	
Select multi-reference as the frequency reference.	F0-03 (Main frequency source X selection)	F0-03 = 6 (Multi-reference)	
Set the number of references.	None	A maximum of 16 references are supported, with four DI terminals. The mappings between the numbers of references and DI terminals are as follows: 2 references: one DI terminal K1 3 to 4 references: two DI terminals K1 and K2 5 to 8 references: three DI terminals K1, K2, and K3 9 to 16 references: four DI terminals K1, K2, K3, and K4	
Set the multi-reference function for DI terminals.	F4-00 (DI1 function selection) to F4-04 (DIO2 function selection)	Multi-reference terminal K1	Value: 12
		Multi-reference terminal K2	Value: 13
		Multi-reference terminal K3	Value: 14
		Multi-reference terminal K4	Value: 15
Set the frequency for each reference[1]	FC-00 (Reference 0) to FC-15 (Reference 15)	Set the frequency for each reference, in percentage. 100% corresponds to F0-10 (Maximum frequency).	
	F0-10 (Maximum frequency)	When frequency reference is set to multi-reference, 100% of the parameters FC-00 (Reference 0) to FC-15 (Reference 15) corresponds to F0-10 (Maximum frequency).	

[1] The four multi-reference terminals have 16 state combinations, representing 16 frequency reference values, as listed in the following table.

Table 5-5 Combinations of multi-reference terminals

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

5.8 Start and Stop Commands

Parameter No.	Parameter Name	Setting Range	Default
F0-02	Command source selection	0: External LCD panel/Commissioning software 1: Terminal I/O control The running is implemented by the FWD, REV, JOGF, and JOGR functions of the multi-function input terminal. 2: Communication control	0

Select an input channel for the drive control commands. The control commands of the drive include the start, stop, forward run, reverse run, and jog commands.

5.8.1 Start/Stop by External LCD Operating Panel/Commissioning Software

Use the RUN or STOP/RES key on the operating panel, or the start/stop button of the software tool.

5.8.2 Start/Stop by Terminals

Parameter No.	Parameter Name	Setting Range		Default
F4-11	Terminal I/O control mode	0: Two-wire mode 1 1: Two-wire mode 2	2: Three-wire mode 1 3: Three-wire mode 2	0

These parameters define the four modes to control the drive operation with external terminals (DIs), including DI1, DI2, DIO1, and DIO2. In the following contents, only DI1, DI2, and DIO1 are used for brief description. That is, set the values of F4-00 (DI1 function selection), F4-01 (DI2 function selection) and F4-03 (DIO1 function selection) to select the functions of the DI1, DI2, and DIO1 terminals. For details about function definition, see the description of F4-00 (DI1 function selection) to F4-03 (DIO1 function selection).

0 (Two-wire mode 1): This is the most commonly used two-wire mode. The DI1 and DI2 terminals determine the running direction of the motor.

The following table describes the parameter settings.

Parameter No.	Parameter Name	Value	Function Description
F4-11	Terminal I/O control mode	0	Two-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 terminal function selection	2	Reverse run (REV)

K1	K2	Running Command
1	0	Forward
0	1	Reverse
1	1	Stop
0	0	Stop

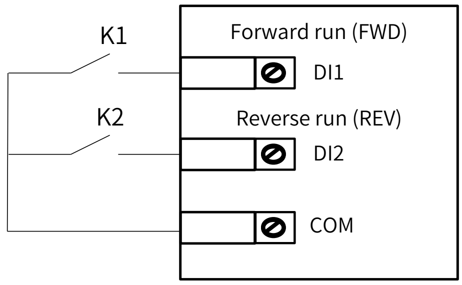


Figure 5-8 Two-wire mode 1

As shown in the previous figure, when K1 is closed, the drive runs in forward direction. When K2 is closed, the drive runs in reverse direction. When K1 and K2 are closed or open simultaneously, the drive stops running.

1 (two-wire mode 2): In this mode, DI1 controls running, and DI2 controls the running direction.

The following table describes the parameter settings.

Parameter No.	Parameter Name	Value	Function Description
F4-11	Terminal I/O control mode	1	Two-wire mode 2
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 terminal function selection	2	Reverse run (REV)

K1	K2	Running Command
1	0	Forward
1	1	Reverse
0	0	Stop
0	1	Stop

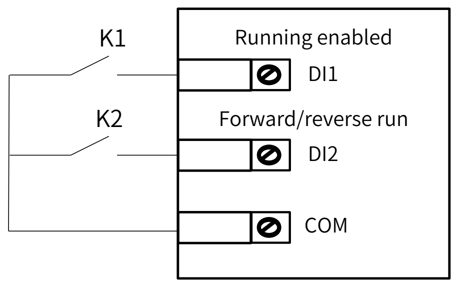


Figure 5-9 Two-wire mode 2

As shown in the figure, when K1 is closed and K2 is open, the drive runs in forward mode. When both K1 and K2 are closed, the drive runs in reverse mode. When K1 is open, the drive stops running.

2 (three-wire mode 1): In this mode, DIO1 is the enable terminal, and the direction is controlled by DI1 and DI2.

The following table describes the parameter settings.

Parameter No.	Parameter Name	Value	Function Description
F4-11	Terminal I/O control mode	2	Three-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 terminal function selection	2	Reverse run (REV)
F4-03	DIO1 function selection	3	Three-wire control

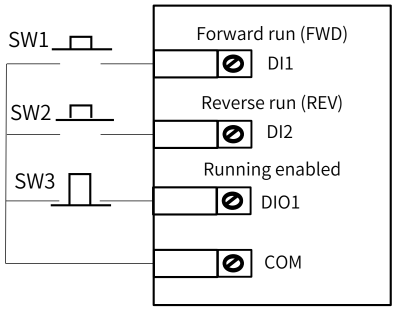


Figure 5-10 Three-wire control mode 1

As shown in the figure, when SW3 is closed, pressing SW1 makes the drive run in forward direction and pressing SW2 makes the drive run in reverse direction. The drive stops immediately after SW3 is open. SW3 must be kept closed when the drive has started and is running normally. The commands of SW1 and SW2 take effect immediately when SW3 is closed. The drive running status is determined by the last operation on the three buttons.

3 (three-wire mode 2): In this mode, DIO1 is the enable terminal, DI1 issues the running command, and DI2 determines the running direction.

The following table describes the parameter settings.

Parameter No.	Parameter Name	Value	Function Description
F4-11	Terminal I/O control mode	3	Three-wire mode 2
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 terminal function selection	2	Reverse run (REV)
F4-03	DIO1 function selection	3	Three-wire control

K	Running direction
0	Forward
1	Reserve

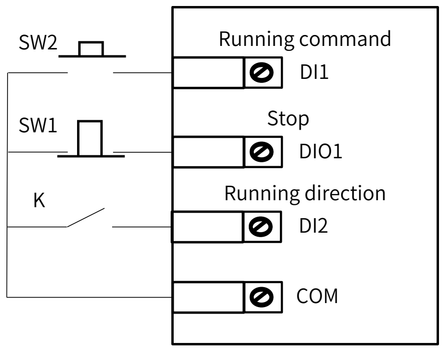


Figure 5-11 Three-wire control mode 2

As shown in the figure, when SW1 is closed, pressing SW2 makes the drive run and pressing SW1 makes the drive stop immediately. When K is open, the drive runs in forward direction. When K is closed, the drive runs in reverse direction. SW1 must be kept closed when the drive has started and is running normally. The commands of SW2 take effect immediately when SW1 is closed.

5.8.3 Start/Stop by Communication

The host controller issues running commands by communication, which can be set as required.

Procedure	Parameter No.	Description	
Set the frequency reference setting channel to communication setting.	F0-02	F0-02 = 2	
Select a communication method.	Fd-10	CANopen communication	Fd-10 = 1
		CANlink communication	Fd-10 = 2
PROFIBUS-DP and Modbus are always effective, so it is not required to set them.			

5.9 Start Procedure Settings

5.9.1 Start Mode Selection

Parameter No.	Parameter Name	Range	Default
F6-00	Start mode	0: Direct startup 1: Flying start (asynchronous motor) 2: Vector pre-excitation startup (asynchronous motor)	0

0: Direct startup

If the startup DC injection braking time is set to 0, the drive starts running at the start frequency. If the startup DC injection braking time is not 0, DC injection braking is performed, and then the drive starts running at the start frequency.

This mode is applicable to the small inertia loads. The frequency curve during the start process is as follows. The DC injection braking function is applicable to the drive with loads such as elevators and lifting machines. The start frequency is suitable for the drive requiring a starting torque, for example, a cement mixer.

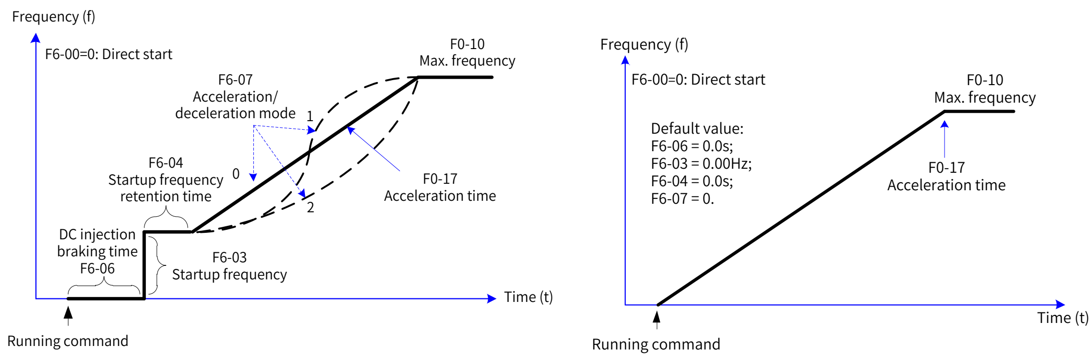


Figure 5-12 Direct startup

1: Flying start

This mode is suitable for the drive with large inertia loads. The frequency curve during the start process is as follows. If the motor is still running by inertia, the drive catches the running speed first, and then starts. This avoids overcurrent upon startup.

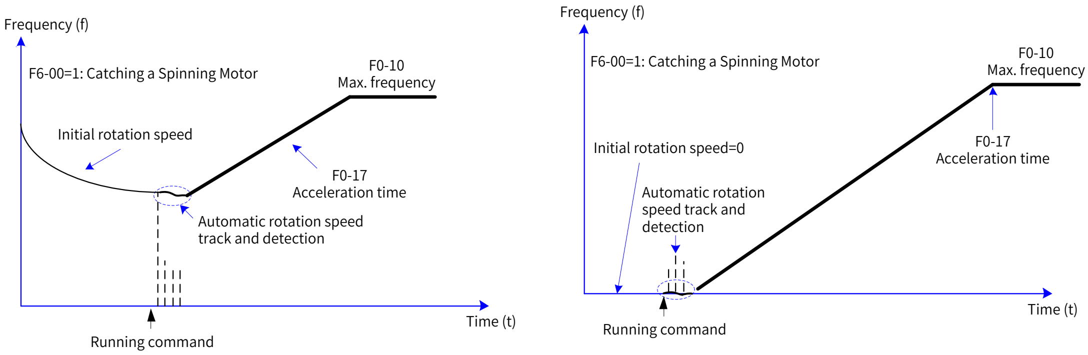


Figure 5-13 Flying start

2: Vector pre-excitation startup

This mode is applicable only to the loads of induction asynchronous motor (vector pre-excitation takes effect only in SVC or FVC mode). Performing vector pre-excitation before startup improves the response speed of the asynchronous motor, which is applicable to the applications requiring fast acceleration.

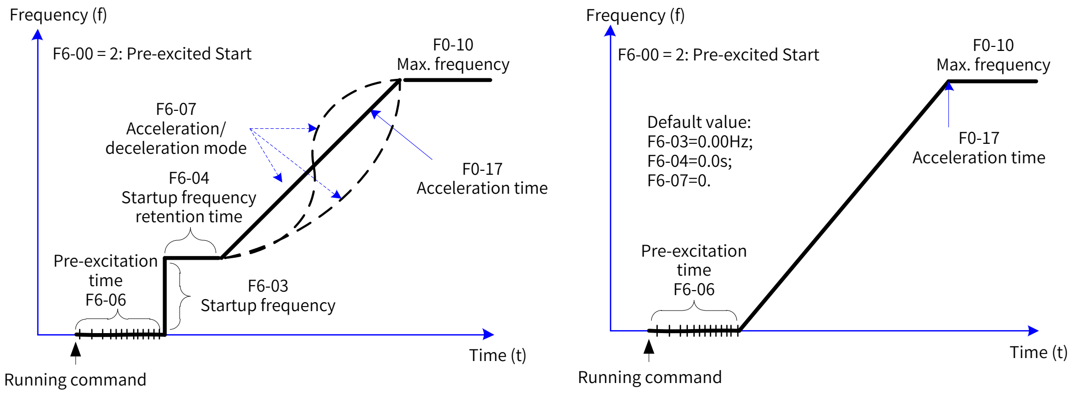


Figure 5-14 Vector pre-excitation startup

5.9.2 Startup Frequency

Parameter No.	Parameter Name	Setting Range	Default
F6-03	Startup frequency	0.00 Hz to 10.00 Hz	0.00 Hz
F6-04	Startup frequency active time	0.0s to 100.0s	0.0s

To retain the motor torque upon startup, set an appropriate startup frequency. The startup frequency must be kept for a period of time so that the flux can be set up during motor startup.

F6-03 (Startup frequency) is not restricted by the lower limit of frequency. However, when the target frequency is lower than the startup frequency, the drive runs at the startup frequency.

The startup frequency active time is not included in the acceleration time but is included in the simple PLC running time.

5.10 Stop Process Settings

The drive supports two stop modes: decelerate to stop and coast to stop, which is selected by setting F6-10 (Stop mode). You can set whether to use DC braking during the shutdown segment.

5.10.1 Stop Mode Selection

Parameter No.	Parameter Name	Setting Range	Default
F6-10	Stop mode	0: Decelerate to stop 1: Coast to stop	0

0: Decelerate to stop

After the STOP command takes effect, the drive reduces the output frequency based on the deceleration time, and the motor stops when the output frequency drops to 0.

1: Coast to stop

After the STOP command takes effect, the drive stops output immediately. Then, the motor and load coasts to stop following mechanical inertia.

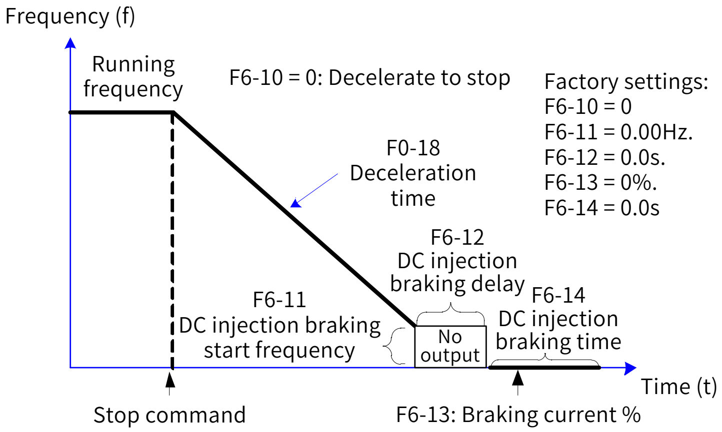


Figure 5-15 Decelerate to stop

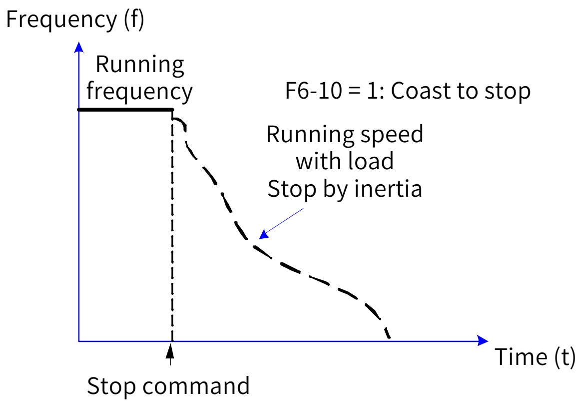


Figure 5-16 Coast to stop

5.10.2 DC Injection Braking

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F6-11	Shutdown DC injection braking/Position lock start frequency	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	During a decelerate-to-stop process, the drive starts DC injection braking when the running frequency drops to this frequency.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F6-12	Shutdown DC injection braking delay time	0.0s	0.0s to 100.0s	When the running frequency drops to the DC injection braking start frequency, the drive stops output for a certain period, and then starts DC injection braking. If DC injection braking is performed at a high speed, a fault such as overcurrent may occur.
F6-13	Shutdown DC injection braking current	0%	0% to 100%	The shutdown DC injection braking current is set as follows: 1) The shutdown DC injection braking current is set to a proportion to the rated motor current. The maximum current cannot exceed 80% of the rated drive current. 2) When the motor control mode is set to FVC, the shutdown DC injection braking does not take effect. When the torque does not reach the maximum, the motor runs at 0 Hz.
F6-14	Shutdown DC injection braking active time	0.0s	0.0s to 100.0s	DC injection braking holding time. When this value is 0, the DC injection braking process is canceled.

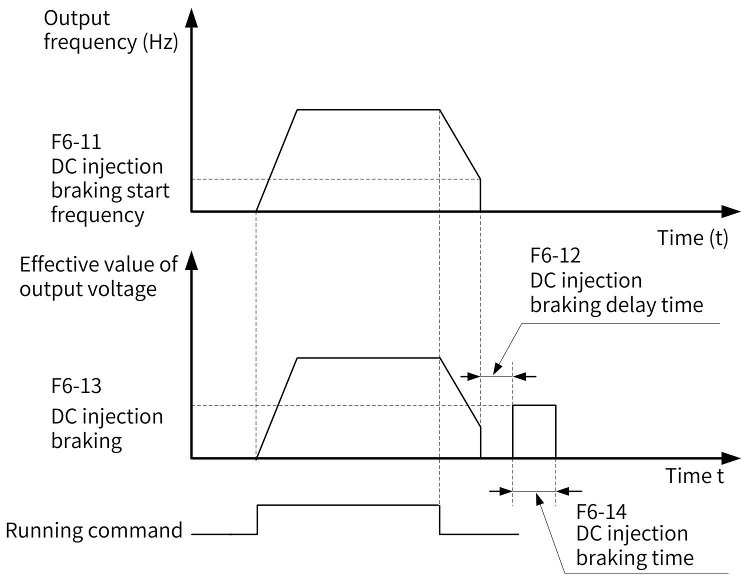


Figure 5-17 DC injection braking process

5.11 Acceleration/Deceleration Time Settings

Parameter No.	Parameter Name	Setting Range	Default
F0-17	Acceleration time 1	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	Model dependent
F0-18	Deceleration time 1	0.00s to 650.00s (F0-19 = 2) 0.0s to 6500.0s (F0-19 = 1) 0s to 65000s (F0-19 = 0)	Model dependent
F0-25	Acceleration/Deceleration time base frequency	0: Maximum frequency (F0-10) 1: Frequency reference 2: 100 Hz	0

The acceleration time is the time that a drive spends to accelerate from zero frequency to F0-25

(Acceleration/Deceleration time base frequency), that is, t1 in Figure 5-18.

The deceleration time is the time that a drive spends to decelerate from F0-25 (Acceleration/Deceleration time base frequency) to zero frequency, that is, t2 in Figure 5-18.

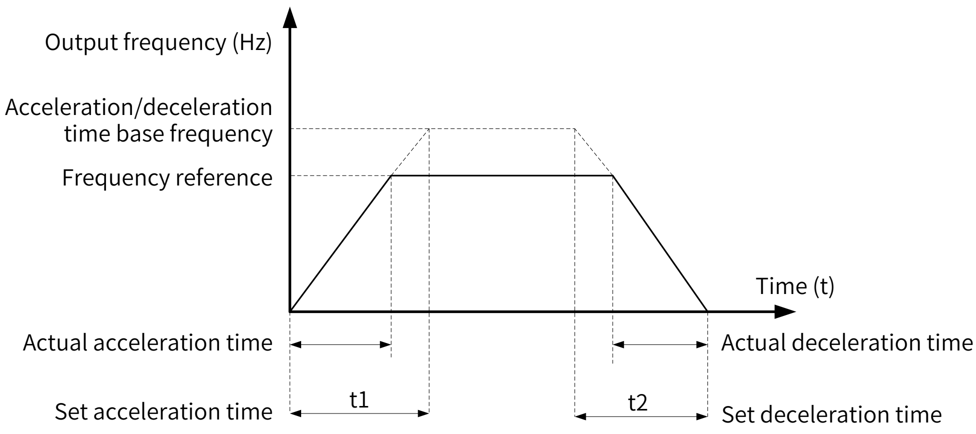


Figure 5-18 Acceleration/Deceleration time

MD810 provides four groups of acceleration/deceleration time, which can be selected using DI terminals (terminal functions 16 and 17). The four groups of time is set by the following parameters:

Group 1: F0-17 (Acceleration time 1, default), F0-18 (Deceleration time 1, default); Group 2: F8-03 (Acceleration time 2) and F8-04 (Deceleration time 2); group 3: F8-05 (Acceleration time 3) and F8-06 (Deceleration time 3); group 4: F8-07 (Acceleration time 4) and F8-08 (Deceleration time 4)

Parameter No.	Parameter Name	Setting Range	Default
F0-19	Acceleration/Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	1

To meet field requirements, MD810 provides three acceleration/deceleration time units: 1s, 0.1s, and 0.01s.

NOTE

◆ Note that when the parameters are modified, the decimal places in the four groups of acceleration/deceleration time will change.

5.12 Running Status Check

5.12.1 Digital Outputs (DOs)

The control board provides three digital outputs: DIO1, DIO2, and TA/TB/TC. DIO1 and DIO2 are transistor output channels that drive the 24 V DC signal circuit, and TA/TB/TC is the relay output that drives 250 V AC circuit.

To configure DIO1 and DIO2 as DOs, set F4-41 (DIO terminal type).

The values of F5-01 (FMR output function selection) to F5-04 (DO1 function selection) define a function for each DO, among 40 functions that indicate working status and alarms for the drive, which meets automatic control requirements of customers.

Port Name	Parameter	Output Feature Description
DIO1-COM	The ones position of F5-04 (DO1 function selection) and F4-41 (DIO terminal type) is 1 (DO).	Transistor. Drive capability: 24 VDC, 50 mA
DIO2-COM	When F5-00 (DIO2 terminal output mode) is set to 0 [Pulse output (FMP)], the tens positions of F5-06 (FMP output function selection) and F4-41 (DIO terminal type) are 1 (DO/FMP).	Transistor that outputs high frequency pulse 10 Hz to 100 kHz. Drive capability: 24 VDC, 50 mA
	When F5-00 (DIO2 terminal output mode) is set to 1, the tens positions of F5-01 (FMR output function selection) and F4-41 (DIO terminal type) are 1 (DO/FMP).	Transistor. Drive capability: 24 VDC, 50 mA
TA/TB/TC	F5-02 (Relay function selection)	Relay. Drive capability: 24 VDC, 3 A

When F5-00 (DIO2 terminal output mode) is set to 0 [Pulse output (FMP)], DIO2 works in high-speed pulse output mode. The output pulse frequency indicates the internal running parameter values. When the value is large, the output pulse frequency is high. When the value is 100%, the output pulse frequency is the maximum FMP output frequency set by F5-09 (Maximum FMP output frequency). The internal parameter attributes are defined by using F5-06 (FMP output function selection).

5.12.2 Analog Output (AO)

The drive supports one analog output (AO). AO indicates internal running parameters by using the an analog signal. The parameter attributes are defined by using F5-10 (AO1 zero offset coefficient) and F5-11 (AO1 gain).

Port	Input Signal Feature	
AO-GND	F5-23 = 0: voltage output	F5-23 = 1: current output

Parameter No.	Parameter Name	Setting Range	Default
F5-10	AO zero offset coefficient	-100.0% to +100.0%	0.0%
F5-11	AO1 gain	-10.00 to +10.00	1.00

The preceding parameters are used to define the AO curve as required.

If b indicates zero offset, k indicates gain, and X indicates standard output, then the actual output Y is (kX+b).

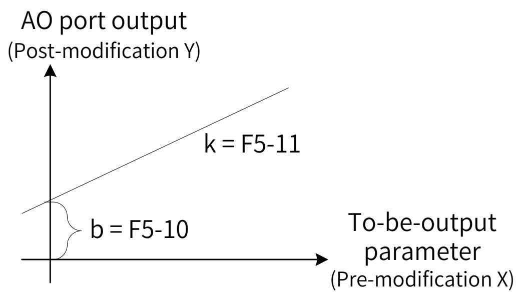


Figure 5-19 AO signal modified performance curve

The 100% of AO zero offset coefficient corresponds to 10 V (or 20 mA). Standard output indicates the analog output quantity corresponding to 0 V to 10 V (or 0 mA to 20 mA) output when there is no zero offset or gain modification.

For example, if the analog output is running frequency, and you need the modified output to be 8 V when frequency is 0 Hz and the modified output to be 4 V when frequency is 40 Hz, then set F5-11 (AO1 gain) to -0.5 and F5-10 (AO zero offset coefficient) to 80%.

5.13 Motor Auto-tuning

5.13.1 Auto-tuning Method

The drive obtains internal electric parameters of the controlled motor in the following ways: dynamic auto-tuning, static auto-tuning 1, static auto-tuning 2, and manual parameter input.

Auto-tuning Method	Applicable Scenario	Effect
Dynamic no-load auto-tuning F1-37 (Auto-tuning selection) = 2 (Asynchronous motor complete auto-tuning)	The motor can easily be separated from the application system.	Best
Dynamic load auto-tuning F1-37 (Auto-tuning selection) = 2 (Asynchronous motor complete auto-tuning)	It is difficult to separate the motor from the application system, but the motor can run with the load. The load has a small force of friction, which is close to the no-load friction in constant speed running.	The smaller the force of friction is, the better the effect is.
Static auto-tuning 1 F1-37 (Auto-tuning selection) = 1 (Asynchronous motor static auto-tuning)	It is difficult to separate the motor from the load, and dynamic auto-tuning is not allowed.	Moderate
Static auto-tuning 2 F1-37 (Auto-tuning selection) = 3 (Asynchronous motor static complete auto-tuning)	It is difficult to separate the motor from the load, and dynamic auto-tuning is not allowed. This mode is recommended for static auto-tuning. The auto-tuning time in this mode is longer than that in static auto-tuning 1.	Better
Manual parameter input	It is difficult to separate the motor from the application system. You need to copy the parameters of another motor of the same type, which are successfully tuned by the drive, to parameters F1-00 (Motor type selection) to F1-10 (Asynchronous motor no-load current).	Better

NOTE

◆ The auto-tuning of an asynchronous motor is used as an example in the preceding table. To tune a synchronous motor, select an auto-tuning mode by setting F1-37 (Auto-tuning selection) to 11 [Synchronous motor no-load partial auto-tuning (back EMF exclusive)], 12 (Synchronous motor dynamic no-load auto-tuning), or 13 (Synchronous motor static complete auto-tuning).

5.13.2 Auto-tuning Procedure

This section describes the auto-tuning for the default motor 1. The auto-tuning method for motor 2 is the same except that the parameter numbers need to be modified.

Step 1: If the motor can be separated from the load, separate the motor from the load mechanically after power-off, making the motor run without load.

Step 2: Power on the drive and set F0-02 (Command source selection) to 0.

Step 3: Enter the accurate parameters (for example, F1-00 to F1-05) on the motor nameplate. Set the following parameters for the motor:

Motor	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 rotation speed

If an encoder is equipped, enter the encoder parameters (F1-27, F1-28, and F1-30).

Step 4: For an asynchronous motor, set F1-37 (Auto-tuning selection) to 2 (Asynchronous motor complete auto-tuning). For a synchronous motor, set F1-37 (Auto-tuning selection) to 12 (Synchronous motor dynamic no-load auto-tuning). Press **Enter** to confirm. Then the panel displays TUNE, as shown below:

The drive controls the acceleration and deceleration of the motor, and the run indicator is on. After a 2-minute auto-tuning process, the preceding display disappears and parameter setting is displayed, indicating that the auto-tuning is complete.

After the complete auto-tuning of an asynchronous motor is finished, the drive automatically computes the following motor parameters:

Motor	Parameter	
Motor 1	F1-06: Asynchronous/Synchronous motor stator resistance F1-07: Asynchronous motor rotor resistance F1-08: Asynchronous motor leakage inductive reactance	F1-09: Asynchronous motor mutual inductive reactance F1-10: Asynchronous motor no-load current

After the complete auto-tuning of a synchronous motor is finished, the drive automatically computes the following motor parameters:

Motor	Parameter	
Motor 1	F1-06: Asynchronous/Synchronous motor stator resistance F1-17: Synchronous motor axis D inductance	F1-18: Synchronous motor axis Q inductance F1-19: Synchronous motor back EMF

If the motor cannot be separated from load, set F1-37 (Auto-tuning selection) to 3 (Asynchronous motor static complete auto-tuning). For a synchronous motor, set F1-37 (Auto-tuning selection) to 13 (Synchronous motor static complete auto-tuning). Then start motor parameter auto-tuning.

5.13.3 Auto-tuning Procedure on LED Operating Panel

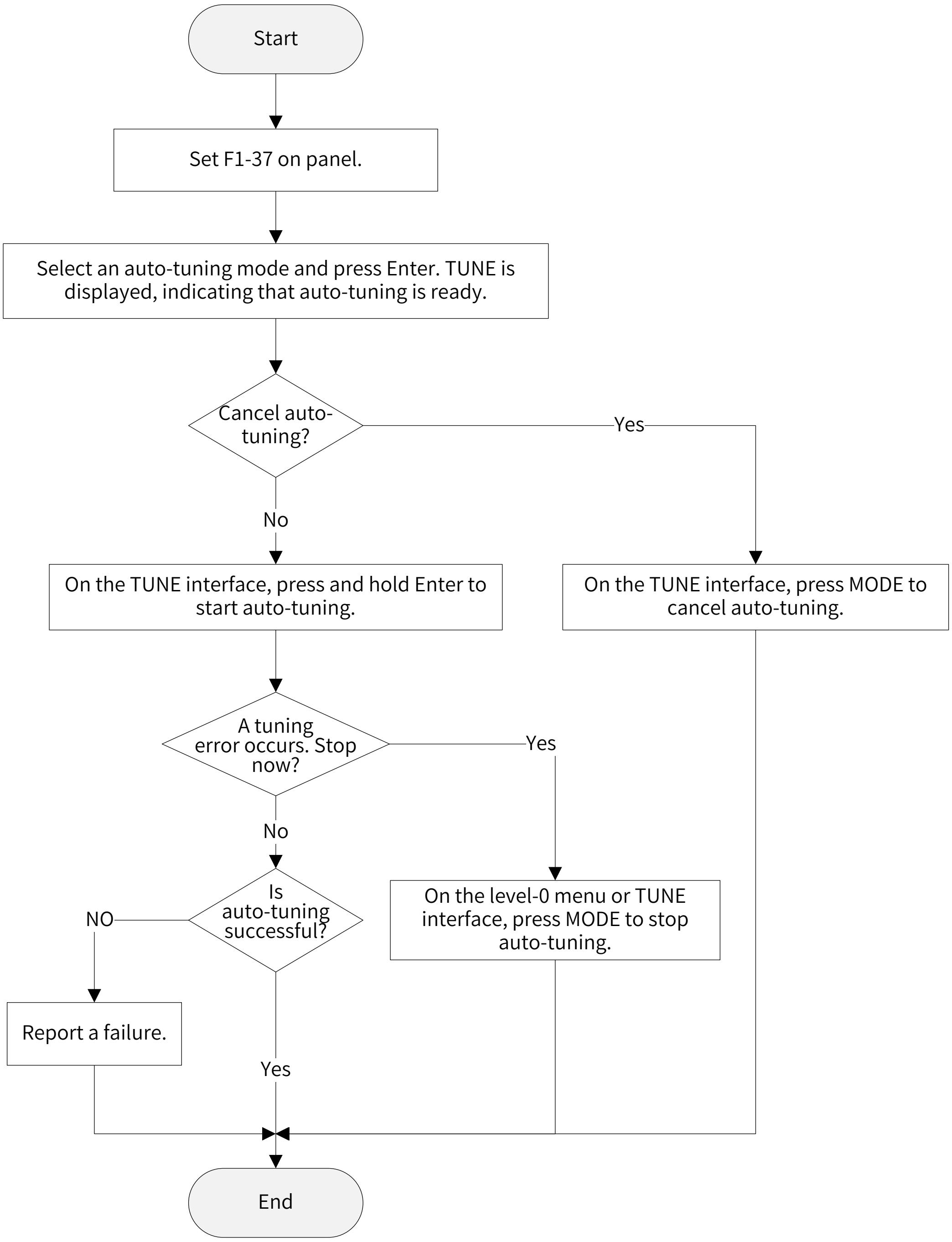


Figure 5-20 LED operating panel auto-tuning process

5.13.4 Jog Procedure on LED Operating Panel

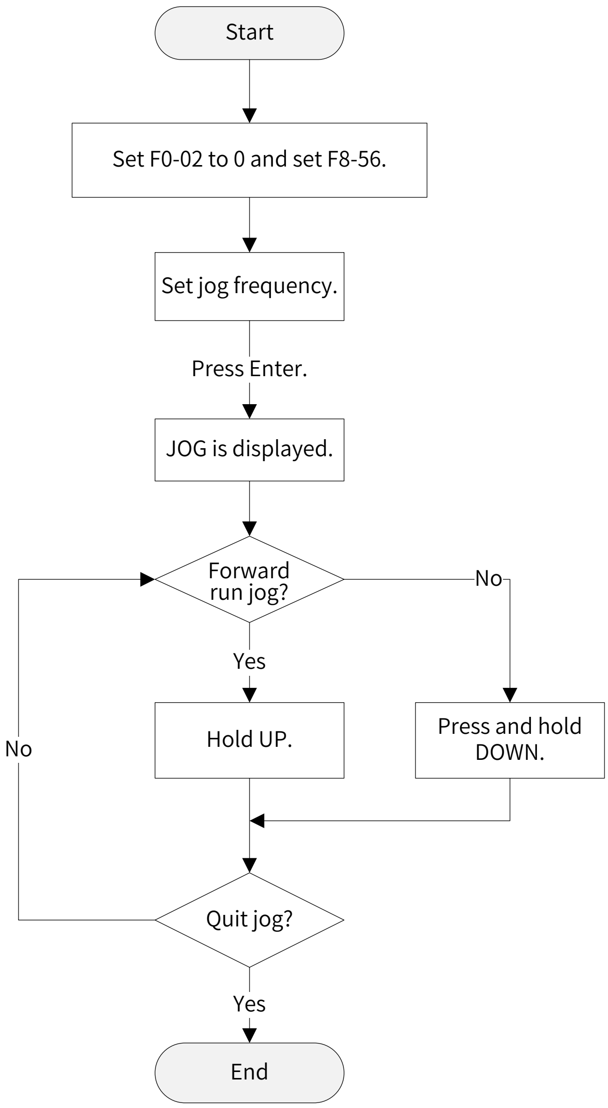


Figure 5-21 LED operating panel jogging process

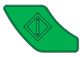
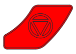
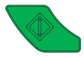
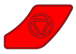
6 Drive Unit Parameters

6.1 Command Source Setting

Drive commands are used to control actions of a drive, such as start, stop, forward running, reverse running, and jogging. The commands can be issued from three sources: iPanel/software tool, terminals, and communication. Set F0-02 (Command source selection) to select a command source.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-02	Command source selection	0	0	External LCD panel/Commissioning software
			1	Terminal I/O control
			2	Communication control

1) Using an external LCD operating panel as the command source

Set F0-02 (Command source selection) to 0 (External LCD panel/Commissioning software) and use the  key and  key on the iPanel to control the drive. When you press the  key, the drive starts (the RUN indicator is on). When you press the  key during running of the drive, the drive stops (the RUN indicator is off). For details about operations on the external LCD operating panel, see "4.2 External LCD Operating Panel".

2) Using terminals as the command source

Set F0-02 (Command source selection) to 1 (Terminal I/O control) and use terminals to start and stop the drive.

Set F4-11 (Terminal I/O control mode) to select a terminal control mode. The drive supports four terminal control modes: two-wire mode 1, two-wire mode 2, three-wire mode 1, and three-wire mode 2.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-11	Terminal I/O control mode	0	0: Two-wire mode 1 1: Two-wire mode 2 2: Three-wire mode 1 3: Three-wire mode 2	These values represent the four modes for controlling the drive with external terminals.

You can use any of multifunctional terminals DI1 to DI2 and DIO1/DIO2 as external input terminals. To use DIO1/DIO2 terminals, you need to set F4-41 (Terminal I/O control mode) to define the DIO function. That is, set the values of F4-00 (DI1 function selection) to F4-04 (DIO2 function selection) to select the functions of the DIx input terminals. For details about function definition, see F4-00 (DI1) to F4-04 (DIO2) terminal function selection in "C.1 Basic Function Parameters".

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-41	DIO terminal type	00	Ones position: DIO1 type 0: DI/PulseIn 1: DO Tens position: DIO12 type 0: DI 1: DO/FMP	PulseIn refers to pulse input. FMP refers to pulse output.

■ Two-wire mode 1: F4-11 = 0. This is the most commonly used two-wire mode.

For example, terminal DI1 is assigned with the forward running function, and terminal DI2 is assigned with the reverse running function. Connect the forward running switch to DI1 and the reverse running switch to DI2.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-11	Terminal I/O control mode	0	Two-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)

When control switch SW1 is closed and SW2 is open, the motor runs in forward direction. When SW1 is open and SW2 is closed, the motor runs in reverse direction. When both SW1 and SW2 are open or closed, the motor does not run. See the following figures.

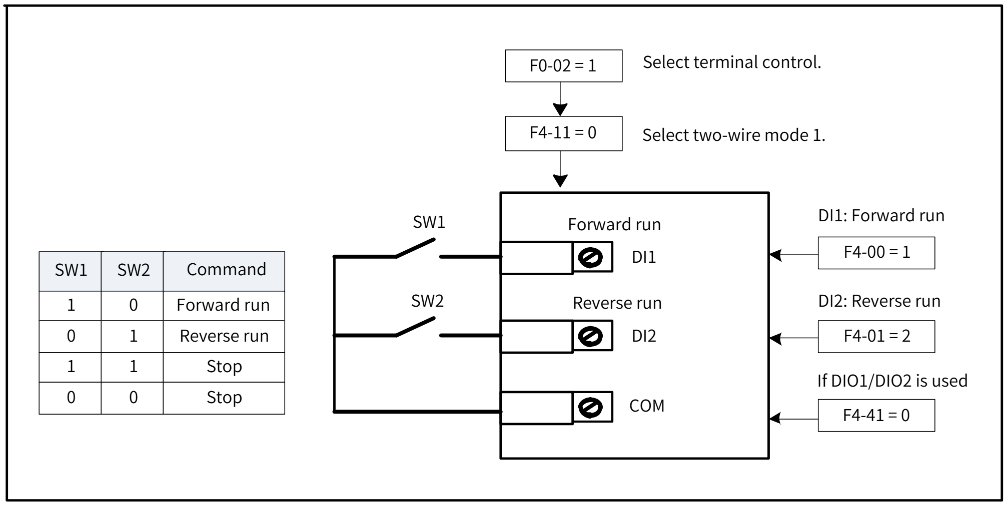


Figure 6-1 Wiring and parameter settings in two-wire mode 1

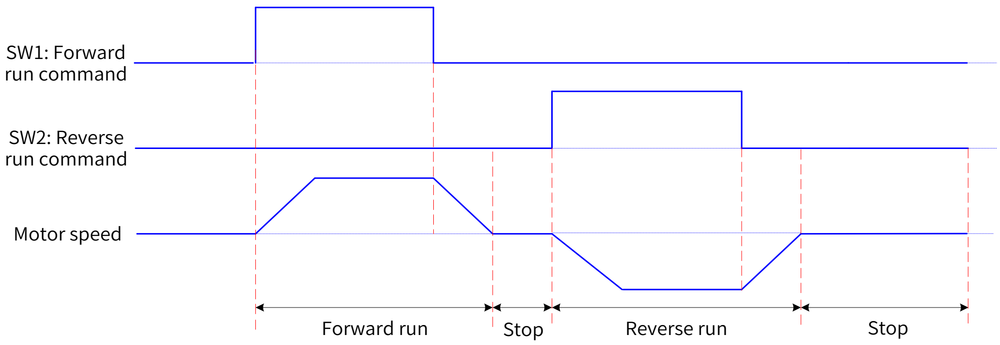


Figure 6-2 Sequence diagram in two-wire mode 1 (normal condition)

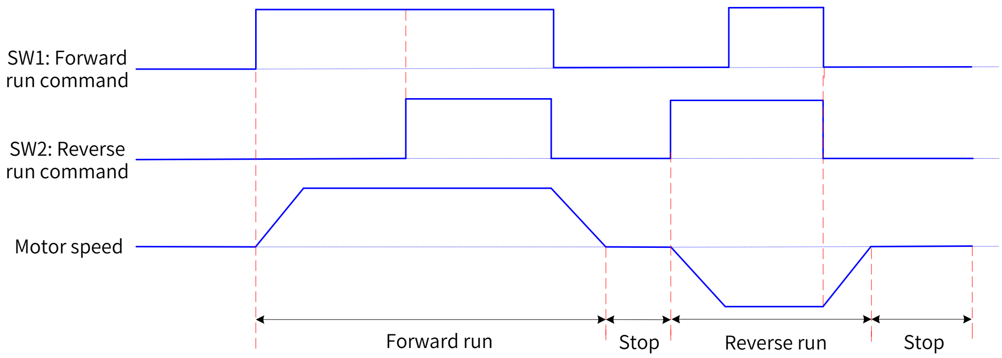


Figure 6-3 Sequence diagram in two-wire mode 1 (abnormal condition)

■ Two-wire mode 2: F4-11 = 1

For example, terminal DI1 is assigned with the RUN command function, and terminal DI2 is assigned with the forward/reverse running direction function. Use and set the parameters according to the following table.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-11	Terminal I/O control mode	1	Two-wire mode 2
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)

When control switch SW1 is closed, the motor starts to run. When SW2 is open, the motor runs in forward direction. When SW2 is closed, the motor runs in reverse direction. When SW1 is open, the motor does not run no matter whether SW2 is open or closed. See the following figures.

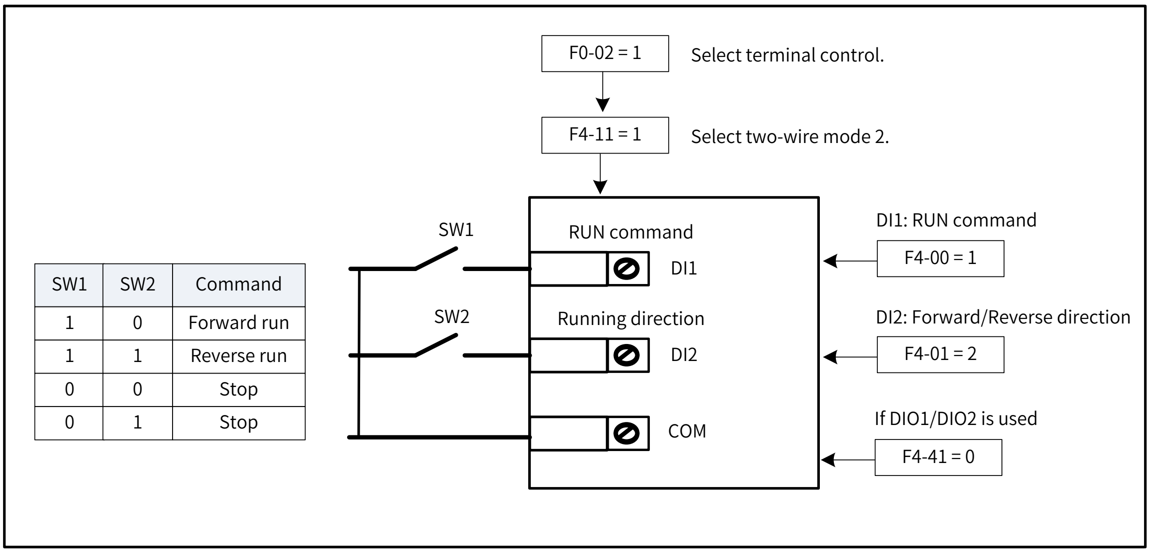


Figure 6-4 Wiring and parameter settings in two-wire mode 2

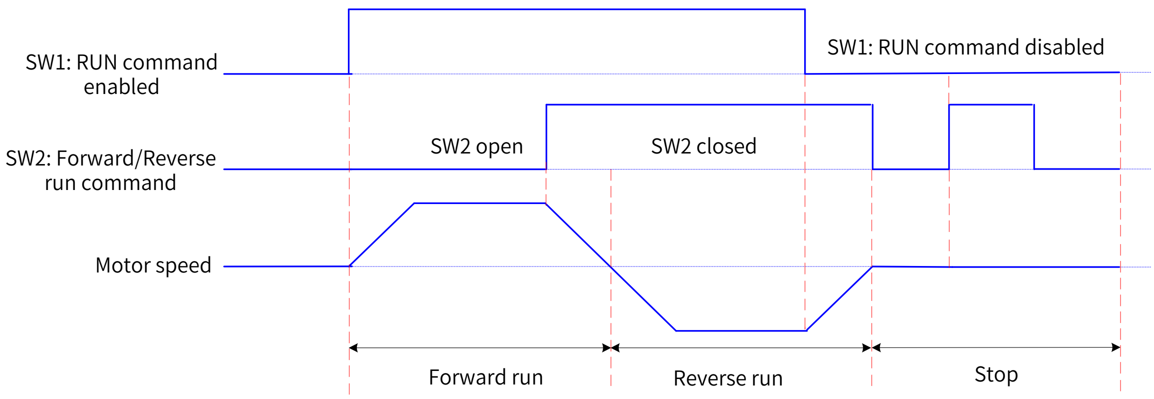


Figure 6-5 Sequence diagram in two-wire mode 2

■ Three-wire mode 1: F4-11 = 2

For example, terminal DIO1 is assigned with the three-wire running control function, terminal DI1 is assigned with the forward running function, and terminal DI2 is assigned with the reverse running function. In this control mode, start and stop of the AC drive must be controlled using buttons on the AC drive. Connect the start/stop button to DIO1, the forward run button to DI1, and the reverse run button to DI2. Use and set the parameters according to the following table.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-11	Terminal I/O control mode	2	Three-wire mode 1
F4-00	DI1 function selection	1	Forward run (FWD)
F4-01	DI2 function selection	2	Reverse run (REV)
F4-03	DIO1 function selection	3	Three-wire control

SW3 is a normally closed switch, whereas SW1 and SW2 are normally open switches. When SW3 is closed, pressing SW1 makes the drive run in forward direction and pressing SW2 makes the AC drive run in reverse direction. The AC drive stops immediately after SW3 is open. SW3 must be kept closed when the AC drive has started and is running normally. Commands of SW1 and SW2 take effect immediately when SW3 is closed.

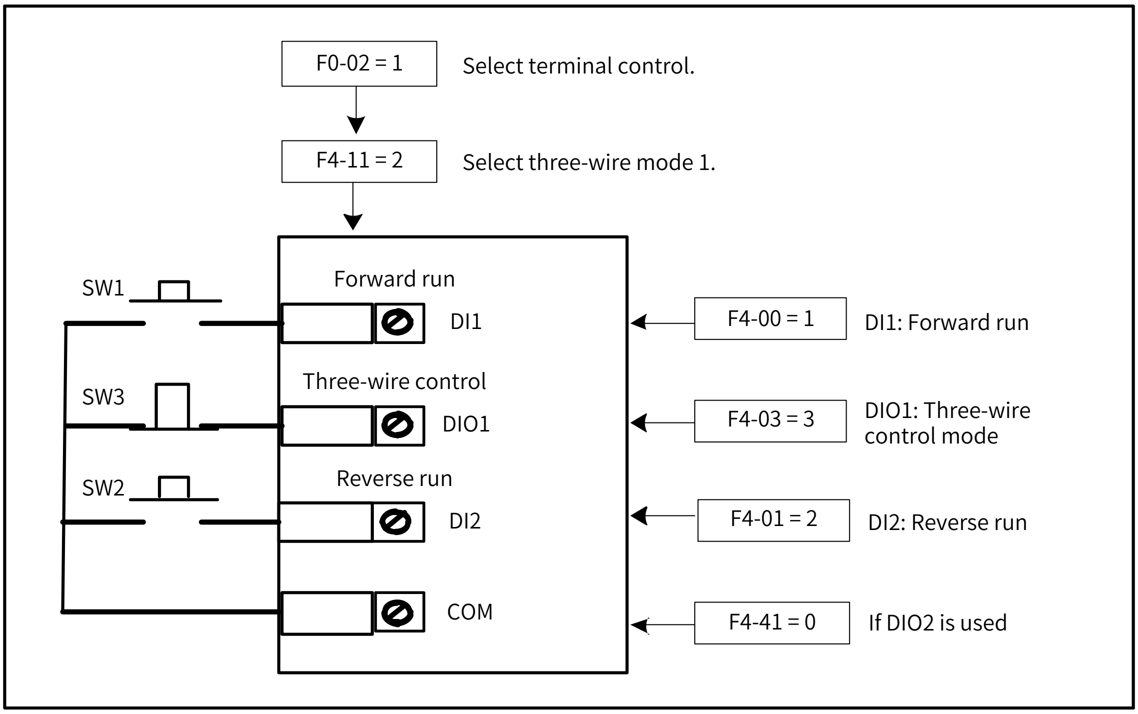


Figure 6-6 Wiring and parameter settings in three-wire mode 1

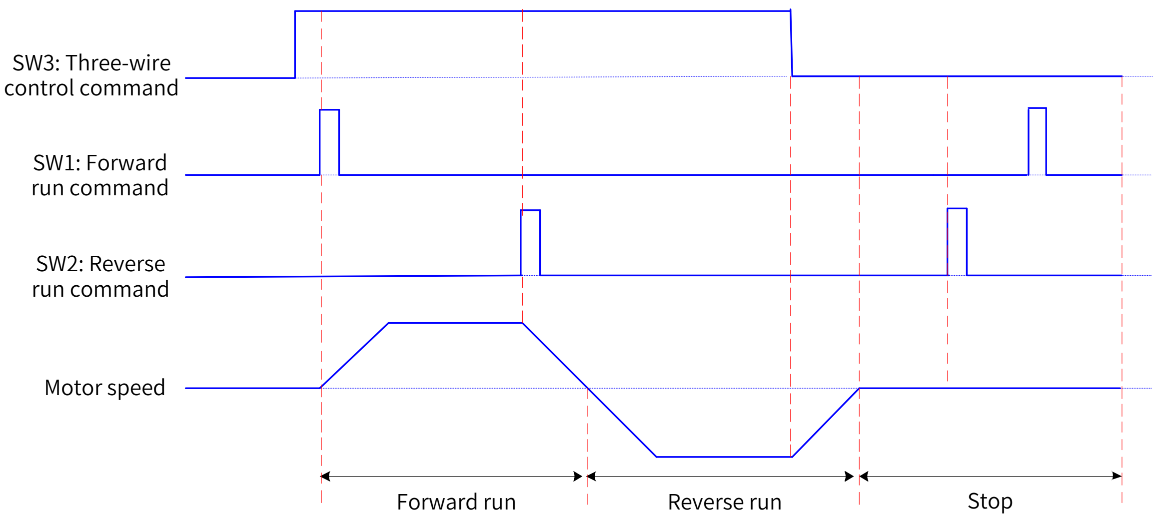


Figure 6-7 Sequence diagram in three-wire mode 1

- Three-wire mode 2: F4-11 = 3

For example, terminal DIO1 is assigned with the three-wire running control function, terminal DI1 is assigned with the RUN command function, and terminal DI2 is assigned with the forward/reverse running direction function. Connect the start/stop button to DIO1, the run button to DI1, and forward/reverse run button to DI2. The following table describes the parameter settings.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-11	Terminal I/O control mode	3	Three-wire mode 2
F4-00	DI1 function selection	1	Running command
F4-01	DI2 function selection	2	Forward/Reverse running
F4-03	DIO1 function selection	3	Three-wire control

When SW3 is closed and the AC drive has been started by pressing SW1, the drive runs in forward direction if SW2 is open and in reverse direction if SW2 is closed. The AC drive stops immediately when SW3 is open. SW3 must be kept closed when the AC drive has started and is running normally. Commands of SW1 take effect immediately when SW3 is closed.

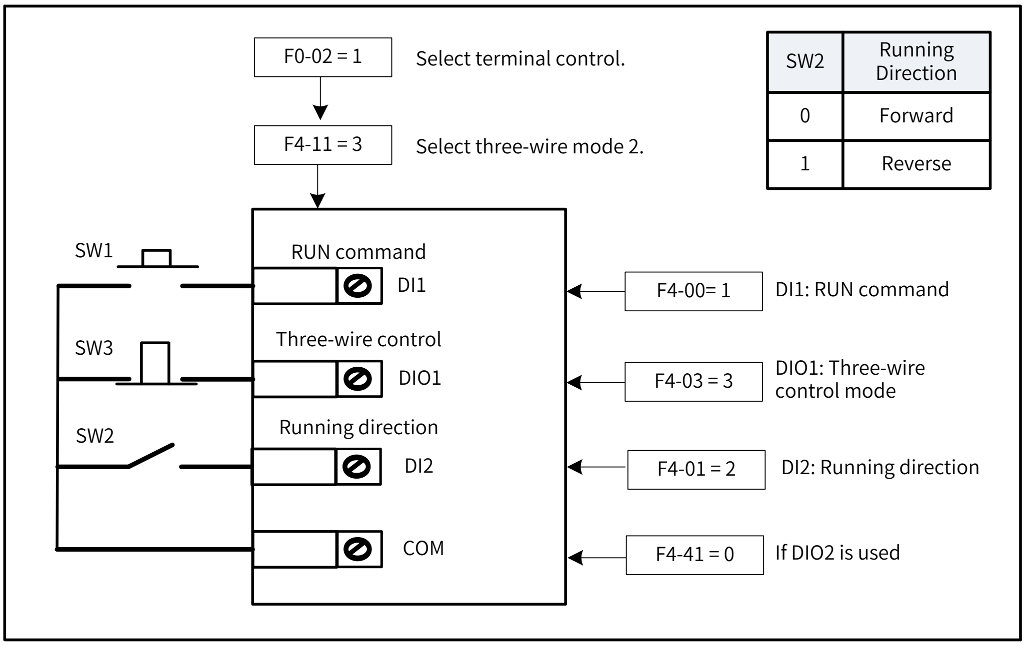


Figure 6-8 Wiring and parameter settings in three-wire mode 2

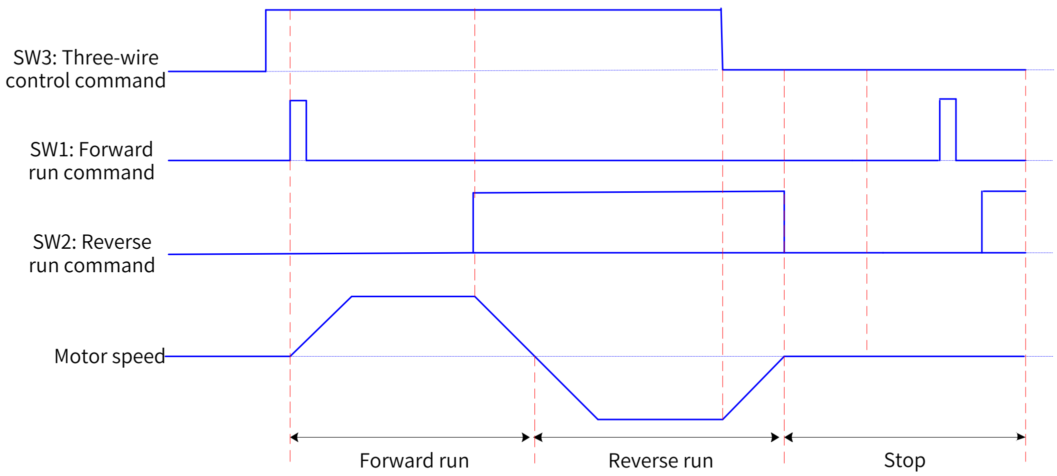


Figure 6-9 Sequence diagram in three-wire mode 2

3) Using communication as the command source

Set F0-02 (Command source selection) to 2 (Communication control) to issue drive commands through communication. This mode is used to control drive actions, such as start and stop. For details about parameter settings, see "Appendix B Communication".

6.2 Frequency Reference Source Setting

The AC drive supports three sources of frequency reference: main frequency reference, auxiliary frequency reference, and main and auxiliary calculation.

6.2.1 Selecting a Main Frequency Source

Set F0-03 (Main frequency source X selection) to select a source of the main frequency reference. The drive supports 10 sources of main frequency reference: digital setting (non-retentive at power failure), digital setting (retentive at power failure), AI1, AI2, pulse reference, multi-reference, simple PLC, PID, communication setting, and synchronization control.

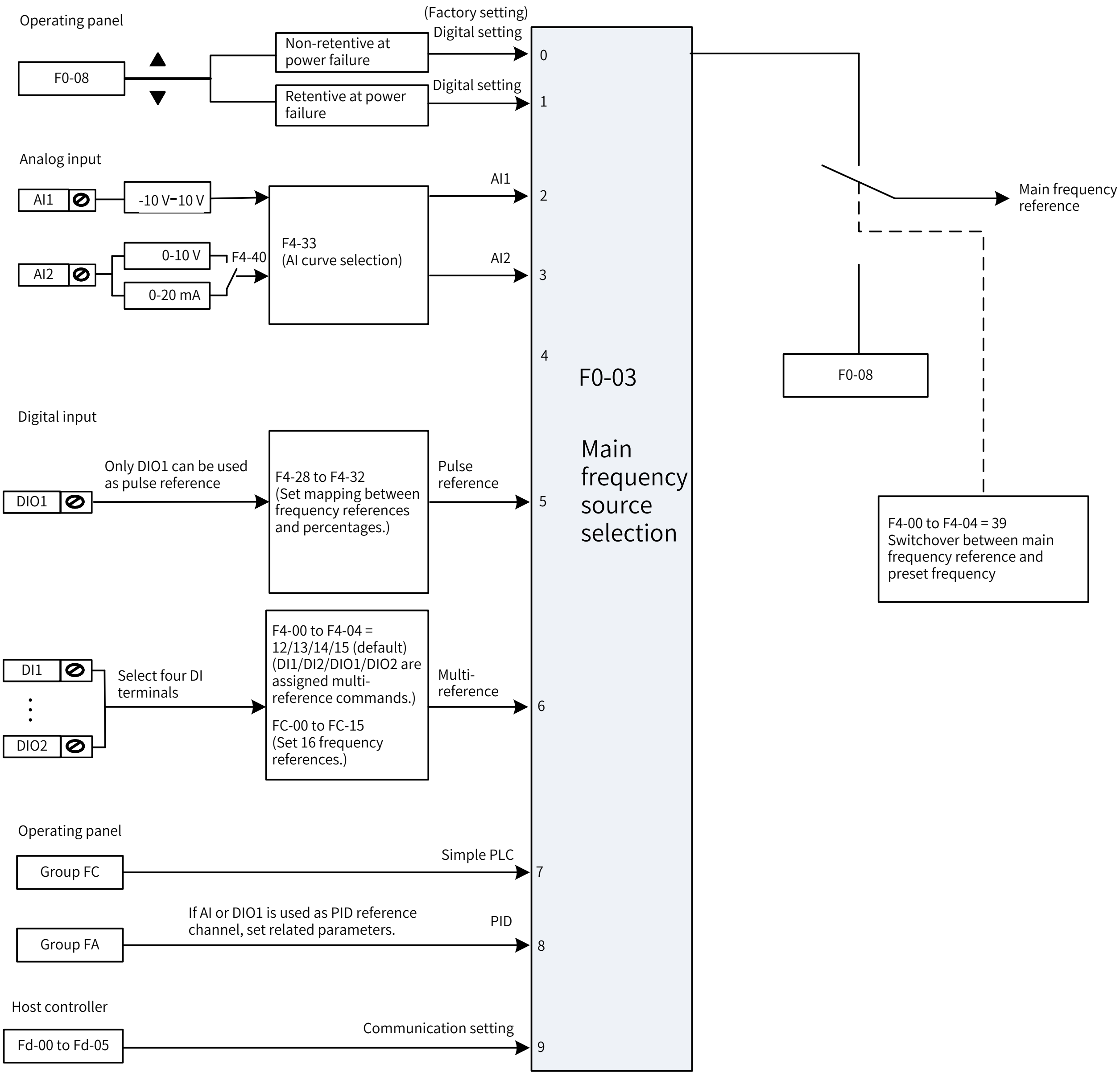


Figure 6-10 Main frequency source selection

Parameter No.	Parameter Name	Setting Range	Default
F0-03	Main frequency source X selection	0: Digital setting (initial value F0-08 can be modified by keypad or terminal UP/DOWN, non-retentive at power failure) 1: Digital setting (initial value F0-08 can be modified by keypad or terminal UP/DOWN, retentive at power failure) 2: AI1 3: AI2 4: (Reserved) 5: Pulse reference (DIO1) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication setting 10: Synchronization control	0

6.2.2 Setting the Main Frequency Using the Operating Panel (Digital Setting)

The main frequency can be set on the operating panel under two conditions:

■ F0-03 = 0 (non-retentive at power failure): When the drive is powered on again after it is stopped or encounters a power failure, the frequency value restores to F0-08 (Preset frequency). F0-08 (Preset frequency) can be changed by pressing the ▲ and ▼ keys on the keypad (or controlling UP/DOWN multifunctional terminals).

■ F0-03 = 1 (retentive at power failure): When the drive is powered on again after a power failure, the main frequency restores to the value set before the power failure.

Parameter No.	Parameter Name	Default	Setting Range
F0-08	Preset frequency	50.00 Hz	0.00 Hz to F0-10 (Maximum frequency)
F0-10	Maximum frequency	50.00 Hz	5.00 Hz to 600.00 Hz

NOTE

◆ Distinguish this parameter from F0-23 (Retentive of digital setting frequency upon stop). F0-23 determines whether the frequency setting is retained or reset when the drive is stopped. F0-23 is only related to drive stop, rather than power failures.

■ F0-23 = 0 means non-retentive upon stop. After you set F0-08 (Preset frequency) on the panel and revise the value by using the ▲ key and ▼ key on the keypad or UP/DOWN terminals, the revised frequency value will be reset to 0 upon a stop.

■ F0-23 = 1 means retentive upon stop. After you set F0-08 (Preset frequency) on the panel and revise the value by using the ▲ key and ▼ key or UP/DOWN terminals, the revised frequency value will be retained upon a stop.

For example, set F0-08 (Preset frequency) to 40 Hz and use the ▲ key to adjust it to 45 Hz. If F0-23 (Retentive of digital setting frequency upon stop) is set to 0 (Disabled), the target frequency restores to 40 Hz (value of F0-08) after the drive stops. If F0-23 (Retentive of digital setting frequency upon stop) is set to 1 (Enabled), the target frequency is still 45 Hz after the drive stops.

Parameter No.	Parameter Name	Default	Setting Range
F0-23	Retentive of digital setting frequency upon stop	0	0: Disabled 1: Enabled

6.2.3 Setting the Main Frequency Using Analog Input Terminals

Two analog input (AI) terminals, AI1 and AI2, can be used to set the main frequency. If F0-03 (Main frequency source X selection) is set to 2 (AI1), AI1 is used to set the main frequency. If F0-03 (Main frequency source X selection) is set to 3 (AI2), AI2 is used to set the main frequency.

As a frequency source, each AI terminal supports five types of AI curves. This section describes how to set AI curves, and explains how to select AI curves for the AI terminals.

Procedure	Parameter	Description	
(Step 1) Set AI curves: Set the mappings between voltage/current inputs on the AI terminals and the preset values.	F4-13 (AI curve 1 minimum input) to F4-16 (Corresponding percentage of AI curve 1 maximum input)	Setting of curve 1	Commonly used
	F4-18 (AI curve 2 minimum input) to F4-21 (Corresponding percentage of AI curve 2 maximum input)	Setting of curve 2	Commonly used
	F4-23 (AI curve 3 minimum input) to F4-26 (Corresponding percentage of AI curve 3 maximum input)	Setting of curve 3	Commonly used
	A6-00 (AI curve 4 minimum input) to A6-07 (Corresponding percentage of AI curve 4 maximum input)	Setting of curve 4	
	A6-08 (AI curve 5 minimum input) to A6-15 (Corresponding percentage of AI curve 5 maximum input)	Setting of curve 5	
	F4-34 (Setting for AI less than minimum input)	Setting for AI less than minimum input	
(Step 2) Select AI curves for the AI terminals. Select AI curves and set the filter time.	F4-33 (AI curve selection)	AI curve selection (You can select any AI curve for the AI terminals. Generally, use the default setting F4-33 = 321, indicating curve 1 for AI1 and curve 2 for AI2.)	
	F4-17 (AI1 filter time), F4-22 (AI2 filter time)	Filter time of AI1 and AI2	
(Step 3) Select an AI terminal as the frequency source. Select an AI terminal as the source of frequency reference based on terminal features.	F0-03 (Main frequency source X selection)	F0-03 = 2	AI1 as the source
		F0-03 = 3	AI2 as the source. Voltage input or current input can be selected by using F4-40 (AI2 input type).

NOTE

◆ When an AI terminal is used as the main frequency source, the voltage/current input value of 100% corresponds to F0-10 (Maximum frequency).

1) Setting AI curves

Five types of AI curves are available, among which curve 1, curve 2, and curve 3 are two-point curves, set by F4-13 (AI curve 1 minimum input) to F4-26 (Corresponding percentage of AI curve 3 maximum input). Curve 4 and curve 5 are four-point curves, set by parameters of group A6. AI curve parameters are actually used to set the mappings between the analog input voltage (or current) values and the preset values.

For example, AI curve 1 is set using parameters F4-13 (AI curve 1 minimum input) to F4-16 (Corresponding percentage of AI curve 1 maximum input). The following figure shows the factory settings of curve 1, and the following table describes these parameters.

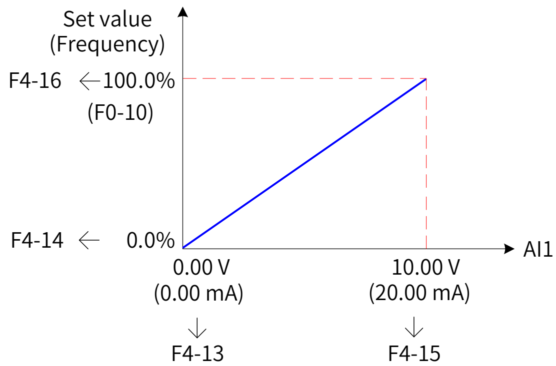


Figure 6-11 Settings of AI curve 1

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-13	AI curve 1 minimum input	0.00 V	-10.00 V to F4-15 (AI curve 1 maximum input)	When the analog input voltage is lower than F4-13, the minimum input or 0.0% prevails, depending on the setting of F4-34 (Setting for AI less than minimum input).
F4-14	Corresponding percentage of AI curve 1 minimum input	0.0%	-100.00% to +100.0%	
F4-15	AI curve 1 maximum input	10.00 V	F4-13 to 10.00 V	When the analog input voltage is higher than F4-15, the maximum input prevails.
F4-16	Corresponding percentage of AI curve 1 maximum input	100.0%	-100.00% to +100.0%	

NOTE

- When an AI terminal is used as the main frequency source, 100% of voltage/current input corresponds to the value of F0-10 (Maximum frequency). When analog input current is used as frequency reference, 1 mA current corresponds to 0.5 V voltage, and 0–20 mA current corresponds to 0–10 V current.
- Curve 2 and curve 3 are set in the same way as curve 1. Parameters F4-18 (AI curve 2 minimum input) to F4-21 (Corresponding percentage of AI curve 2 maximum input) are used to set curve 2, and parameters F4-23 (AI curve 3 minimum input) to F4-26 (Corresponding percentage of AI curve 3 maximum input) are used to set curve 3. The following figure shows settings of AI curve 2.

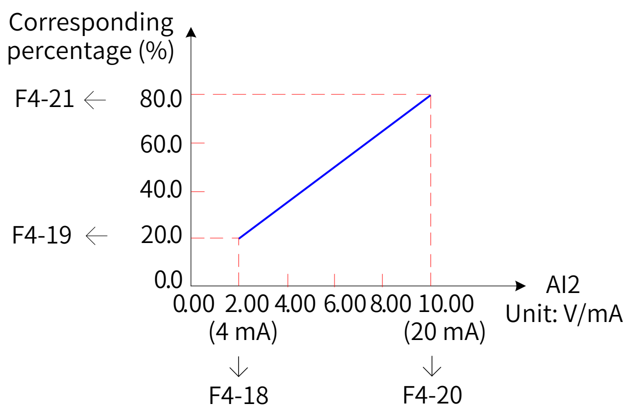


Figure 6-12 Settings of AI curve 2

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-18	AI curve 2 minimum input	0.00 V	0.00 V to F4-20 (AI curve 2 maximum input)	-
F4-19	Corresponding percentage of AI curve 2 minimum input	0.0%	-100.00% to +100.0%	-
F4-20	AI curve 2 maximum input	10.00 V	F4-18 (AI curve 2 minimum input) to 10.00	-
F4-21	Corresponding percentage of AI curve 2 maximum input	100.0%	-100.00% to +100.0%	-
F4-23	AI curve 3 minimum input	0.00 V	-10.00 V to F4-25 (AI curve 3 maximum input)	-
F4-24	Corresponding percentage of AI curve 3 minimum input	0.0%	-100.00% to 100.0%	-
F4-25	AI curve 3 maximum input	10.00 V	F4-23 (AI curve 3 minimum input) to 10.00 V	-
F4-26	Corresponding percentage of AI curve 3 maximum input	100.0%	-100.00% to +100.0%	-

Curve 4 and curve 5 provide functions similar to those of curves 1 to 3, except that curves 1 to 3 are straight lines, whereas curve 4 and curve 5 are four-point curves enabling more flexible mappings. The following figure shows settings of curve 4 and curve 5.

NOTE

- When setting curve 4 and curve 5, ensure that the minimum input voltage, inflection 1 input voltage, inflection 2 input voltage, and maximum input voltage are set in ascending order.

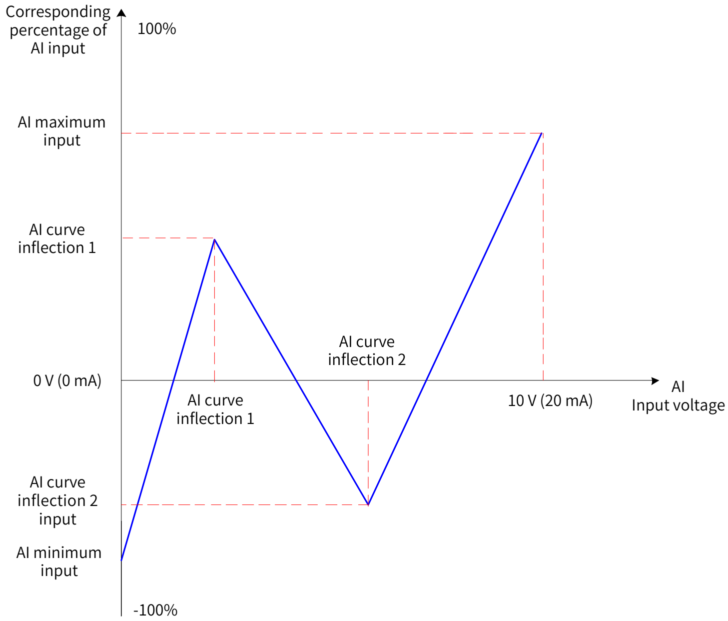


Figure 6-13 Settings of curve 4 and curve 5

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A6-00	AI curve 4 minimum input	0.00 V	-10.00 V to A6-02	-
A6-01	Corresponding percentage of AI curve 4 minimum input	0.0%	-100.00% to +100.0%	-
A6-02	AI curve 4 inflection 1 input	3.00 V	A6-00 to A6-04	-
A6-03	Corresponding percentage of AI curve 4 inflection 1 input	30.0%	-100.0% to +100.0%	-
A6-04	AI curve 4 inflection 2 input	6.00 V	A6-02 (AI curve 4 inflexion 1 input) to A6-06 (AI curve 4 maximum input)	-
A6-05	Corresponding percentage of AI curve 4 inflection 2 input	60.0%	-100.0% to +100.0%	-
A6-06	AI curve 4 maximum input	10.00 V	A6-04 (AI curve 4 inflexion 2 input) to 10.00 V	-
A6-07	Corresponding percentage of AI curve 4 maximum input	100.0%	-100.0% to +100.0%	-
A6-08	AI curve 5 minimum input	-10.00 V	-10.00 V to A6-10	-
A6-09	Corresponding percentage of AI curve 5 minimum input	-100.0%	-100.0% to +100.0%	-
A6-10	AI curve 5 inflection 1 input	-3.00 V	A6-08 (AI curve 5 minimum input) to A6-12 (AI curve 5 inflexion 2 input)	-
A6-11	Corresponding percentage of AI curve 5 inflection 1 input	-30.0%	-100.0% to +100.0%	-
A6-12	AI curve 5 inflection 2 input	3.00 V	A6-10 (AI curve 5 inflexion 1 input) to A6-14 (AI curve 5 maximum input)	-
A6-13	Corresponding percentage of AI curve 5 inflection 2 input	30.0%	-100.0% to +100.0%	-

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A6-14	AI curve 5 maximum input	10.00 V	A6-12 (AI curve 5 inflexion 2 input) to +10.00 V	-
A6-15	Corresponding percentage of AI curve 5 maximum input	100.0%	-100.0% to +100.0%	-

2) Selecting AI curves for the AI terminals

The curves of terminals AI1 and AI2 are determined by the units and tens positions of F4-33 (AI curve selection), respectively. The two AI terminals can use any of the five curves.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-33	AI curve selection	21	Ones position: 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 position: AI2 curve selection, same as above Hundreds position: Reserved	F4-33 = 321 means that AI1 uses curve 1 and AI2 uses curve 2.
F4-17	AI1 filter time	0.10s	0.00s to 10.00s	The two parameters are used to set the software filter time for the AI terminals.
F4-22	AI2 filter time	0.10s	0.00s to 10.00s	

A longer AI filter time enhances the anti-interference capability but leads to slower response to frequency adjustment. A shorter filter time enables faster response to frequency adjustment but weakens the anti-interference capability. When analog input is subject to interference in the application environment, increase the filter time to stabilize the detected analog input signals. However, the longer the filter time is, the slower the response to analog input detection will be. Therefore, set appropriate filter time based on the actual application environment.

3) Setting an AI terminal as the main frequency source

The MD810 control board provides two analog input terminals AI1 and AI2. AI1 provides voltage input of -10 V to 10 V. AI2 provides voltage input of 0 V to 10 V or current input of 0 mA to 20 mA, depending on the setting of F4-40 (AI2 input type). The following describes how to set each AI terminal as the main frequency source.

For example, if you select curve 1 for terminal AI1 (set the ones position of F4-33 to 1) and use AI1 voltage input as the main frequency source, the input voltage values 2 V to 10 V must be mapped to frequency values 10 Hz to 40 Hz. Set the corresponding parameters according to the following figure.

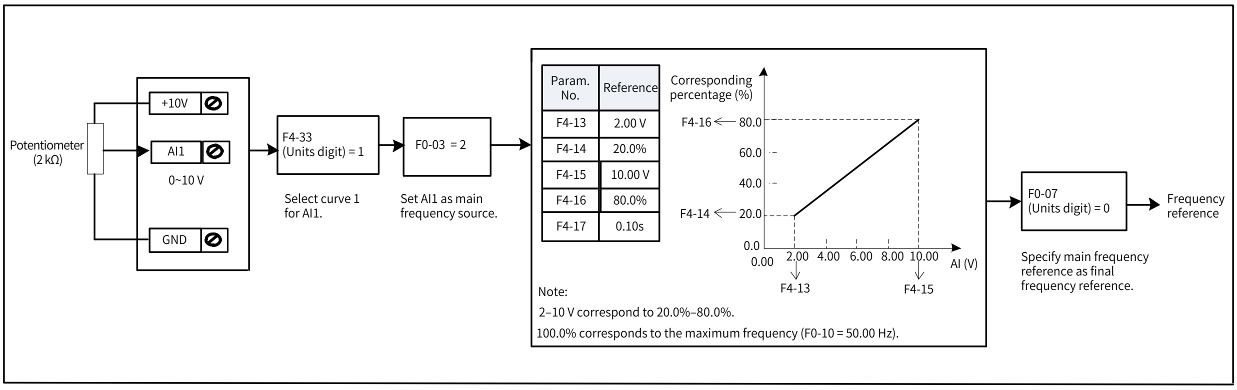


Figure 6-14 Parameter settings for AI1 voltage input as the main frequency source

AI2 can provide analog voltage input (0–10 V) or analog current input (0–20 mA).

When AI2 provides analog current input of 0 mA to 20 mA, the corresponding input voltage values are 0 V to 10 V. If the input current ranges from 4 mA to 20 mA, current input of 4 mA corresponds to voltage of 2 V, and current input of 20 mA corresponds to voltage of 10 V.

For example, if you select curve 2 for terminal AI2 (set the tens position of F4-33 to 2) and use AI2 current input as the main frequency source, the input current values 4 mA to 20 mA must be mapped to frequency values 0 Hz to 50 Hz. Set the corresponding parameters according to the following figure.

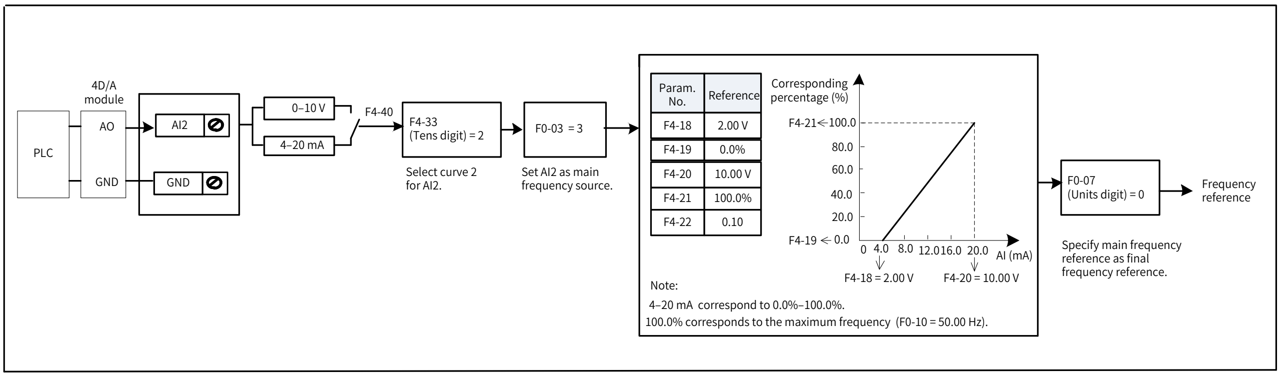


Figure 6-15 Parameter settings for AI2 current input as the main frequency source

6.2.4 Setting the Main Frequency Using Pulse Reference

When F0-03 (Main frequency source X selection) is set to 5 [Pulse reference (DIO1)], pulse reference is selected as the main frequency source. When the main frequency source is set to pulse reference (DIO1), the pulse reference must be obtained from multifunctional input terminal DIO1. The pulse reference signal specifications are: voltage of 9–30 V and frequency of 0–100 kHz.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-28	Pulse minimum input	0.00 kHz	0.00 kHz to F4-30 (Pulse max. input)	
F4-29	Corresponding percentage of pulse minimum input	0.0%	-100.0% to +100.0%	Percentage against F0-10 (Maximum frequency)
F4-30	Pulse max. input	50.00 kHz	F4-28 (Pulse minimum input) to 100.00 kHz	
F4-31	Corresponding percentage of pulse maximum input	100.0%	-100.0% to +100.0%	Percentage against the maximum frequency F0-10 (Maximum frequency)
F4-32	Pulse filter time	0.10s	0.00s to 10.00s	

The mapping between the input pulse frequency from terminal DIO1 and the corresponding percentage is set using parameters F4-28 (Pulse minimum input) to F4-31 (Corresponding percentage of pulse maximum input). The mapping relation is shown as a two-point straight line. The value 100% mapped to the pulse input is the percentage against the maximum frequency F0-10 (Maximum frequency), as shown in the following figure.

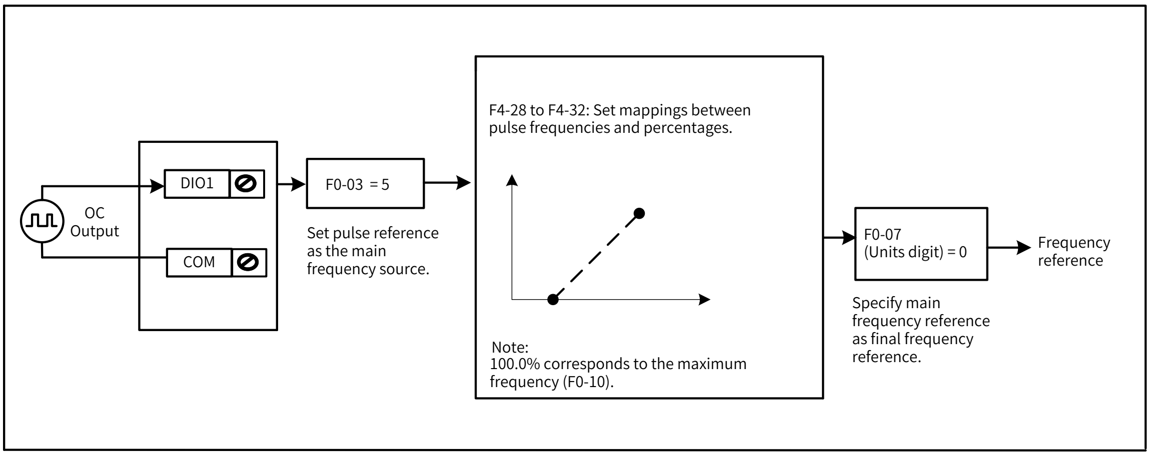


Figure 6-16 Parameter settings for pulse input as the main frequency source

6.2.5 Setting the Main Frequency Using Multi-reference

When F0-03 (Main frequency source X selection) is set to 6 (Multi-reference), multi-reference is selected as the main frequency source. This mode is applicable to the scenarios that do not require continuous adjustment of the drive running frequency and only need to use several frequency values.

An MD810 drive supports a maximum of 16 running frequencies, which can be set through combinations of input signals from the four DI terminals. You can also use less than four DI terminals as the multi-reference source. In this case, the missing digits are padded with 0s.

The mapping between the number of frequency references and the number of DI terminals is as follows: 2 references with one DI terminal K1; 3–4 references with two DI terminals K1 and K2; 5–8 references with three DI terminals K1, K2, and K3; 9–16 references with four DI terminals K1, K2, K3, and K4. The required frequency references are set using parameters of the FC group, as listed in the following table.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FC-00	Reference 0	0.0%	-100.0% to +100.0%	The reference values are percentages against the maximum frequency. The positive and negative signs of the values determine the running direction of the drive. A negative value indicates reverse running. The default acceleration time and deceleration time are the values of F0-17 (Acceleration time 1) and F0-18 (Deceleration time 1), respectively.
FC-01	Reference 1	0.0%	-100.0% to +100.0%	
FC-02	Reference 2	0.0%	-100.0% to +100.0%	
FC-03	Reference 3	0.0%	-100.0% to +100.0%	
FC-04	Reference 4	0.0%	-100.0% to +100.0%	
FC-05	Reference 5	0.0%	-100.0% to +100.0%	
FC-06	Reference 6	0.0%	-100.0% to +100.0%	
FC-07	Reference 7	0.0%	-100.0% to +100.0%	
FC-08	Reference 8	0.0%	-100.0% to +100.0%	
FC-09	Reference 9	0.0%	-100.0% to +100.0%	
FC-10	Reference 10	0.0%	-100.0% to +100.0%	
FC-11	Reference 11	0.0%	-100.0% to +100.0%	
FC-12	Reference 12	0.0%	-100.0% to +100.0%	
FC-13	Reference 13	0.0%	-100.0% to +100.0%	
FC-14	Reference 14	0.0%	-100.0% to +100.0%	
FC-15	Reference 15	0.0%	-100.0% to +100.0%	
FC-51	Reference 0 source	0	0 to 6	0: FC-00 1: AI1 2: AI2 3: Reserved 4: Pulse reference 5: PID 6: Set by F0-08 (Preset frequency), modified by terminal UP/DOWN

When using multi-reference as the main frequency source, set the DI terminal function selection parameters to values of 12 to 15 to select the input terminals.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-00	DI1 function selection	12	Multi-reference terminal 1
F4-01	DI2 function selection	13	Multi-reference terminal 2
F4-03	DIO1 function selection	14	Multi-reference terminal 3
F4-04	DIO2 function selection	15	Multi-reference terminal 4
F4-41	DIO terminal type	00	DIO1 and DIO2 as input terminals

In the following figure, terminals DI1, DI2, DIO1, and DIO2 are used as multi-reference input terminals. Their values constitute a 4-bit binary value, and different combinations of the bits represent different frequencies. When values of (DI1, DI2, DIO1, DIO2) are (0, 0, 1, 0), they constitute a binary value of 2. In this case, the frequency value set by FC-02 (Reference 2) is selected. (See "Table 6-1 Multi-reference function description" for details about frequency selection.) Then, the target frequency is calculated automatically by FC-02 (Reference 2) x F0-10 (Maximum frequency). The following figure shows the frequency setting.

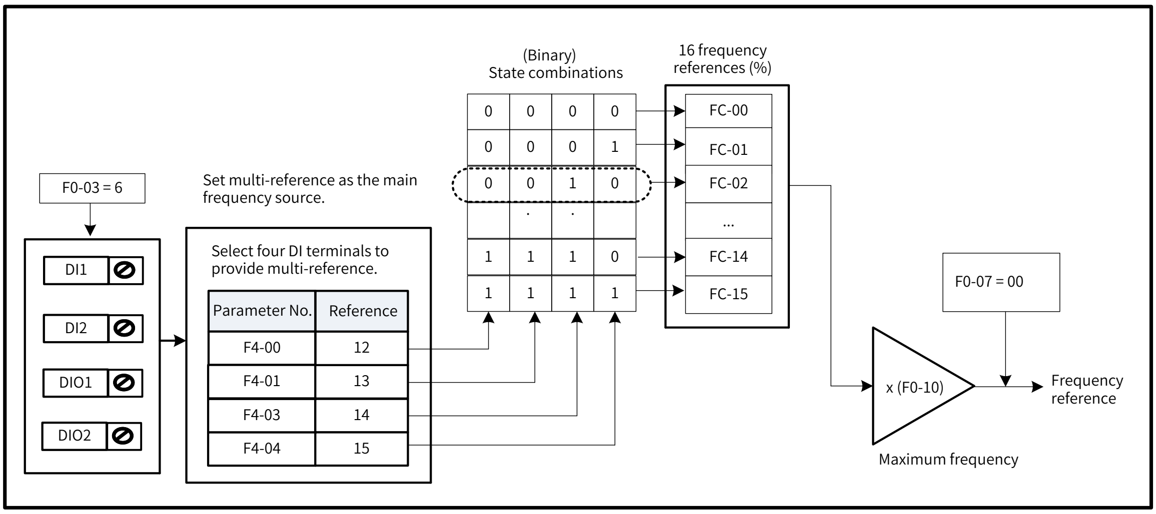


Figure 6-17 Frequency setting in multi-reference mode

The four multi-reference input terminals have 16 state combinations, representing 16 frequency reference values, as listed in the following table.

Table 6-1 Multi-reference function description

K4	K3	K2	K1	Reference	Parameter
OFF	OFF	OFF	OFF	Reference 0	FC-00 (FC-51 = 0)
OFF	OFF	OFF	ON	Reference 1	FC-01
OFF	OFF	ON	OFF	Reference 2	FC-02
OFF	OFF	ON	ON	Reference 3	FC-03
OFF	ON	OFF	OFF	Reference 4	FC-04
OFF	ON	OFF	ON	Reference 5	FC-05
OFF	ON	ON	OFF	Reference 6	FC-06
OFF	ON	ON	ON	Reference 7	FC-07
ON	OFF	OFF	OFF	Reference 8	FC-08
ON	OFF	OFF	ON	Reference 9	FC-09
ON	OFF	ON	OFF	Reference 10	FC-10
ON	OFF	ON	ON	Reference 11	FC-11
ON	ON	OFF	OFF	Reference 12	FC-12
ON	ON	OFF	ON	Reference 13	FC-13
ON	ON	ON	OFF	Reference 14	FC-14
ON	ON	ON	ON	Reference 15	FC-15

NOTE

◆ In addition to the main frequency source, multi-reference can also be used as the voltage source for V/F separation (see description of F3-13 in 6.5.1 "V/F Curve Setting"), process PID source (see description of FA-00 (PID reference setting channel) in "6.2.7 Setting the Main Frequency Using PID").

6.2.6 Setting the Main Frequency Using Simple PLC

When F0-03 (Main frequency source X selection) is set to 7 (Simple PLC), simple PLC is selected as the main frequency source.

When using simple PLC as the main frequency source, use FC-00 (Reference 0) to FC-15 (Reference 15) to set frequency references (see "6.2.5 Setting the Main Frequency Using Multi-reference"), and use FC-18 (Running time of simple PLC reference 0) to FC-49 (Acceleration/Deceleration time of simple PLC reference 15) to set the running time and acceleration/deceleration time of each reference, as shown in the following table.

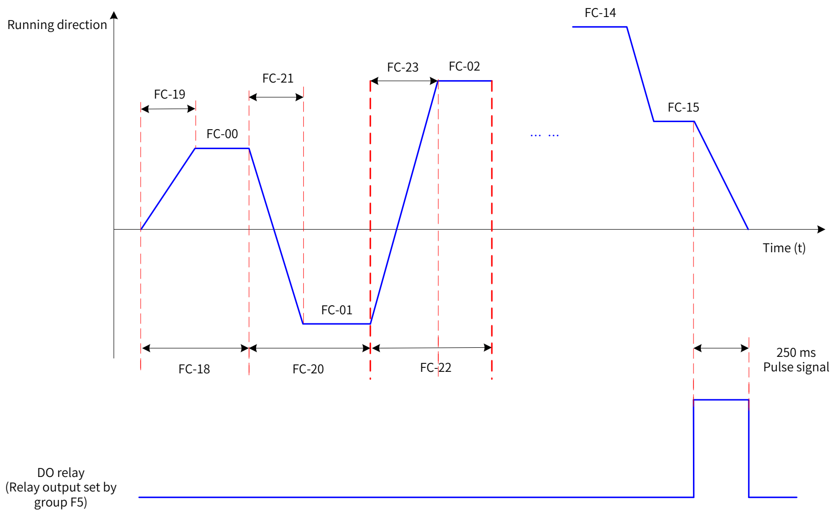


Figure 6-18 Simple PLC as the main frequency source

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FC-18	Running time of simple PLC reference 0	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-19	Acceleration/Deceleration time of simple PLC reference 0	0	0 to 3	-
FC-20	Running time of simple PLC reference 1	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-21	Acceleration/Deceleration time of simple PLC reference 1	0	0 to 3	-
FC-22	Running time of simple PLC reference 2	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-23	Acceleration/Deceleration time of simple PLC reference 2	0	0 to 3	-
FC-24	Running time of simple PLC reference 3	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-25	Acceleration/Deceleration time of simple PLC reference 3	0	0 to 3	-
FC-26	Running time of simple PLC reference 4	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-27	Acceleration/Deceleration time of simple PLC reference 4	0	0 to 3	-
FC-28	Running time of simple PLC reference 5	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-29	Acceleration/Deceleration time of simple PLC reference 5	0	0 to 3	-
FC-30	Running time of simple PLC reference 6	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-31	Acceleration/Deceleration time of simple PLC reference 6	0	0 to 3	-
FC-32	Running time of simple PLC reference 7	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-33	Acceleration/Deceleration time of simple PLC reference 7	0	0 to 3	-
FC-34	Running time of simple PLC reference 8	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-35	Acceleration/Deceleration time of simple PLC reference 8	0	0 to 3	-
FC-36	Running time of simple PLC reference 9	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-37	Acceleration/Deceleration time of simple PLC reference 9	0	0 to 3	-

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FC-38	Running time of simple PLC reference 10	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-39	Acceleration/Deceleration time of simple PLC reference 10	0	0 to 3	-
FC-40	Running time of simple PLC reference 11	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-41	Acceleration/Deceleration time of simple PLC reference 11	0	0 to 3	-
FC-42	Running time of simple PLC reference 12	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-43	Acceleration/Deceleration time of simple PLC reference 12	0	0 to 3	-
FC-44	Running time of simple PLC reference 13	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-45	Acceleration/Deceleration time of simple PLC reference 13	0	0 to 3	-
FC-46	Running time of simple PLC reference 14	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-47	Acceleration/Deceleration time of simple PLC reference 14	0	0 to 3	-
FC-48	Running time of simple PLC reference 15	0.0s (h)	0.0s (h) to 6553.5s (h)	-
FC-49	Acceleration/Deceleration time of simple PLC reference 15	0	0 to 3	-
FC-50	Time unit of simple PLC running	0	0: s (second) 1: h (hour)	-

When using simple PLC as the main frequency source, set FC-16 (Simple PLC running mode) to select the simple PLC running mode, and set FC-17 (Simple PLC retentive selection) to determine whether to retain the PLC running stage and running frequency upon a power failure or stop. The following table describes the parameters.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FC-16	Simple PLC running mode	0	0: Stop after running for one cycle	The drive stops automatically after running a single cycle, and starts again only after receiving the RUN command again.
			1: Keep final values after running one cycle	The drive automatically retains the running frequency and direction in the last stage after running a single cycle. After a restart, the drive starts to run from the initial PLC state.
			2: Repeat after running for one cycle	The drive automatically starts the next cycle after running one cycle until it receives the STOP command.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FC-17	Simple PLC retentive selection	00	Ones position: Retentive selection upon power failure	
			0: Non-retentive upon power failure	The drive restarts the PLC process every time it is powered on.
			1: Retentive upon power failure	The drive retains the PLC running stage and running frequency before a power failure. Upon the next power-on, the drive resumes from the stage before the last power failure.
			Tens position: Retentive selection upon stop	
			0: Non-retentive upon stop	The drive restarts the PLC process every time it starts.
			1: Retentive upon stop	The drive retains the PLC running stage and running frequency before a stop. Upon the next start, the drive resumes from the stage before the last stop.
FC-50	Time unit of simple PLC running	0	0: s (second) 1: h (hour)	This parameter is used to set the time unit of simple PLC running.
FC-51	Reference 0 source	0	0: FC-00 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: PID 6: Set by F0-08 (Preset frequency), modified by terminal UP/DOWN	-

NOTE

◆ In addition to the main frequency source, simple PLC can also be used as the voltage source for V/F separation. (See the description of F3-13 in "6.5.1 V/F Curve Setting".)

6.2.7 Setting the Main Frequency Using PID

When F0-03 (Main frequency source X selection) is set to 8 (PID), PID is selected as the main frequency source.

PID control is a commonly used process control method, which calculates the proportion, integral, and differential of the difference between feedback signals and target signals of the controlled variable, and adjusts the output frequency of the drive accordingly. This method finally creates a closed-loop system to stabilize the controlled variable at the target value. Generally, PID output can be used as the running frequency for field closed-loop process control applications, such as constant pressure closed-loop control and constant tension closed-loop control.

- Proportional gain Kp: When there is a deviation between the PID input and output, the PID regulator adjusts the output to reduce the deviation of the controlled variable. The deviation reduction speed depends on the proportion coefficient Kp. The greater the Kp value is, the faster the deviation reduces. However, a large Kp value often causes oscillation, especially when the deviation lasts for long. The smaller the Kp value is, the lower the probability that oscillation will occur. However, a small Kp value leads to a slow adjustment speed. (Proportional gain of 100.0 means that when the PID feedback value has a 100% of deviation from the preset value, the PID regulator adjusts the output frequency reference at a step of the maximum frequency.)
- Integral time Ti: It determines the strength of integral adjustment by the PID regulator. The shorter the integral time is, the stronger integral adjustment the PID regulator provides. (The integral time

refers to the amount of time that the integral regulator spends to continuously adjust the output frequency reference at a step of the maximum frequency when the deviation between the PID feedback value and preset value is 100.0%.)

■ Differential time Td: It determines the strength of deviation change rate adjustment by the PID regulator. The longer the differential time is, the stronger deviation change rate adjustment the PID regulator provides. (The differential time refers to the period during which the feedback value changes at a rate of 100.0%, and the differential regulator adjusts the output frequency reference at a step of the maximum frequency.)

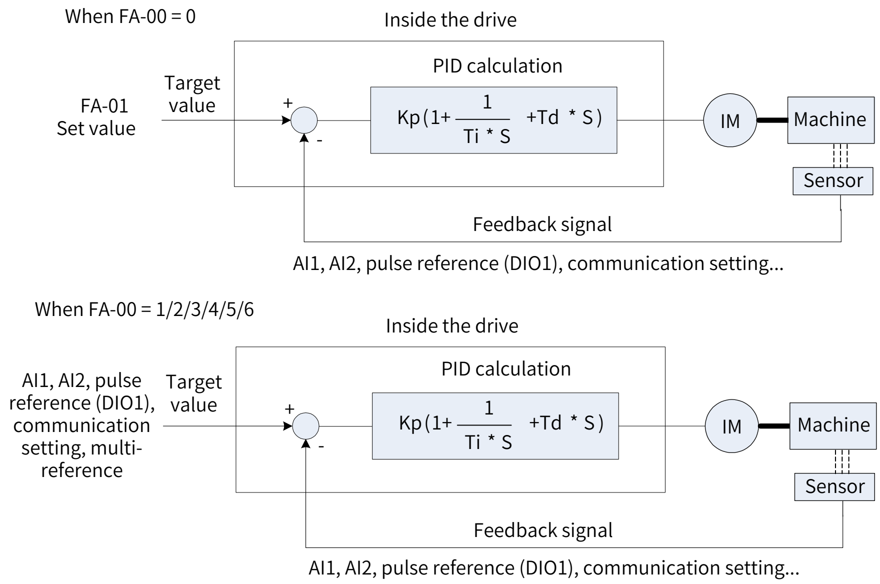


Figure 6-19 Process PID control

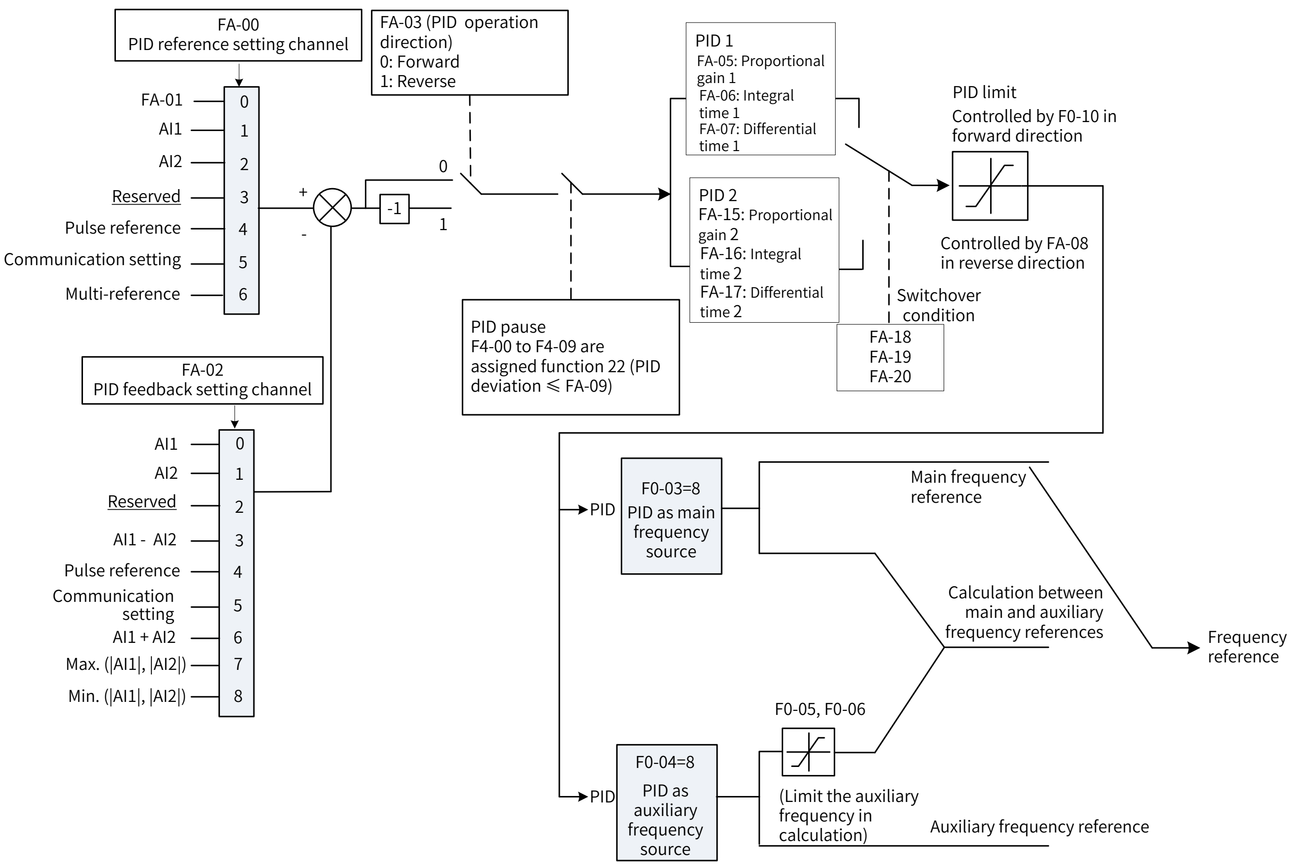


Figure 6-20 Process PID control parameter settings

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FA-00	PID reference setting channel	0	0: FA-01 1: AI1 2: AI2 3: Reserved 4: Pulse reference (DIO1) 5: Communication setting (1000H) 6: Multi-reference	This parameter is used to select the channel for setting the PID target value. The PID target value is a relative value. The value of 100% corresponds to 100% of the feedback value of the controlled system. Note: When FA-00 is set to 6 (Multi-reference), FC-51 (Reference 0 source) cannot be set to 5 (PID).
FA-01	PID digital setting	50.0%	0.0% to 100.0%	This parameter must be set when FA-00 (PID reference setting channel) is set to 0. The value of 100% corresponds to the maximum feedback value.
FA-02	PID feedback setting channel	0	0: AI1 1: AI2 2: Reserved 3: AI1 - AI2 4: Pulse reference (DIO1) 5: Communication setting (1000H) 6: AI1 + AI2 7: Max. (|AI1|, |AI2|) 8: Min. (|AI1|, |AI2|)	This parameter is used to select the channel for setting the PID feedback.
FA-03	PID operation direction	0	0: Normal	If the feedback signal value is smaller than the PID reference signal value, the drive's output frequency increases.
			1: Inverse	If the feedback signal value is smaller than the PID reference signal value, the drive's output frequency decreases.
FA-04	PID reference and feedback range	1000	0 to 65535	The value of this parameter is dimensionless and is only used to display the PID reference and feedback values. For example, when this parameter is set to 1000, the PID reference (0% to 100%) and feedback (0 to 1000) have a linear relation.
FA-05	Proportional gain Kp1	20.0	0.0 to 1000.0	In most of the systems only the PI regulator has to be adjusted.
FA-06	Integral time Ti1	2.00s	0.01s to 10.00s	
FA-07	Differential time Td1	0.000s	0.000s to 10.000s	
FA-08	PID output limit in reverse direction	0.00 Hz	0.00 Hz to the maximum frequency	When the frequency source is pure PID, the minimum value of the PID output is the value set in this parameter..
FA-09	PID deviation limit	0.0%	0.0% to 100.0%	This parameter helps to maintain both the precision and stability of system output.
FA-10	PID differential limit	0.10%	0.00% to 100.0%	In the PID regulator, the differential value often causes system oscillation and is therefore restricted within a narrow range. FA-10 is used to set the PID differential output value range.
FA-11	PID reference change time	0.00s	0.00s to 650.00s	This parameter is used to set the time required for the PID reference value to change from 0.0% to 100.0%.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FA-12	PID feedback filter time	0.00s	0.00s to 60.00s	PID feedback filter reduces the impact of interference on feedback signals, but also slows down response of the closed-loop system.
FA-13	PID deviation gain	100.0%	0.0% to 100.0%	-
FA-15	Proportional gain Kp2	20.0	0.0 to 1000.0	These parameters are used for switchover with the other group of PID parameters, which can be controlled manually using DI terminals or automatically based on PID deviations. Parameters FA-15 to FA-17 are set similarly to parameters FA-05 to FA-07.
FA-16	Integral time Ti2	2.00s	0.01s to 10.00s	
FA-17	Differential time Td2	0.000s	0.000s to 10.000s	
FA-18	PID parameter switchover condition	0	0: No switchover	-
			1: Switchover via DI	DI function selection must be set to 43 (PID parameter switchover terminal). When this terminal is invalid, parameter group 1 (FA-05 to FA-07) is used. When this terminal is valid, parameter group 2 (FA-15 to FA-17) is used.
			2: Auto switchover based on deviation	When the absolute value of the deviation between the reference and feedback values is smaller than PID deviation 1 for auto switchover (FA-19), parameter group 1 is used for PID control. When the absolute value of the deviation between the reference and feedback values is greater than PID deviation 2 for auto switchover (FA-20), parameter group 2 is used for PID control. When the deviation between the reference and feedback values is between PID deviation 1 and deviation 2 for auto switchover, the linear interpolated values of the two groups of PID parameters are used, as shown in the following figure.
			3: Auto switchover based on running frequency	In this auto switchover mode, when the drive runs at a frequency between 0 Hz and the maximum frequency, the linear interpolated values of the two groups of PID parameters are used.
			6: Auto adjustment based on winding diameter	In this auto switchover mode, when the current winding diameter changes between B0-08 (Maximum winding diameter) and B0-09 (Reel diameter), the linear interpolated values of the two groups of PID parameters are used. The minimum winding diameter corresponds to PID parameter group 1 (FA-05 to FA-07), and the maximum winding diameter corresponds to PID parameter group 2 (FA-15 to FA-17).
			7: Auto adjustment based on percentage of maximum winding diameter	In this auto switchover mode, when the current winding diameter changes between B0-08 (Maximum winding diameter) x FA-20 (PID deviation 2 for auto switchover) and B0-08 (Maximum winding diameter) x FA-19 (PID deviation 1 for auto switchover), the linear interpolated values of the two groups of PID parameters are used.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FA-19	PID deviation 1 for auto switchover	20.0%	0.00 to FA-20	The value of 100% corresponds to the maximum deviation between the reference and feedback values. These parameters take effect when FA-18 is set to 2.
FA-20	PID deviation 2 for auto switchover	80.0%	FA-19 to 100.0%	
FA-21	PID initial value	0.0%	0.0% to 100.0%	Upon startup of the drive, the PID output stays at the initial value (FA-21) for a specified period (PID initial value active time set by FA-22). Then, the PID regulator starts the closed-loop control calculation. "Figure 6-22 PID initial value function" shows a sketch diagram of the PID initial value function.
FA-22	PID initial value active time	0.00s	0.00s to 650.00s	-
FA-25	PID integral property	0	Stop integral operation 0: Disabled 1: Enabled	When this parameter is set to 0, the integral operation stop function is invalid no matter whether the DI function is valid.
FA-26	Detection level of PID feedback loss	0.0%	0.0%: No detection; 0.1% to 100.0%	-
FA-27	Detection time of PID feedback loss	0.0s	0.0s to 20.0s	This parameter is used to determine whether the PID feedback is lost. When the PID feedback value stays below FA-26 longer than FA-27, the drive reports Error 31.

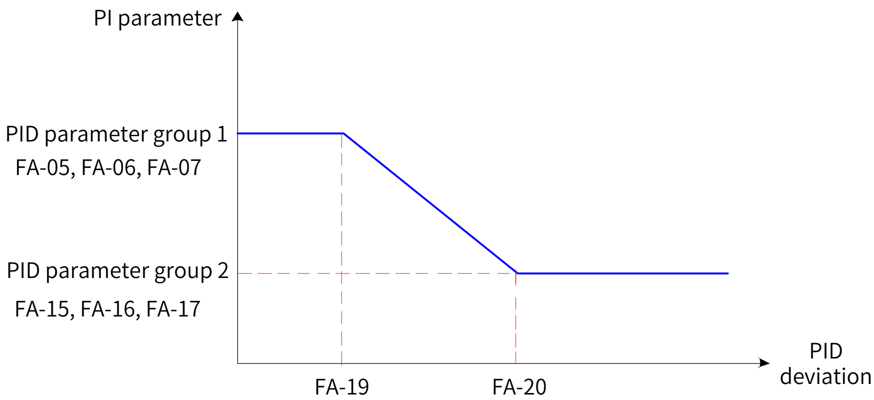


Figure 6-21 PID parameter switchover

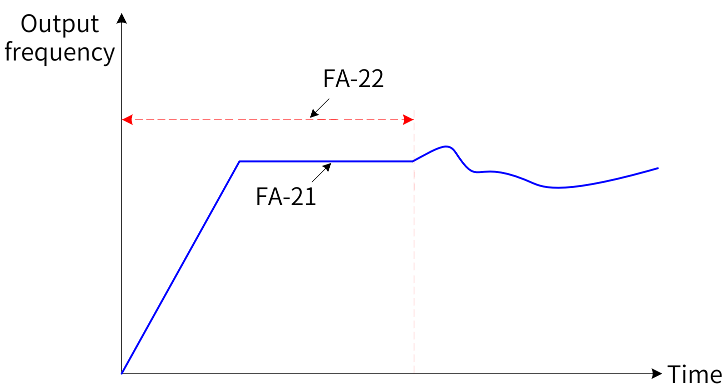


Figure 6-22 PID initial value function

NOTE

- When PID is used as the main frequency source, the upper limit, lower limit, and value range of the output frequency are described as follows (example: pure PID or main frequency + PID as the frequency source).

  When the PID output limit in reverse direction is 0 or reverse running is disabled (one of the following three conditions):

  (1) FA-08 = 0, F8-13 = 0; (2) FA-08=0, F8-13 = 1; (3) FA-08 ≠ 0, F8-13 = 1

  Output upper limit: frequency reference upper limit

  Output lower limit: frequency reference lower limit

  Output range: F0-14 (Frequency reference lower limit) to F0-12 (Frequency reference upper limit)

  When the PID output limit in reverse direction is not 0 and reverse running is enabled (FA-08 ≠ 0, F8-13 = 0):

  Output upper limit: frequency reference upper limit

  Output lower limit: frequency reference lower limit: -PID output limit in reverse direction

  Output range: -FA-08 (-PID output limit in reverse direction) to F0-12 (Frequency reference upper limit)
- For details about PID adjustment, see "7.5 PID Adjustment Methods".

6.2.8 Setting the Main Frequency Using Communication Mode

The following table describes different communication addresses.

Communication Address	Supported Communication Type	Description
0x1000	CANlink, Modbus, PROFIBUS-DP	Percentages of -100.00% to +100.00% corresponding to values of -10000 to 10000
0x7310	CANopen, CANlink, Modbus, PROFIBUS-DP	The value has two decimal places. For example, if you enter a decimal number of 1000, the frequency reference is set to 10.00 Hz. Note that frequency reference cannot be used together with speed reference (0x7317).
0x7317	CANopen, CANlink, Modbus, PROFIBUS-DP	The unit is 1 revolution per minute (RRM). Note that speed reference cannot be used together with frequency reference (0x7310).

6.2.9 Selecting an Auxiliary Frequency Source

Set F0-04 (Auxiliary frequency source Y selection) to select a source of the auxiliary frequency reference. The drive supports nine sources of auxiliary frequency reference: digital setting (non-retentive at power failure), digital setting (retentive at power failure), AI1, AI2, pulse reference, multi-reference, simple PLC, PID, communication setting, and synchronous control, as shown in the following figure.

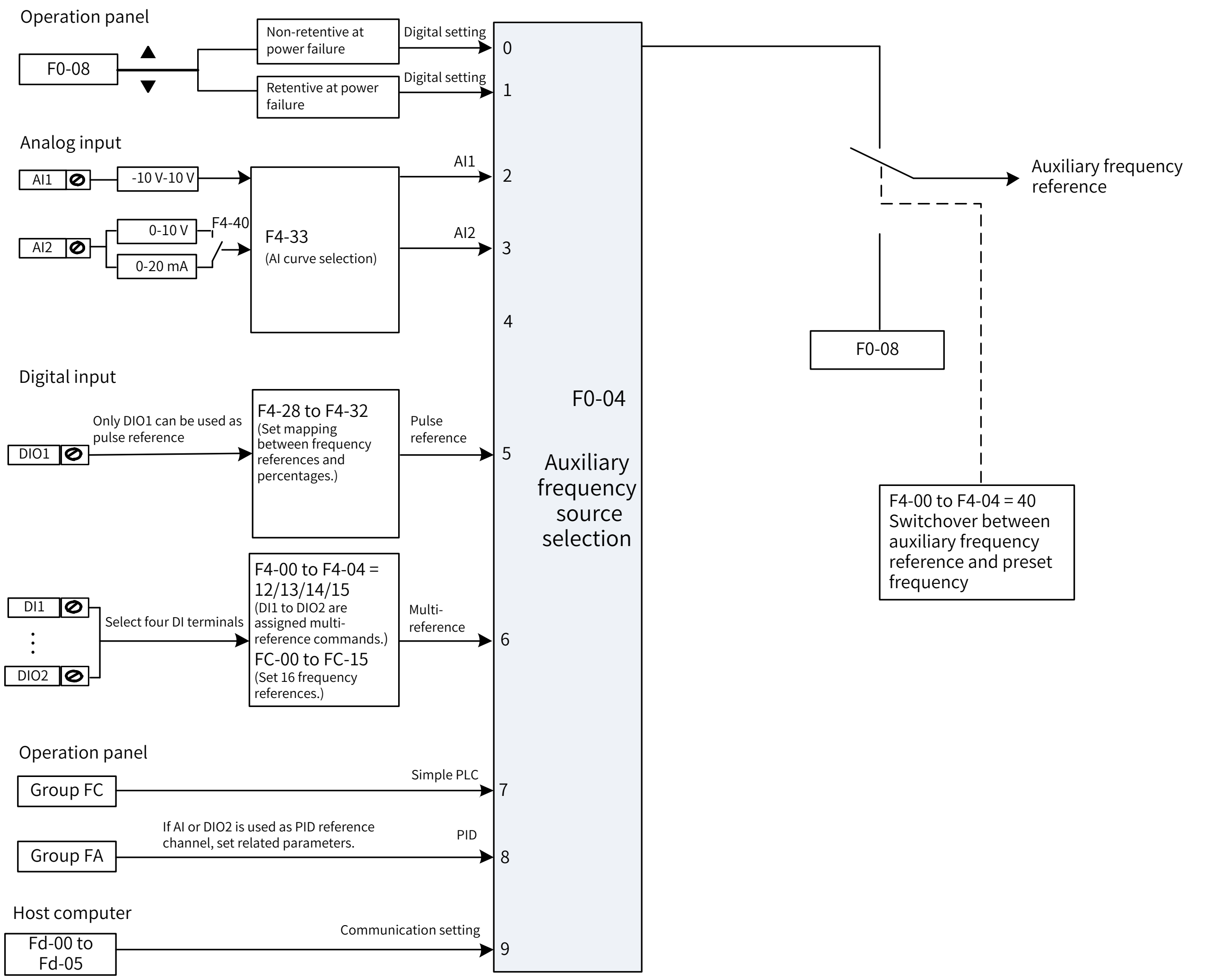


Figure 6-23 Selection of the auxiliary frequency source

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-04	Auxiliary frequency source Y selection	0	0	Operating panel (digital setting, non-retentive at power failure)
			1	Operating panel (digital setting, retentive at power failure)
			2	AI1
			3	AI2
			5	Pulse reference (DIO1)
			6	Multi-reference
			7	Simple PLC
			8	PID
			9	Communication setting

When the auxiliary frequency reference is used independently for frequency setting, it is set in the same way as the main frequency reference. When the auxiliary frequency reference is used together with the main frequency reference for frequency setting, set it according to "6.2.10 Setting the Frequency Based on Main and Auxiliary Calculation".

6.2.10 Setting the Frequency Based on Main and Auxiliary Calculation

The main and auxiliary frequency references can be used together for frequency setting. You can use F0-07 (Final frequency reference setting selection) to set the relation between the target frequency and the main and auxiliary frequency references. Four relations are available:

1) Main frequency reference: The main frequency reference is used as the target frequency directly.
2) Auxiliary frequency reference: The auxiliary frequency reference is used as the target frequency directly.
3) Main and auxiliary calculation: Five calculation methods are supported, namely, main frequency + auxiliary frequency, main frequency - auxiliary frequency, max. (main frequency, auxiliary frequency), min. (main frequency, auxiliary frequency), and main frequency x auxiliary frequency.
4) Frequency switchover: The final frequency reference switches among the preceding references through terminal selection or automatic switchover. In this mode, the DI function selection parameter must be set to 18 (frequency source switchover).

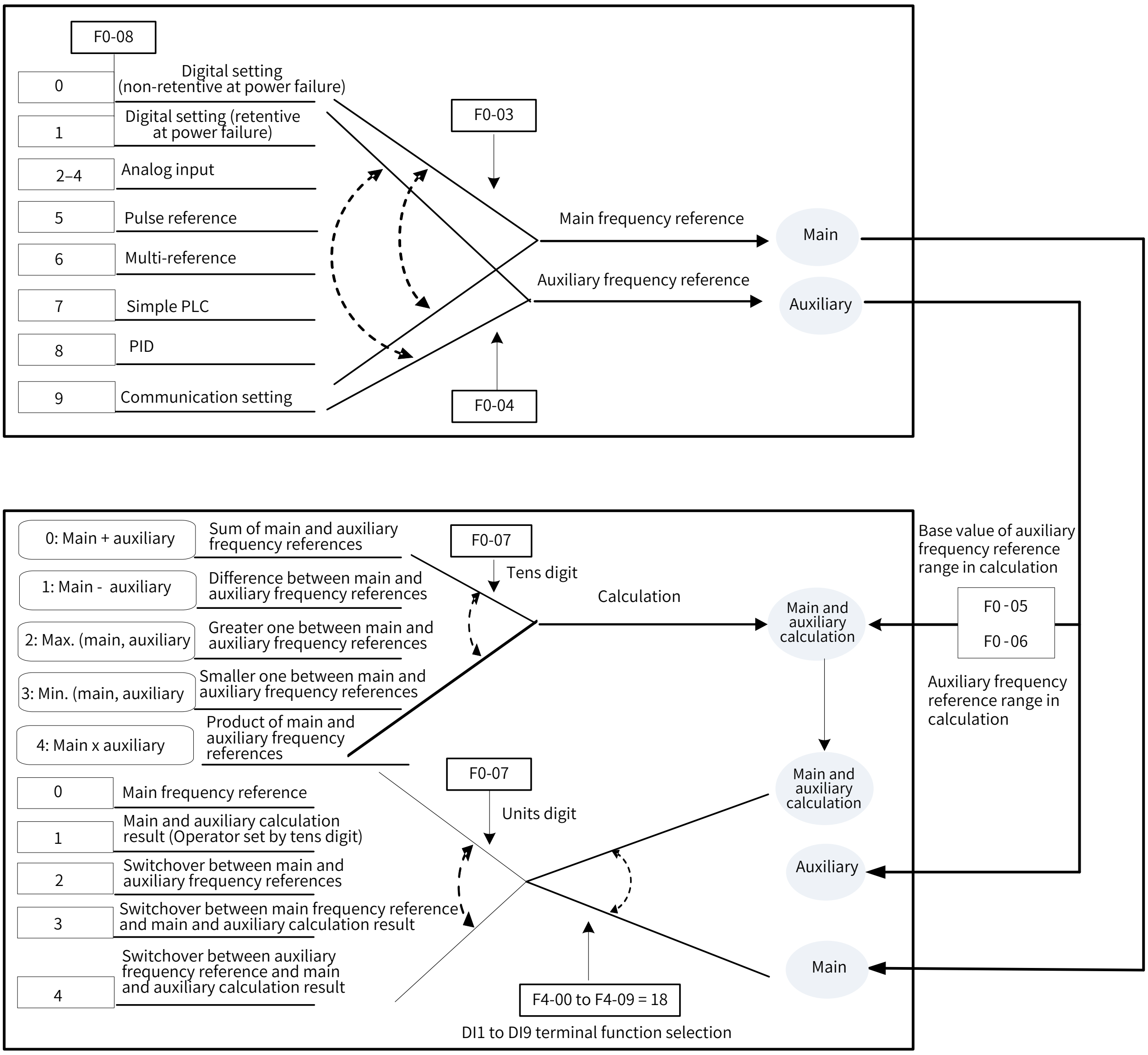


Figure 6-24 Final frequency setting based on main and auxiliary frequency references

Parameter No.	Parameter Name	Default	Setting Range
F0-07	Final frequency reference setting selection	00	Ones position: Frequency source selection 0: Main frequency reference X 1: Main and auxiliary calculation result (based on tens position) 2: Switchover between main frequency reference X and auxiliary frequency reference Y 3: Switchover between main frequency reference X and main and auxiliary calculation result 4: Switchover between auxiliary frequency reference Y and main and auxiliary calculation result Tens position: Main and auxiliary calculation relationship 0: Main + auxiliary 1: Main - auxiliary 2: Max. (main, auxiliary) 3: Min. (main, auxiliary) 4: Main x Auxiliary

The following table describes the main and auxiliary calculation methods.

Calculation Method	Main Frequency Source Selection	Auxiliary Frequency Source Selection	Description
+	Digital setting	AI, pulse reference, multi-reference, simple PLC, or communication setting	1. UP/DOWN adjustment is invalid. 2. Output range: F0-08 (Preset frequency) + auxiliary frequency reference.
	AI, pulse reference, multi-reference, simple PLC, or communication setting	Digital setting	1. UP/DOWN adjustment is valid. 2. Output range: main frequency reference + UP/DOWN.
	Digital setting	PID	1. UP/DOWN adjustment is invalid. 2. Digital setting is fixed to 0. 3. Output range: auxiliary frequency reference.
	PID	Digital setting	1. UP/DOWN adjustment is invalid. 2. Digital setting is fixed to 0. Output range: main frequency reference
	AI, pulse reference, multi-reference, simple PLC, or communication setting	PID	1. UP/DOWN adjustment is invalid. 2. The minimum frequency is invalid. 3. Output range: main frequency reference + auxiliary frequency reference
	PID	AI, pulse reference, multi-reference, simple PLC, or communication setting	1. UP/DOWN adjustment is invalid. 2. Output: auxiliary frequency reference
	Digital setting	Digital setting	1. UP/DOWN adjustment is valid. 2. Output range: main frequency reference + UP/DOWN, same as single-reference digital setting
-/x/Max/Min	Any source	Any source	1. When digital setting is used, UP/DOWN adjustment is invalid, and the initial frequency value is set by F0-08 (Preset frequency). 2. PID is invalid when it is used. 3. Simple PLC is invalid when it is used. 4. When digital setting is used for both main and auxiliary frequency references, the main frequency reference is valid, the auxiliary reference is invalid, and UP/DOWN adjustment is valid.

Calculation Method	Main Frequency Source Selection	Auxiliary Frequency Source Selection	Description
Single frequency source	Digital setting	-	1. UP/DOWN adjustment is valid. 2. Output main frequency value + UP/DOWN adjustment 3. UP/DOWN adjustment range: (maximum frequency - main frequency) to (minimum frequency - main frequency) 4. UP/DOWN adjustment cannot reverse the frequency direction.
	PID	-	1. The minimum frequency is invalid. 2. PID output range: PID output lower limit to maximum frequency. 3. When reverse running is disabled and the PID output lower limit is set to a negative value, 0 is taken as the PID output lower limit.
	Other		None

Parameter No.	Parameter Name	Default	Setting Range
F0-05	Base value of range of auxiliary frequency source Y for main and auxiliary calculation	0	0: Maximum frequency 1: Main frequency reference X
F0-06	Range of auxiliary frequency source Y for main and auxiliary calculation	100%	0% to 150%

These two parameters take effect only in main frequency + auxiliary frequency calculation to limit the range of the auxiliary frequency.

Parameter No.	Parameter Name	Default	Setting Range
F0-27	Main frequency reference coefficient	10.00%	0.00% to 100.00%
F0-28	Auxiliary frequency coefficient	10.00%	0.00% to 100.00%

These two parameters are used for main frequency x auxiliary frequency calculation. Assuming that the main frequency is Frq1, and the auxiliary frequency is Frq2, the target frequency is calculated as follows:

Frq = (Frq1 x F0-27) x (Frq2 x F0-28)

6.2.11 Setting the Frequency Reference Limits (Frequency Setting)

Frequency reference upper limit: controls the maximum frequency if the motor is not allowed to run at a frequency above a specific value.

Frequency reference lower limit: controls the minimum frequency if the motor is not allowed to run at a frequency below a specific value.

Maximum frequency: controls the maximum output frequency.

Setting channel of frequency reference upper limit: used to select the source of the frequency reference upper limit.

Frequency reference upper limit offset: used to set the offset of the frequency reference upper limit. This parameter takes effect only when the source of the frequency reference upper limit is AI.

Parameter No.	Parameter Name	Default	Setting Range
F0-10	Maximum frequency	50.00 Hz	5.00 Hz to 600.00 Hz
F0-11	Setting channel of frequency reference upper limit	0	0: Set by F0-12 (Frequency reference upper limit) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting 6: Multi-reference
F0-12	Frequency reference upper limit	50.00 Hz	F0-14 (Frequency reference lower limit) to F0-10 (Maximum frequency)
F0-13	Frequency reference upper limit offset	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)
F0-14	Frequency reference lower limit	0.00 Hz	0.00 Hz to F0-12 (Frequency reference upper limit)

6.2.12 Setting the Running Mode for Frequency Below the Frequency Lower Limit

If the running frequency of the drive is lower than the frequency reference lower limit, set F8-14 (Running mode when frequency reference lower than frequency lower limit) to select a running mode for the drive.

Run at zero speed: The drive runs with output frequency 0, and the RUN indicator on the operating panel is on.

Stop: The drive does not run, and the RUN indicator on the operating panel is off.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-14	Running mode when frequency reference lower than frequency lower limit	0	0: Run at frequency lower limit	If the running frequency is lower than the frequency lower limit, the drive runs at the frequency lower limit.
			1: Stop	If the running frequency is lower than the frequency lower limit, the drive stops。
			2: Run at zero speed	If the running frequency is lower than the frequency lower limit, the drive runs at zero speed.

6.3 Start and Stop Modes

This section describes the drive start and stop modes.

6.3.1 Start Modes

A drive supports three startup modes: direct startup, flying start, and vector pre-excitation startup. Set F6-00 (Start mode) to select a drive startup mode according to the following table.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F6-00	Start mode	0	0: Direct startup 1: Flying start (AC asynchronous motor) 2: Vector pre-excitation startup (AC asynchronous motor)	Flying start is recommended if you want to start a motor running at a high speed. Flying start and vector pre-excitation startup can only be used for AC asynchronous motors.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F6-01	Flying start mode	0	0: From stop frequency 1: From 50 Hz 2: From F0-10 (Maximum frequency)	This parameter takes effect only in V/F control mode.
F6-02	Flying start speed	20	1 to 100	This parameter takes effect only in V/F control mode.
F6-03	Startup frequency	0.00 Hz	0.00 Hz to 10.00 Hz	When the frequency reference is lower than the startup frequency, the drive runs at the startup frequency.
F6-04	Startup frequency active time	0.0s	0.0s to 100.0s	This parameter does not take effect during a switchover of the running direction. The startup frequency active time is not included in the acceleration time but is included in the simple PLC running time.
F6-05	Startup DC injection braking current/ pre-excited current	50%	0% to 100%	A higher DC injection braking current means a larger braking force. The value of 100% corresponds to the motor's rated current (current upper limit: 80% of the drive's rated current).
F6-06	Startup DC injection braking active time/pre-excitation active time	0.0s	0.0s to 100.0s	Startup DC injection braking takes effect only in direct startup mode.

1) Direct startup

When F6-00 (Start mode) is set to 0 (Direct startup), the drive uses the direct startup mode. This mode is applicable to most of loads. Its sequence is shown in "Figure 6-25 Sequence of direct startup". Direct startup with startup frequency is applicable to lifting loads, such as elevators and cranes. Its sequence is shown in "Figure 6-26 Sequence of direct startup with startup frequency". Direct startup with DC injection braking is applicable to scenarios where motors may be spinning upon startup of the drive. Its sequence is shown in "Figure 6-27 Sequence of direct startup with DC braking".

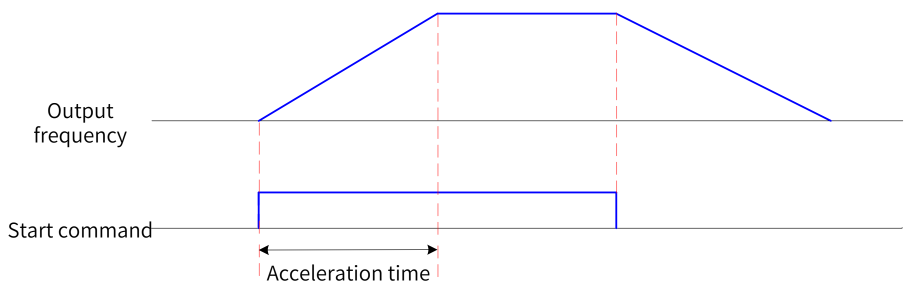


Figure 6-25 Sequence of direct startup

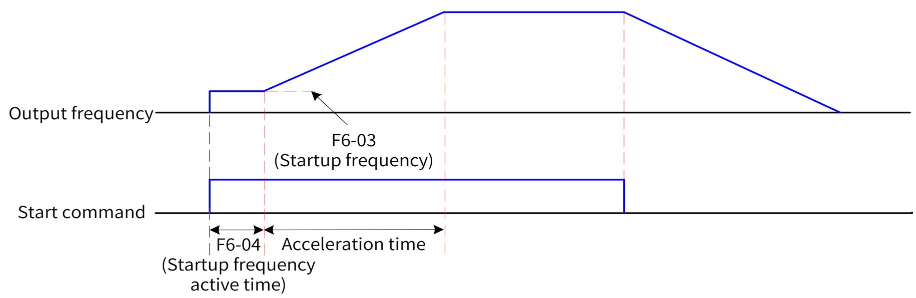


Figure 6-26 Sequence of direct startup with startup frequency

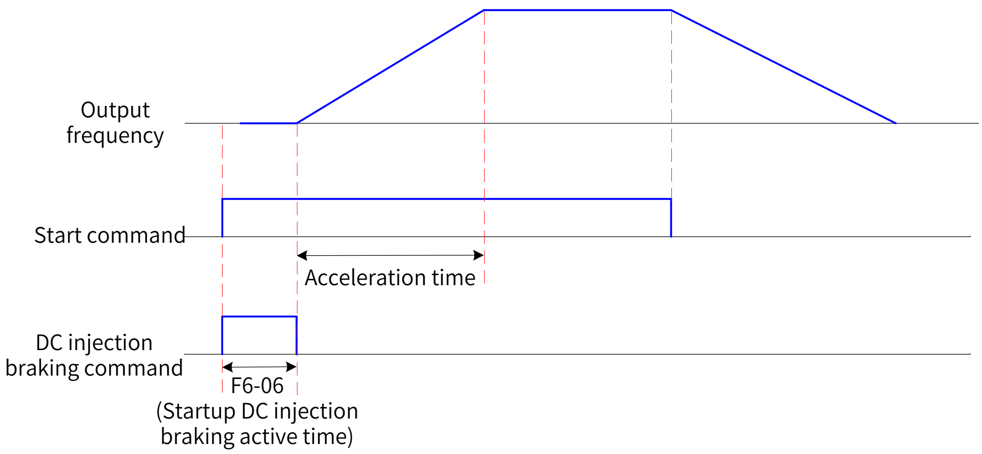


Figure 6-27 Sequence of direct startup with DC braking

2) Flying start

When F6-00 (Start mode) is set to 1, the drive first determines the motor rotation speed and direction, and then starts at the detected frequency of the motor. This mode is applicable to high-inertia mechanical loads. If the motor is still spinning at inertia before startup of the drive, this startup mode can prevent overcurrent upon startup. The following diagram shows the frequency curve during the startup process.

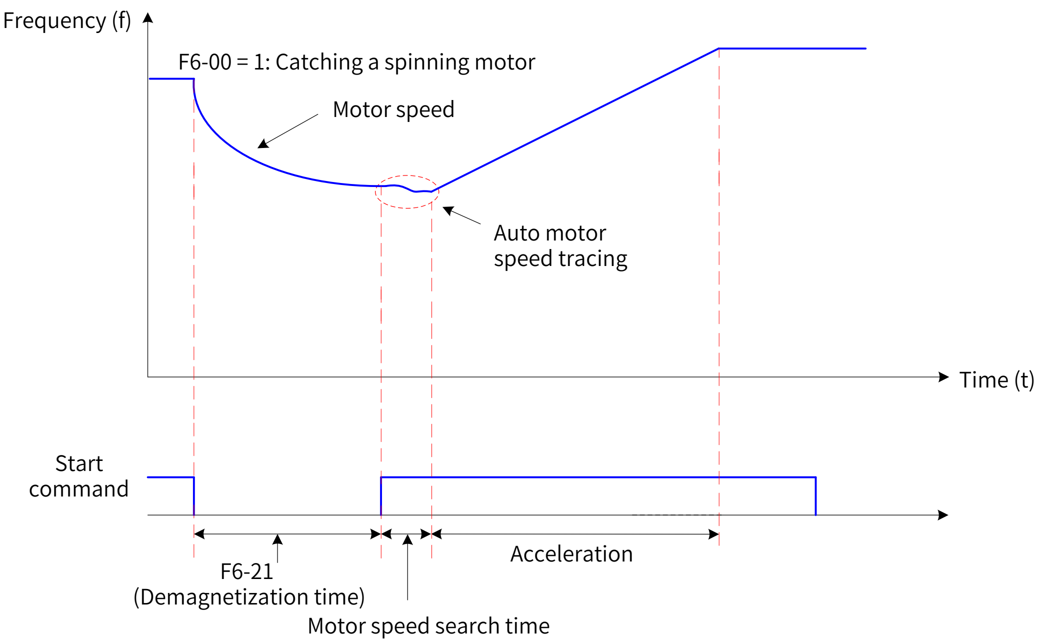


Figure 6-28 Flying start

3) Vector pre-excitation startup

When F6-00 (Start mode) is set to 2, the drive uses the vector pre-excitation startup mode. This mode is applicable only to the SVC and FVC modes of asynchronous motors. Before startup, the drive performs pre-excitation for the motor, which speeds up response of the motor and reduces the startup current. The sequence of this mode is the same as that of startup after DC injection braking. It is recommended that the pre-excited current be set to 1.5 times F1-10 (Asynchronous motor no-load current). The maximum pre-excited current cannot exceed the motor's rated current. If the pre-excited current is equal to F1-10 (Asynchronous motor no-load current), the optimal pre-excitation time is three times the rotor time constant. The rotor time constant is calculated using the following formula: F1-09 (Asynchronous motor mutual inductive reactance) + F1-08 (Asynchronous motor leakage inductive reactance)/F1-07 (Asynchronous motor rotor resistance). The unit of mutual inductive reactance and leakage inductive reactance is H, and the unit of rotor resistance is Ω. If the pre-excited current is larger than the no-load current, increase the pre-excitation time proportionally.

6.3.2 Stop Modes

A drive supports two stop modes: decelerate to stop and coast to stop. Set F6-10 (Stop mode) to select a drive stop mode according to the following table.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F6-10	Stop mode	0	0: Decelerate to stop 1: Coast to stop	
F6-11	Shutdown DC injection braking/ Position lock start frequency	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	During a decelerate-to-stop process, the drive starts DC injection braking or position lock when the running frequency drops to this frequency. The recommended start frequency for shutdown DC injection braking is 2% of the motor's rated frequency.
F6-12	Shutdown DC injection braking delay time	0.0s	0.0s to 100.0s	When the running frequency drops to the shutdown DC injection braking start frequency, the drive stops output for a certain period, and then starts DC injection braking.
F6-13	Shutdown DC injection braking current	50%	0% to 100%	A higher DC injection braking current means a larger braking force. The value of 100% corresponds to the motor's rated current (current upper limit: 80% of the drive's rated current).
F6-14	Shutdown DC injection braking active time	0.0s	0.0s to 100.0s	When the shutdown DC injection braking active time is 0, the DC injection braking process is canceled.

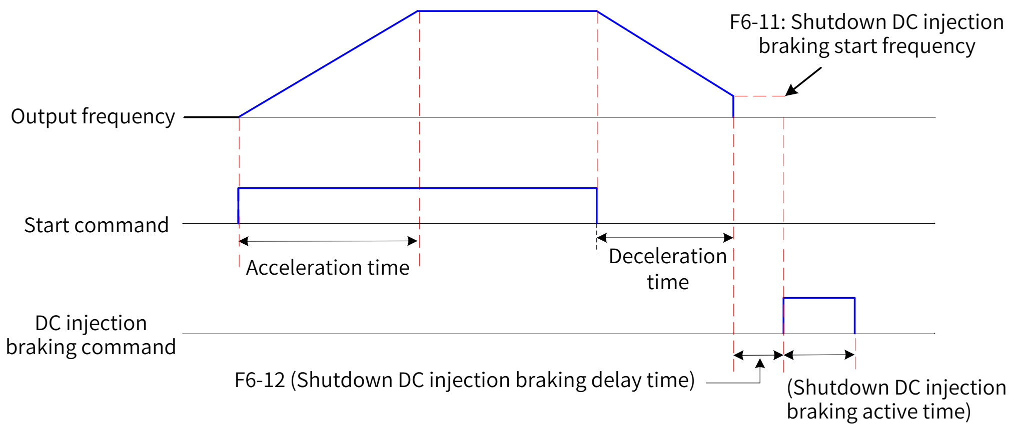


Figure 6-29 Sequence of shutdown DC injection braking

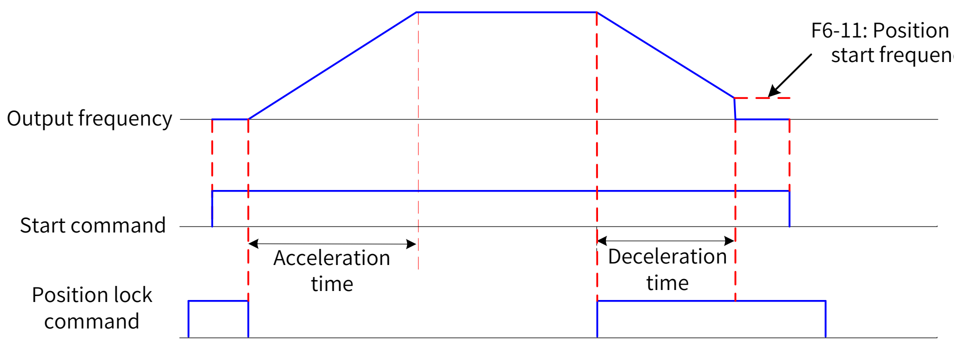


Figure 6-30 Sequence of position lock

1) Decelerate to stop

When F6-10 (Stop mode) is set to 0 (Decelerate to stop), the drive decelerates to stop. (After the STOP command takes effect, the drive reduces the output frequency based on the deceleration time, and the motor stops when the output frequency drops to 0.)

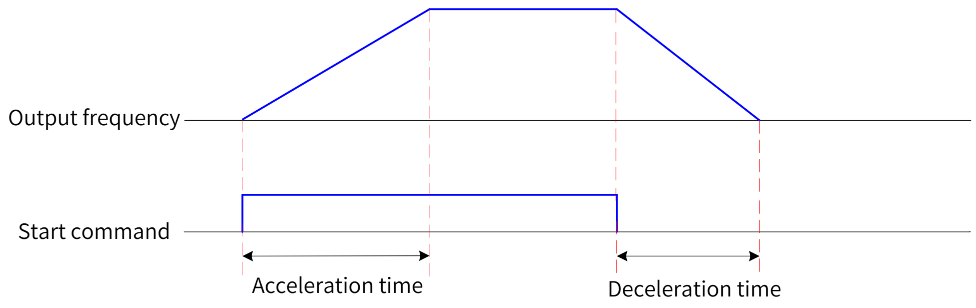


Figure 6-31 Decelerate-to-stop sequence

2) Coast to stop

When F6-10 (Stop mode) is set to 1 (Coast to stop), the drive coasts to stop. (After the STOP command takes effect, the drive stops output immediately. Then, the motor coasts to stop following mechanical inertia and load.)

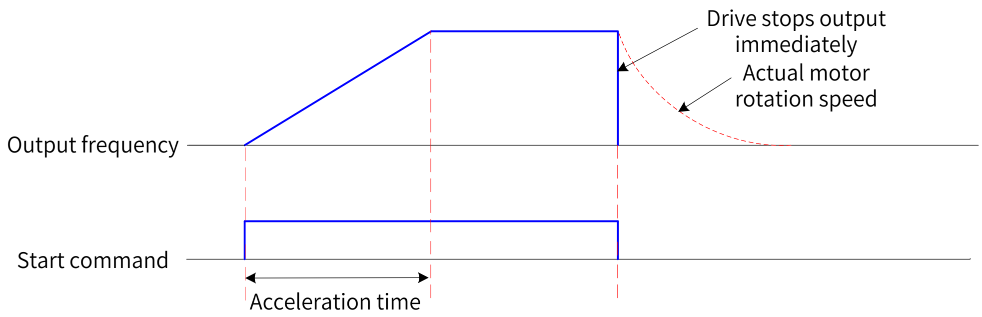


Figure 6-32 Coast-to-stop sequence

6.3.3 Setting the Acceleration/Deceleration Time and Curve

The acceleration time is the time that a drive spends to accelerate from zero frequency to F0-25 (Acceleration/Deceleration time base frequency). The deceleration time is the time that the drive spends to decelerate from F0-25 (Acceleration/Deceleration time base frequency) to zero frequency.

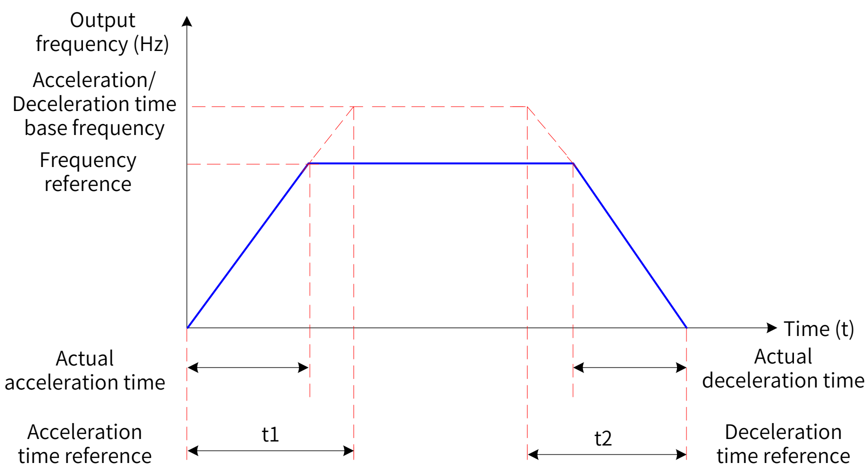


Figure 6-33 Acceleration/Deceleration time

MD810 provides four groups of acceleration/deceleration time, which can be selected using DI terminals. For example, you can select DI1 and DI2 as the acceleration/deceleration time switchover terminals.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-00	DI1 function selection	16	Terminal 1 for acceleration/deceleration selection
F4-01	DI2 function selection	17	Terminal 2 for acceleration/deceleration selection

DI1 State	DI2 State	Acceleration/Deceleration Time Selection
OFF	OFF	Group 1: F0-17 (Acceleration time 1), F0-18 (Deceleration time 1)
ON	OFF	Group 2: F8-03 (Acceleration time 2), F8-04 (Deceleration time 2)
OFF	ON	Group 3: F8-05 (Acceleration time 3), F8-06 (Deceleration time 3)
ON	ON	Group 4: F8-07 (Acceleration time 4), F8-08 (Deceleration time 4)

Table 6-2 Acceleration/Deceleration time selection by DI terminals

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-17	Acceleration time 1	Model dependent	0s to 65000s	F0-19 (Acceleration/Deceleration time unit) = 0 (1s)
			0.0s to 6500.0s	F0-19 (Acceleration/Deceleration time unit) = 1 (0.1s)
			0.00s to 650.00s	F0-19 (Acceleration/Deceleration time unit) = 2 (0.01s)
F0-18	Deceleration time 1	Model dependent	0s to 65000s	F0-19 (Acceleration/Deceleration time unit) = 0 (1s)
			0.0s to 6500.0s	F0-19 (Acceleration/Deceleration time unit) = 1 (0.1s)
			0.00s to 650.00s	F0-19 (Acceleration/Deceleration time unit) = 2 (0.01s)
F8-03	Acceleration time 2	Model dependent	Same as value range of F0-17 (Acceleration time 1)	-
F8-04	Deceleration time 2	Model dependent	Same as value range of F0-18 (Deceleration time 1)	-
F8-05	Acceleration time 3	Model dependent	Same as value range of F0-17 (Acceleration time 1)	-
F8-06	Deceleration time 3	Model dependent	Same as value range of F0-18 (Deceleration time 1)	-
F8-07	Acceleration time 4	0.0s	Same as value range of F0-17 (Acceleration time 1)	-
F8-08	Deceleration time 4	0.0s	Same as value range of F0-18 (Deceleration time 1)	-
F0-19	Acceleration/ Deceleration time unit	1	0: 1s 1: 0.1s 2: 0.01s	This parameter determines the number of decimal places in the four groups of acceleration/ deceleration time.
F0-25	Acceleration/ Deceleration time base frequency	0	0: Maximum frequency 1: Frequency reference 2: 100 Hz	-

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F6-07	Acceleration/ Deceleration mode	0	0: Linear acceleration/ deceleration	This parameter is used to select the frequency change mode during the start and stop processes of a drive. 0: The output frequency increases or decreases linearly. 1: When the target frequency changes dynamically in real time, the output frequency increases or decreases in real time following an S curve. This change mode is applicable to scenarios requiring high comfort and capable of real-time response.
			1: S-curve acceleration/ deceleration	
F6-08	Time proportion of S-curve start segment	30.0%	0.0% to (100.0% - F6-09)	The values of F6-08 and F6-09 must meet the following condition: F6-08 + F6-09 ⩽ 100.0%
F6-09	Time proportion of S-curve end segment	30.0%	0.0% to (100.0% - F6-08)	-

6.4 Motor Auto-tuning

Motor auto-tuning is an operation that a drive performs to obtain motor parameters.

Available motor auto-tuning methods are: asynchronous motor static partial auto-tuning, asynchronous motor dynamic complete auto-tuning, and asynchronous motor static complete auto-tuning.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-37	Auto-tuning selection	0	0: No operation	Motor auto-tuning is disabled.
			1: Asynchronous motor static partial auto-tuning	The drive only obtains some of motor parameters through auto-tuning, including the stator resistance, rotor resistance, and leakage inductive reactance.
			2: Asynchronous motor complete auto-tuning	The drive obtains all motor parameters through auto-tuning. In FVC mode, encoder parameters (F1-27 to F1-34) need to be checked.
			3: Asynchronous motor static complete auto-tuning	The drive obtains all motor parameters through auto-tuning and automatically identifies the running direction of the encoder.

The following table compares the effects of these motor auto-tuning methods.

Auto-tuning Method	Applicable Scenario	Result
Asynchronous motor static partial auto-tuning	It is difficult to separate the motor from the load, and dynamic auto-tuning is not allowed.	Moderate
Asynchronous motor dynamic complete auto-tuning	The motor can be easily separated from the application system.	Best
Asynchronous motor static complete auto-tuning	It is difficult to separate the motor from the load, and dynamic complete auto-tuning is not allowed.	Better

1) Asynchronous motor static partial auto-tuning procedure

Step	Operation
Step 1	After powering on the drive, select the LED operating panel as the command source (set F0-02 to 0).
Step 2	Enter motor parameters (F1-00 to F1-05) correctly according to its nameplate.

Step	Operation
Step 3	Set F1-37 (Auto-tuning selection) to 1 (Asynchronous motor static auto-tuning) and press ENTER on the operating panel. The display on the panel is: 
Step 4	Press and hold down the ENTER key for more than 3s. The motor does not turn but the drive powers it on. The RUN indicator turns on. When the preceding display disappears and the operating panel displays parameters normally, the auto-tuning process is completed. After auto-tuning, the drive automatically calculates the values of F1-06 (Asynchronous/Synchronous motor stator resistance) to F1-08 (Asynchronous motor leakage inductive reactance).

2) Asynchronous motor dynamic complete auto-tuning procedure

When a drive is connected to a motor with constant output or used in a scenario requiring high precision, use dynamic complete auto-tuning after separating the motor from the load, to achieve the best auto-tuning effect.

Step	Operation
Step 1	After powering on the drive, select the operating panel as the drive command source (set F0-02 to 0).
Step 2	Enter motor parameters (F1-00 to F1-05) correctly according to its nameplate.
Step 3	If F0-01 (1st motor control mode) is set to 1 (FVC), enter encoder parameters (F1-27, F1-28, and F1-30).
Step 4	Set F1-37 (Auto-tuning selection) to 2 (Asynchronous motor complete auto-tuning) and press ENTER on the operating panel. The display on the panel is: 
Step 5	Press and hold down the ENTER key for more than 3s. The drive then drives the motor to accelerate, decelerate, or run in forward or reverse direction, and the RUN indicator turns on. The auto-tuning process lasts for a certain period. When the preceding display disappears and the operating panel displays parameters normally, the auto-tuning process is completed. After complete auto-tuning, the drive automatically calculates the values of F1-06 (Asynchronous/Synchronous motor stator resistance) to F1-10 (Asynchronous motor no-load current) and F1-30 (Encoder wiring flag).

3) Asynchronous motor static complete auto-tuning procedure

Use static complete auto-tuning when the motor cannot be separated from the load.

Step	Operation
Step 1	After powering on the drive, select the operating panel as the command source (set F0-02 to 0).
Step 2	Enter motor parameters (F1-00 to F1-05) correctly according to its nameplate.
Step 3	Set F1-37 (Auto-tuning selection) to 3 (Asynchronous motor static complete auto-tuning) and press ENTER on the operating panel. The display on the panel is: 
Step 4	Press and hold down the ENTER key for more than 3s. The motor does not turn but the drive powers it on. The RUN indicator turns on. When the preceding display disappears and the operating panel displays parameters normally, the auto-tuning process is completed. After auto-tuning, the drive automatically calculates the values of F1-06 (Asynchronous/Synchronous motor stator resistance) to F1-10 (Asynchronous motor no-load current).

NOTE

- ◆ In addition to the three auto-tuning methods, you can also manually enter motor parameters.
- ◆ In addition to using the LED panel as the command source for motor auto-tuning, you can also use an external LCD operating panel (F0-02 = 0), DI terminals (F0-02 = 1) or communication control (F0-02 = 2) as the command source for motor auto-tuning.
- ◆ For the Modbus, PROFIBUS, and CANopen protocols, the PKW parameters support auto-tuning but the PZD parameters do not. To use communication control for motor auto-tuning, set F1-37 (Auto-tuning selection) to select an auto-tuning mode, and then enter the RUN command.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-00	Motor type selection	0	0	Common asynchronous motor
			1	Variable frequency asynchronous motor
			2	Synchronous motor
F1-01	Rated motor power	Model dependent	0.1 kW to 1000.0 kW	F1-00 to F1-05 are parameters on the motor's nameplate. In V/F control, SVC, or FVC mode, the drive needs to perform motor auto-tuning to achieve better control performance. You must set the parameters on the motor's nameplate correctly to ensure accurate auto-tuning result.
F1-02	Rated motor voltage	Model dependent	1 V to 2000 V	
F1-03	Rated motor current	Model dependent	0.1 A to 6553.5 A	
F1-04	Rated motor frequency	Model dependent	0.01 Hz to F0-10 (Maximum frequency)	
F1-05	Rated motor speed	Model dependent	1 RPM to 65535 RPM	
F1-06	Asynchronous/ Synchronous motor stator resistance	Model dependent	0.001 Ω to 65.535 Ω (drive power ≤ 55 kW) 0.0001 Ω to 6.5535 Ω (drive power > 55 kW)	F1-06 to F1-10 are asynchronous motor parameters, which can be obtained through motor auto-tuning. Asynchronous motor static partial auto-tuning can only obtain parameters F1-06 to F1-08. Asynchronous motor dynamic complete auto-tuning can obtain not only parameters F1-06 to F1-10 but also encoder phase sequence F1-30. If the drive does not perform motor auto-tuning, you can manually set the parameters according to values provided by the motor manufacturer.
F1-07	Asynchronous motor rotor resistance	Model dependent	0.001 Ω to 65.535 Ω (drive power ≤ 55 kW) 0.0001 Ω to 6.5535 Ω (drive power > 55 kW)	
F1-08	Asynchronous motor leakage inductive reactance	Model dependent	0.01 mH to 655.35 mH (drive power ≤ 55 kW) 0.001 mH to 65.535 mH (drive power > 55 kW)	
F1-09	Asynchronous motor mutual inductive reactance	Model dependent	0.1 mH to 6553.5 mH (drive power ≤ 55 kW) 0.01 mH to 655.35 mH (drive power > 55 kW)	
F1-10	Asynchronous motor no-load current	Model dependent	0.01 A to F1-03 (drive power ≤ 55 kW) 0.1 A to F1-03 (drive power > 55 kW)	
F1-17	Synchronous motor axis D inductance	Model dependent	0.01 mH to 655.35 mH (drive power ≤ 55 kW) 0.001 mH to 65.535 mH (drive power > 55 kW)	
F1-18	Synchronous motor axis Q inductance	Model dependent	0.01 mH to 655.35 mH (drive power ≤ 55 kW) 0.001 mH to 65.535 mH (drive power > 55 kW)	
F1-19	Synchronous motor back EMF	Model dependent	0.1 V to 6553.5 V	

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-27	Encoder pulses per revolution	1024	1 to 20000	This parameter is used to set the number of pulses per revolution for the encoder. In feedback vector control (FVC) mode using speed sensors, you must set this parameter correctly. Otherwise, the motor cannot run normally.
F1-28	Encoder type	0	0: ABZ incremental encoder 1: 23-bit encoder 2: Resolver	
F1-29	PG signal filter	1	0: Non-adaptive filter 1: Adaptive filter 2: Fixed interlock 3: Automatic interlock	
F1-30	Encoder wiring flag	0	Ones position: AB signal direction or rotation direction Tens position: Reserved	0: Phase A is ahead of phase B during forward running of the motor (phase B is ahead of phase A during reverse running of the motor). 1: Phase B is ahead of phase A during forward running of the motor (phase A is ahead of phase B during reverse running of the motor).
F1-31	Encoder zero position angle	0.0°	0.0° to 359.9°	
F1-32	Motor gear ratio (numerator)	1	1 to 65535	
F1-33	Motor gear ratio (denominator)	1	1 to 65535	
F1-34	Number of pole pairs of resolver	1	1 to 32	
F1-35	Resolver frequency division coefficient	1	0 to 63	
F1-36	PG card wire-breaking detection	0	0: Disabled 1: Enabled	

6.5 Control Performance

6.5.1 V/F Curve Setting

1) Settings of linear, multi-point, and square V/F curves

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F3-00	V/F curve setting	0	0: Linear V/F 1: Multi-point V/F 2: Square V/F 3: 1.2-power V/F 4: 1.4-power V/F 6: 1.6-power V/F 8: 1.8-power V/F 9: Reserved 10: V/F complete separation 11: V/F half separation	-
F3-01	Torque boost	Model dependent	0.0%: (automatic torque boost) 0.1% to 30.0%	-
F3-02	Cut-off frequency of torque boost	50.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-
F3-03	Multi-point V/F frequency 1	0.00 Hz	0.00 Hz to F3-05 (Multi-point V/F frequency 2)	-
F3-04	Multi-point V/F voltage 1	0.0%	0.0% to 100.0%	
F3-05	Multi-point V/F frequency 2	0.00 Hz	F3-03 (Multi-point V/F frequency 1) to F3-07 (Multi-point V/F frequency 3)	
F3-06	Multi-point V/F voltage 2	0.0%	0.0% to 100.0%	
F3-07	Multi-point V/F frequency 3	0.00 Hz	F3-05 (Multi-point V/F frequency 2) to F1-04 (Rated motor frequency)	
F3-08	Multi-point V/F voltage 3	0.0%	0.0% to 100.0%	

■ General constant-torque linear V/F curve

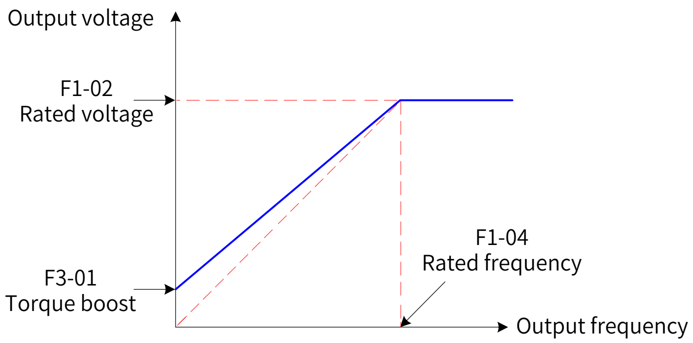


Figure 6-34 General constant-torque linear V/F curve

The output voltage changes linearly with the frequency below the rated motor frequency. This curve is applicable to general mechanical transmission applications, such as high-inertia fan acceleration, punches, centrifuges, and water pumps.

■ User-defined multi-point V/F curve

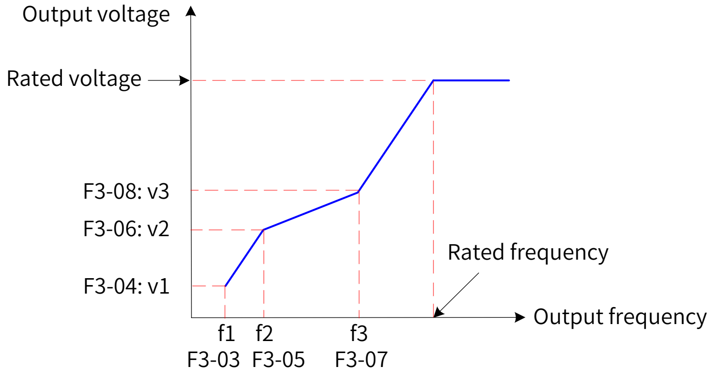


Figure 6-35 User-defined multi-point V/F curve

F3-03 (Multi-point V/F frequency 1) to F3-08 (Multi-point V/F voltage 3) specify user-defined multi-point V/F curves. In these curves, frequency points are in the range of 0.00 Hz to the rated motor frequency, and voltage points are in the range of 0.0% to 100%, corresponding to voltage values of 0 V to the rated motor voltage. Generally, the voltage and frequency values are set based on load characteristics of the motor. The parameter settings must meet the following condition: F3-03 (Multi-point V/F frequency 1) ⩽ F3-05 (Multi-point V/F frequency 2) ⩽ F3-07 (Multi-point V/F frequency 3). The MD810 drive restricts the upper and lower limits of F3-03 (Multi-point V/F frequency 1), F3-05 (Multi-point V/F frequency 2), and F3-07 (Multi-point V/F frequency 3) to ensure correct settings. Set F3-07 (Multi-point V/F frequency 3) first, then F3-05 (Multi-point V/F frequency 2), and finally F3-03 (Multi-point V/F frequency 1).

■ Variable torque square V/F curve

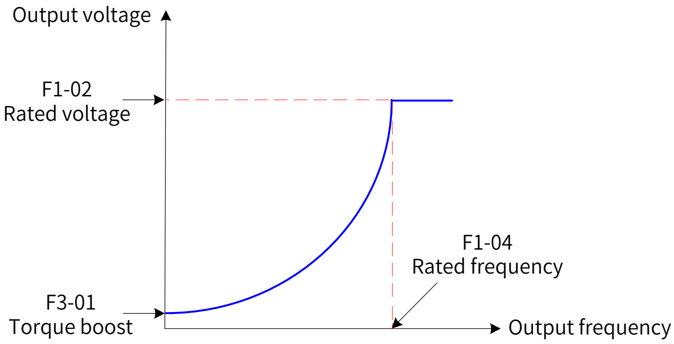


Figure 6-36 Variable torque square V/F curve

Output voltage and output frequency change according to square curve when below the rated frequency. It is applicable to applications such as centrifugal fans where the load is inversely proportional to the speed.

2) V/F separation curve setting

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F3-13	Voltage source for V/F separation	0	0: Digital setting (F3-14, Digital setting of voltage for V/F separation) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Multi-reference Note: The value of 100.0% corresponds to the rated motor voltage.	-
F3-14	Digital setting of voltage for V/F separation	0 V	0 V to rated motor voltage	In V/F half separation mode, the output voltage is two times the value set by this parameter.
F3-15	Voltage rise time of V/F separation	0.0s	0.0s to 1000.0s Note: This parameter indicates the time required for a change from 0 V to the rated motor voltage.	In V/F half separation mode, this parameter does not take effect, and the voltage rise time is the same as the value of F0-17 (Acceleration time 1).
F3-16	Voltage decline time of V/F separation	0.0s	0.0s to 1000.0s Note: This parameter indicates the time required for a change from the rated motor voltage to 0 V.	In V/F half separation mode, this parameter does not take effect, and the voltage decline time is the same as the value of F0-18 (Deceleration time 1).
F3-17	Stop mode selection for V/F separation	0	0: Frequency and voltage declining to 0 independently 1: Frequency declining after voltage declines to 0	-

The voltage rise time of V/F separation is the time required for the output voltage to increase from 0 V to the rated motor voltage. It is t1 in the following figure.

The voltage decline time of V/F separation is the time required for the output voltage to decrease from the rated motor voltage to 0 V. It is t2 in the following figure.

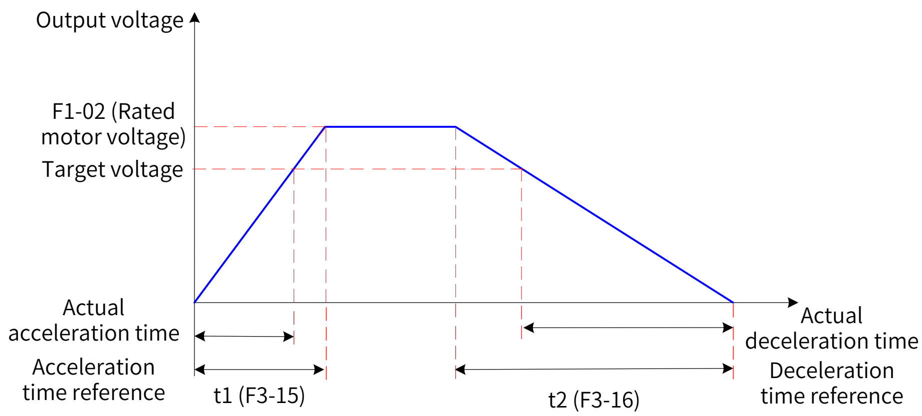


Figure 6-37 V/F separation curve

6.5.2 Drive Output Current (Torque) Limit

During acceleration, constant-speed running, or deceleration, if the output current exceeds the current limit level (default value: 150%, indicating 1.5 times the rated drive current), the overcurrent stall mechanism takes effect. In this case, the output frequency decreases until the output current drops below the current limit level. Then, the output frequency increases again toward the target frequency. Therefore, the acceleration time is prolonged. If the actual acceleration time cannot meet your requirement, increase the value of F3-18 (Current limit level) appropriately.

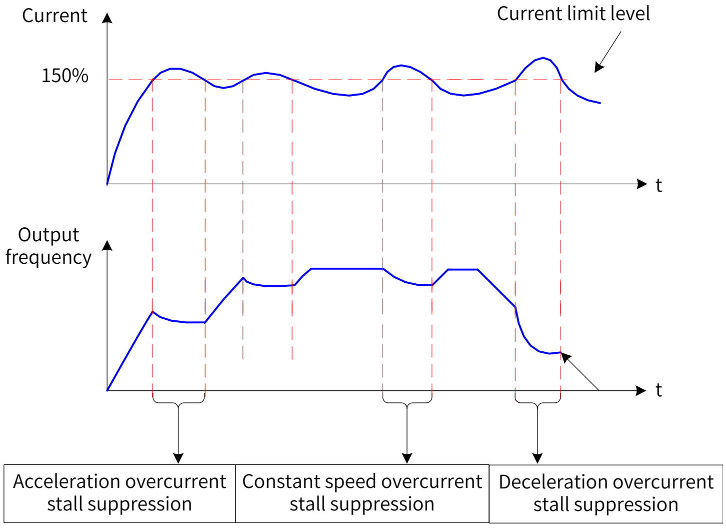


Figure 6-38 Overcurrent stall suppression

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F3-18	Current limit level	150%	50% to 200%	This parameter is used to set the current limit for overcurrent stall.
F3-19	Current limit selection	1	0, 1	0: Disabled 1: Enabled
F3-20	Current limit gain	20	0 to 100	A larger value leads to a better overcurrent suppression effect. However, a too large value may cause current oscillation. If pulse-by-pulse current limiting still occurs after overcurrent stall is enabled, increase the value of this parameter appropriately.
F3-21	Compensation factor of speed multiplying current limit level	50%	50% to 200%	This parameter is used to reduce the current limit level in the high-frequency region. It is invalid when the compensation factor is 50%. In the field-weakening area, the current limit level corresponds to F3-18, for which the recommended value is 100%.

In the high-frequency region, the motor drive current is low. Compared with the region below the rated frequency, the motor speed drops greatly in the high-frequency region under the same current limit level. To improve the motor running performance, you can reduce the current limit level above the rated frequency. For centrifuges or other systems that run at a high frequency, require several-fold field-weakening control, and have high load inertia, this method achieves high acceleration performance and effectively prevents motor stall.

Current limit level in the region above the rated frequency = (fn/fs) x k x LimitCur

In the formula, fs is the running frequency, fn is the rated motor frequency, k is the value of F3-21 (Compensation factor of speed multiplying current limit level), and LimitCur is the value of F3-18 (Current limit level).

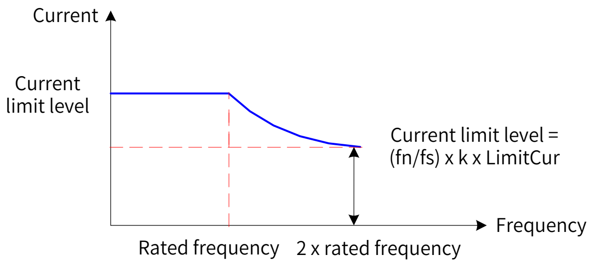


Figure 6-39 Speed multiplying overcurrent stall suppression

NOTE

◆ For a high-power motor with lower than 2 kHz carrier frequency, the pulse-by-pulse current limit response may be prior to overcurrent stall suppression due to increase of the pulse current. As a result, the torque is not high enough. To solve this problem, reduce the current limit level.

6.5.3 Drive Overvoltage Fault Suppression

If the motor is in generating state (motor rotation speed > output frequency) and the bus voltage exceeds the value set in F3-22 (voltage limit) then the overvoltage fault suppression takes effect by adjusting the output frequency. The actual deceleration time is prolonged to prevent a trip. If the actual deceleration time cannot meet your requirement, increase the over-excitation gain appropriately.

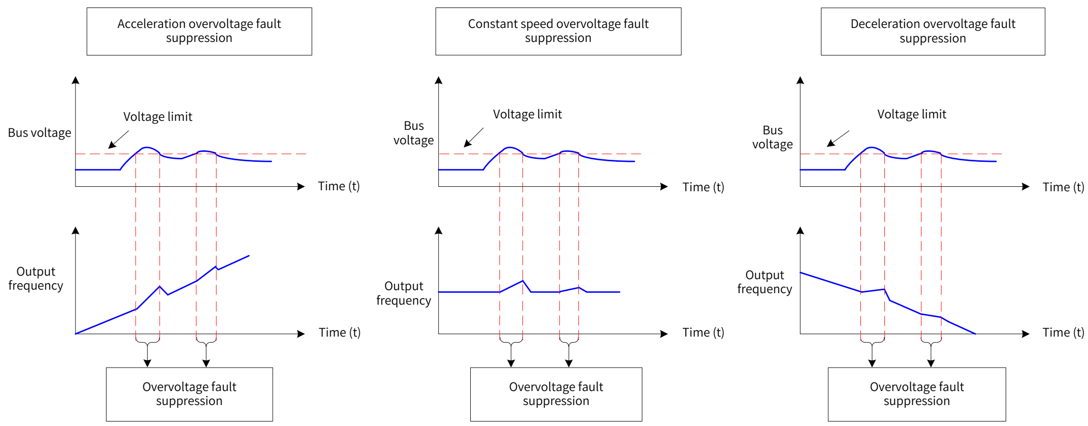


Figure 6-40 Overvoltage fault suppression

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F3-22	Voltage limit	770.0 V	650.0 V to 800.0 V	
F3-23	Voltage limit selection	1	0, 1	0: Disabled 1: Enabled (frequency gain for voltage limit enabled by default)
F3-24	Frequency gain for voltage limit	30	0 to 100	Increasing the value of F3-24 can improve the bus voltage control performance but also cause fluctuation of the output frequency. If the output frequency fluctuates severely, reduce the value of F3-24 appropriately.
F3-25	Voltage gain for voltage limit	30	0 to 100	Increasing the value of F3-25 reduces the bus voltage overshoot.
F3-26	Frequency rise threshold during voltage limit	5 Hz	0 to 50 Hz	This parameter is used to set the frequency rise threshold for overvoltage suppression.
F3-10	V/F over-excitation gain	64	0 to 200	A larger V/F over-excitation gain leads to a better overvoltage suppression performance.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F3-11	V/F oscillation suppression gain	40	0 to 100	-

NOTE

Perform the following settings when using braking resistors, braking units, or energy feedback units on a drive:

- ◆ Set F3-10 (V/F over-excitation gain) to 0.
- ◆ Set F3-23 (Voltage limit selection) to 0; otherwise, the deceleration time may be prolonged.

6.5.4 Running Performance Optimization in V/F Control Mode

1) How to shorten the actual acceleration time in V/F control mode?

Problem Description	Solution
If the actual acceleration time of the motor is much longer than the preset value, take the measures on the right.	If the target frequency is lower than two times the rated frequency and the actual acceleration time cannot meet your requirement, increase the value of F3-18 (Current limit level) at a step of 10%. If the value of F3-18 exceeds 170%, the drive may report an overload error (Err. 10) or fast current limit error (Err. 40).
	If the target frequency is three or four times the rated frequency or higher, the motor may stall easily during rapid acceleration. (The output frequency of the drive has reached the target frequency, but the motor keeps running at a low frequency or the acceleration time is too long.) In this case, change the value of F3-21 (Compensation factor of speed multiplying current limit level) to 100%.

2) How to shorten the actual deceleration time in V/F control mode?

Problem Description	Solution
If the actual deceleration time of the motor is much longer than the preset value, take the measures on the right.	If the drive has no braking resistor or feedback unit, increase the value of F3-10 (V/F over-excitation gain) at a step of ±20. If the increased value of F3-10 (V/F over-excitation gain) causes oscillation overvoltage on the motor, reduce the value of voltage gain for voltage limit.
	If the drive is equipped with braking resistors or energy feedback units and its input voltage rating is 360 V to 420 V, change the value of F9-08 (Braking unit start voltage) to 690 V and the value of F3-10 (V/F over-excitation gain) to 0.
	If shutdown DC injection braking is used, the following settings are recommended: Set F6-11 (Shutdown DC injection braking start frequency) to 0.5 Hz, F6-13 (Shutdown DC injection braking current) to 50%, and F6-14 (Shutdown DC injection braking active time) to 1s.

3) How to limit the output current in V/F control mode and how to prevent overcurrent under extremely high impact load?

Problem Description	Solution
To better protect the motor and control the upper limit of motor current, adjust the upper limit of the drive output current by taking the measures on the right.	The upper limit of the drive output current can be controlled using F3-18 (Current limit level). Relation between the two variables is: Output current upper limit = Rated drive current x Current limit level (default value: 150%). The upper limit of the drive output current should not be smaller than the rated motor current. It is recommended that you set this upper limit to 1.5 times the rated motor current.
	Rapid acceleration, rapid deceleration, or impact load may cause an overcurrent or fast current limiting fault (Err. 40). When this occurs, increase the value of F3-20 (Current limit gain) at a step of ±10. Current oscillation may occur if the step is too large.

4) How to limit the bus voltage to prevent overvoltage in V/F control mode?

Problem Description	Solution
Overcurrent faults often occur on constant-speed power generation loads (such as typical pumping units used in oil fields) and abruptly loading and unloading systems (such as high-power punches). If the factor parameter settings cannot prevent overvoltage faults, take the measures on the right.	Constant-speed intermittent power generation loads: Reduce the value of F3-22 (Voltage limit, default value: 770 V). It is recommended that you set this parameter to around 720 V if there is no specific requirement on the bus voltage upper limit. If overvoltage still occurs, change the value of F3-24 (Frequency gain for voltage limit) to 10 Hz or 20 Hz. (For example, this setting can be used for oil pumping units that generate power in long cycles.)
	When an abrupt loading and unloading system experiences an overcurrent fault, reduce the value of F3-22 (Voltage limit) to around 720 V (recommended).
	High-inertia rapid deceleration loads: If the drive is equipped with braking resistors and its input voltage rating is 360–420 V, change the value of F9-08 (Braking unit start voltage) to 690 V and change the value of F3-10 (V/F over-excitation gain) to 0. If the overvoltage persists, reduce the value of F3-22 (Voltage limit) to around 740 V (recommended).

6.5.5 Speed Loop

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-00	Speed loop proportional gain Kp at low speed	30	1 to 200	-
F2-01	Speed loop integral time Ti at low speed	0.500s	0.001s to 10.000s	-
F2-02	Switchover frequency 1	5.00 Hz	0.00 to F2-05 (Switchover frequency 2)	-
F2-03	Speed loop proportional gain Kp at high speed	20	1 to 200	-
F2-04	Speed loop integral time Ti at high speed	1.00s	0.01s to 10.00s	-
F2-05	Switchover frequency 2	10.00 Hz	F2-02 (Switchover frequency 1) to F0-10 (Maximum frequency)	-
F2-07	Speed feedback filter time	0.004s	0.000s to 0.100s	-

Speed loop PI parameters are divided into low-speed and high-speed groups. When the running frequency is smaller than F2-02 (Switchover frequency 1), F2-00 (Speed loop proportional gain Kp at low speed) and F2-01 (Speed loop integral time Ti at low speed) are used as speed loop PI parameters. When the running frequency is greater than switchover frequency 2, F2-03 (Speed loop proportional gain Kp at high speed) and F2-04 (Speed loop integral time Ti at high speed) are used as speed loop PI parameters. When the running frequency is between switchover frequency 1 and switchover frequency 2, speed loop PI parameters switch between the two groups linearly, as shown in the following figure.

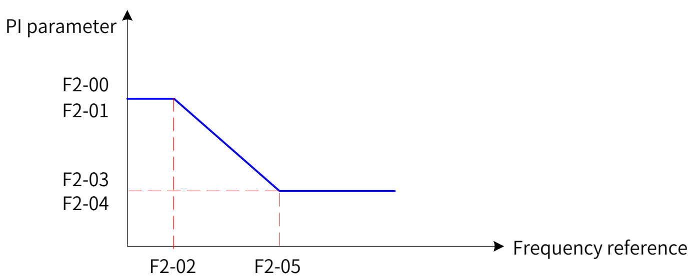


Figure 6-41 Speed loop PI parameter switchover

You can adjust the dynamic speed response performance of vector control by setting the proportional factor and integral time of the speed regulator.

Dynamic response of the speed loop can be sped up by increasing the proportional gain or reducing the integral time. However, a large proportional gain or short integral time may cause system oscillation.

Recommended method: If the factory settings cannot meet your requirements, fine tune the factory settings. First increase the proportional gain to a level that will not cause system oscillation, and then reduce the integral time to enable faster system response at low overshoot.

NOTE

◆ Improper PI parameter settings may lead to a high overshoot. Or even worse, overvoltage may occur when the overshoot drops.

Increasing the value of F2-07 (Speed feedback filter time) improves motor stability, but dynamic speed response also slows down in this case. Reducing the value of F2-07 (Speed feedback filter time) speeds up dynamic speed response, but a small value of this parameter may cause motor oscillation. You can retain the default settings in most cases.

6.5.6 Slip Adjustment in Vector Control Mode

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-06	SVC/FVC slip compensation gain	100%	50% to 200%	This slip adjustment parameter is used to improve the control performance.

In vector control mode (F0-01 = 0 or 1), this parameter can adjust the speed stabilizing accuracy. For example, when the motor's running frequency is lower than the drive's output frequency, you can increase the value of this parameter.

In feedback vector control mode (F0-01 = 1), this parameter can adjust the output current under the same load. For example, if a high-power drive provides low load capacity, decrease the value of this parameter gradually. Note: in most cases the most suitable setting for this parameter is the default value.

6.5.7 Over-excitation in Vector Control Mode

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-08	SVC/FVC over-excitation gain	64	0 to 200	64

For high-inertia loads, vector control over-excitation can speed up the motor deceleration process. The larger the over-excitation gain is, the better the improvement can be. However, vector control over-excitation increases the output current of the drive and the losses in the motor.

6.5.8 Torque Limit

The following table describes the torque limit settings for vector control (FVC or SVC).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-09	Torque limit source in speed control (motoring)	0	0: Digital setting (F2-10) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 100% of the values 1 to 7 corresponding to F2-10	-

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-10	Digital setting of torque limit in speed control (motoring)	150.0%	0.0% to 200.0%	This parameter is used to set the torque limit in motoring state. The value is a percentage against the rated drive current.
F2-11	Torque limit source in speed control (generating)	0	0: Digital setting (F2-10) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 8: Digital setting (F2-12) 100% of the values 1 to 7 corresponding to F2-12	-
F2-12	Digital setting of torque limit in speed control (generating)	150.0%	0.0% to 200.0%	This parameter is used to set the torque limit in generating state. The value is a percentage against the rated drive current.

- In speed control mode, eight torque limit sources are supported. When the drive is in motoring state, the torque limit source is determined by F2-09. When the drive is in generating state, the torque limit source is determined by F2-11.
- In speed control mode, if F2-11 is set to 1 to 8, the torque limit differs in motoring and generating states. In motoring state, the full scale range of torque limit is set by F2-10. In generating state, the full scale range of torque limit is set by F2-12. The following figure shows the torque limit parameters.

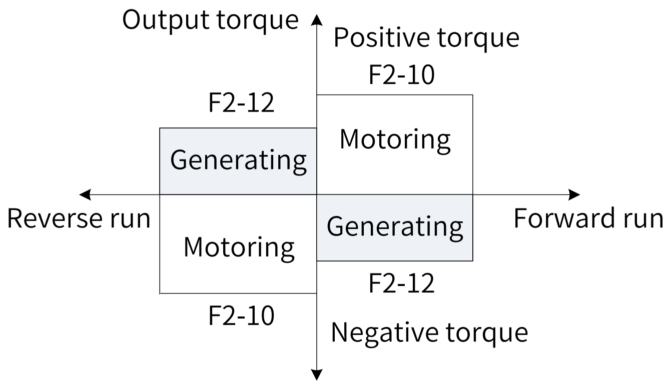


Figure 6-42 Torque limit in speed control mode

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-53	Motoring power limit function	0	0: Disabled 1: Enabled	-
F2-54	Motoring power limit value	Model dependent	0.0% to 200.0%	-

- When a drive is used in a cam driving, rapid acceleration/deceleration, or abrupt unloading scenario and not equipped with braking resistors, you can enable the motoring power limit function to mitigate bus voltage overshoot during motor braking, thus preventing overvoltage. F2-54 (Motoring power limit value) is a percentage against the rated motor power. If overvoltage still occurs after you enable the motoring power limit function, reduce the value of F2-54.

6.5.9 Torque Control

The following table describes the torque control settings.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A0-00	Speed/Torque control selection	0	0: Speed control 1: Torque control	-
A0-01	Torque reference source in torque control	0	0: Digital setting 1 (A0-03) 1: AI1 2: AI2 3: Reserved 4: Pulse reference (DIO1) 5: Communication setting (1000H) 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) (The full scale of options 1–7 corresponds to A0-03.)	-
A0-03	Torque digital setting	150.0%	-200.0% to +200.0%	The value is a percentage against the rated motor torque.
A0-04	Torque filter time	0.000s	0s to 5.000s	-
A0-05	Speed limit digital setting	0.00%	-120.0% to 120.0%	The value is a percentage against F0-10 (Maximum frequency).
A0-07	Acceleration time (torque)	1.00s	0.00s to 650.00s	-
A0-08	Deceleration time (torque)	1.00s	0.00s to 650.00s	-
A0-09	Setting source of speed limit	0	0: Set by A0-05 1: Frequency reference	
A0-10	Speed limit offset	5.00 Hz	0 to F0-10 (Maximum frequency)	
A0-11	Effective mode of speed limit offset	1	0: Bidirectional offset effective 1: Unidirectional offset effective	
A0-12	Frequency acceleration time	1.0s	0.0s to 6500.0s	
A0-13	Frequency deceleration time	1.0s	0.0s to 6500.0s	
A0-14	Torque mode switchover	1	0: No switchover 1: Switchover to speed control at stop 2: Target torque at stop being 0	

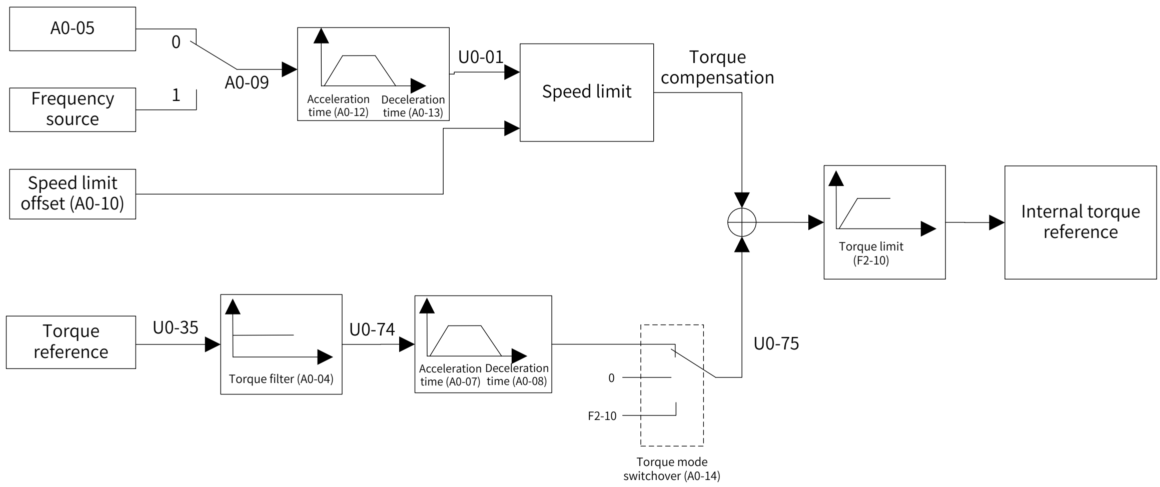


Figure 6-43 Torque control system diagram

■ Speed/Torque control selection (A0-00)

The speed/torque control mode is determined by A0-00 (Speed/Torque control selection).

Multifunctional DI terminals of MD810 provide two torque control functions: torque control disabling (function 29) and speed/torque control switchover (function 46). The two DI terminals must be used together with A0-00 (Speed/Torque control selection) to implement switchover between speed control and torque control.

When the speed/torque control switchover terminal (function 46) is disabled, the control mode is determined by A0-00 (Speed/Torque control selection). If this function is enabled, the control mode is the inversed value of A0-00 (Speed/Torque control selection).

When the torque control disabling terminal is enabled, the drive always works in speed control mode.

■ Torque reference setting in torque control (A0-01 and A0-03)

A0-01 (Torque reference source in torque control) is used to select a torque reference source. Eight sources are supported.

The torque reference is a relative value. The value 100.0% corresponds to the rated motor torque. (Check U0-06 (Output torque) to obtain the motor output torque, and the value 100% corresponds to the rated motor torque.) The torque value range is -200.0% to +200.0%, which means that the maximum torque of the drive is two times the rated motor torque.

■ Frequency limit setting in torque control (A0-05, A0-09, A0-10, and A0-11)

In torque control mode, the frequency limit can be set by A0-05 (Speed limit digital setting) or the frequency source, depending on the value of A0-09 (Setting source of speed limit).

The frequency limit acceleration time and deceleration time are set by A0-12 (Frequency acceleration time) and A0-13 (Frequency deceleration time), respectively.

In torque control mode, if the load torque is smaller than the motor output torque, the motor rotation speed keeps increasing. To prevent runaway or other incidents of the mechanical system, you must limit the maximum motor rotation speed in torque control mode. That is, set the frequency limit in torque control.

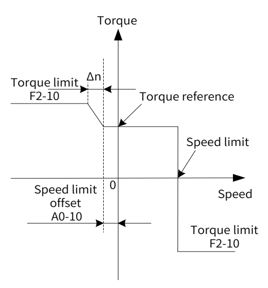
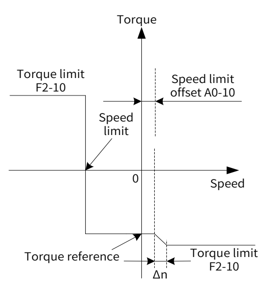
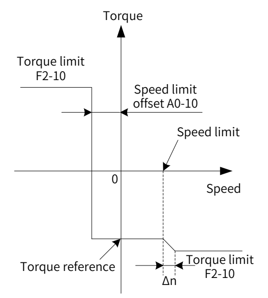
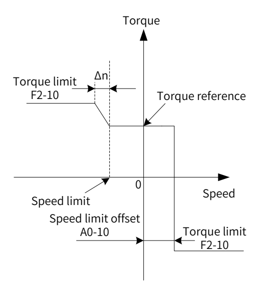
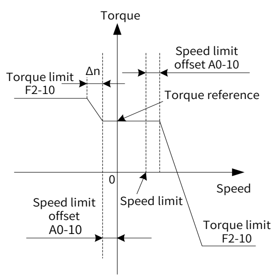
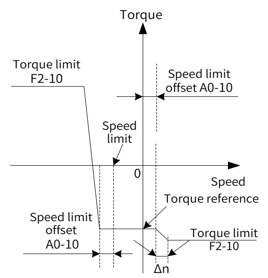
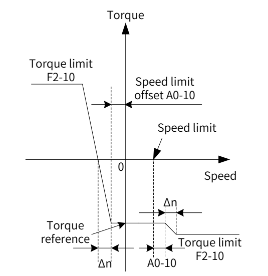
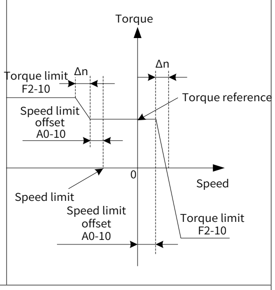
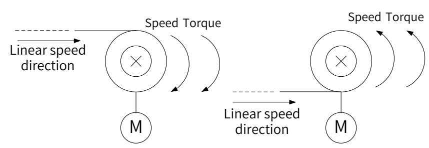
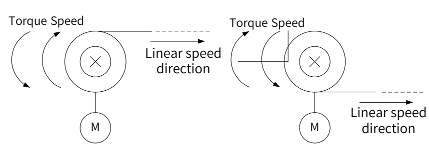
■ Torque acceleration and deceleration time in torque control (A0-07 and A0-08)

In torque control mode, the difference between the motor output torque and load torque determines the speed change rate of the motor and load. As a result, the motor rotation speed may change quickly, causing problems such as high noise or mechanical stress. Setting an appropriate torque acceleration/deceleration time can ensure stable change of the motor rotation speed. The torque acceleration time is the time required for the output torque to increase from 0 to A0-03 (Torque digital setting), and the torque deceleration time is the time required for the output torque to decrease from A0-03 (Torque digital setting) to 0.

Setting the torque acceleration/deceleration time is not recommended for torque control with a small startup torque. In a scenario requiring fast torque change, set the torque acceleration/deceleration time to 0.00s.

For example, two motors drive the same load through a rigid connection. To ensure balanced load distribution between the two motors, one drive is configured as the master and uses the speed control mode, whereas the other is configured as the slave and uses the torque control mode. The output torque of the master drive is used as the torque reference of the slave drive. In this case, the torque of the slave drive must change quickly with the output torque of the master drive. To meet this requirement, set the torque acceleration/deceleration time of the slave drive to 0.00s.

■ Speed limit/Speed limit offset

	Operation Condition			
Command	Forward run	Forward run	Forward run	Forward run
Torque reference direction	+	-	-	+
Speed limit direction	+	-	+	-
Normal running direction	Forward run	Reverse run	Forward run	Reverse run
Unidirectional speed limit offset (A0-11 = 1)				
Bidirectional speed limit offset (A0-11 = 0)				
Application example	Winder 		Unwinder 	

6.5.10 Current Loop Parameter Description

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-13	Current loop proportional gain Kp at low speed	1.0	0.1 to 10.0	The value is obtained automatically through motor auto-tuning.
F2-14	Current loop integral gain Ki at low speed	1.0	0.1 to 10.0	
F2-15	Current loop proportional gain Kp at high speed	1.0	0.1 to 10.0	
F2-16	Current loop integral gain Ki at high speed	1.0	0.1 to 10.0	

Current loop PI parameters for vector control are divided into low-speed and high-speed sets. These parameters can be automatically obtained after asynchronous motor complete auto-tuning and do not need to be modified generally.

Note that the current loop integral regulator uses the integral gain rather than the integral time as the dimension. If the current loop PI gain is too large, the entire control loop may oscillate. In the case of severe current oscillation or torque fluctuation, you can manually reduce the PI proportional gain or integral gain.

6.5.11 Performance Improvement in the Field-Weakening Area

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-21	Maximum output voltage coefficient	105%	100% to 110%	The maximum output voltage coefficient indicates a drive's maximum capability to increase the output voltage. Increasing the value of F2-21 can improve the maximum load capacity of the motor in the field-weakening area. However, this increases the motor's current ripple, causing more heat of the motor. Decreasing the value of F2-21 lowers the load capacity of the motor, but also reduces the current ripple to decrease the heat of the motor. Generally, you can retain the value of this parameter.

6.5.12 FVC Operation and Performance Improvement

1) Brief procedure for setting feedback vector control (FVC)

■ Speed control setting

Table 6-3 Brief procedure for setting speed control in FVC mode

Procedure	Parameter	Description
Verify that wires of the drive are connected correctly.	-	If the drive reports Err. 19.00 during motor auto-tuning, check whether its wiring and motor parameter settings are correct.
Set motor parameters.	F1-01 (Rated motor power), F1-02 (Rated motor voltage), F1-03 (Rated motor current), F1-04 (Rated motor frequency), F1-05 (Rated motor rotation speed)	

Procedure	Parameter	Description
Set the encoder type and pulses per revolution.	F1-27 (Encoder pulses per revolution), F1-28 (Encoder type)	If the drive reports Err. 20.00, check whether the encoder and PG card are working properly.
Select a control mode.	F0-01 (1st motor control mode)	-
Set the motor auto-tuning function.	F1-37 (Auto-tuning selection)	Asynchronous motor dynamic complete auto-tuning takes a certain period. Wait until this process is completed before proceeding to the next step. Asynchronous motor dynamic complete auto-tuning is recommended (F1-37 = 2). When using this auto-tuning mode, separate the motor from the load to enable the motor to run at a high speed. If the motor cannot be separated from the load (for example, motor of a crane), select asynchronous motor static complete auto-tuning (F1-37 = 3).
Set the command source and frequency reference source.	F0-02 (Command source selection), F0-03 (Main frequency source X selection)	-
Perform a trial run.	A0-00 (Speed/Torque control selection) = 0 (Speed control)	-

■ Torque control setting

Table 6-4 Brief procedure for setting torque control in FVC mode

Procedure	Parameters	Description
Verify that wires of the drive are connected correctly.	-	If the drive reports Err. 19.00 during motor auto-tuning, check whether its wiring and motor parameter settings are correct.
Set motor parameters.	F1-01 (Rated motor power), F1-02 (Rated motor voltage), F1-03 (Rated motor current), F1-04 (Rated motor frequency), F1-05 (Rated motor rotation speed)	
Set the encoder type and pulses per revolution.	F1-27 (Encoder pulses per revolution), F1-28 (Encoder type)	If the drive reports Err. 20.00, check whether the encoder and PG card are working properly.
Select a control mode.	F0-01 (1st motor control mode)	-
Set the motor auto-tuning function.	F1-37 (Auto-tuning selection)	Asynchronous motor dynamic complete auto-tuning takes a certain period. Wait until this process is completed before proceeding to the next step. Asynchronous motor dynamic complete auto-tuning is recommended (F1-37 = 2). When using this auto-tuning mode, separate the motor from the load to enable the motor to run at a high speed. If the motor cannot be separated from the load (for example, motor of a crane), select asynchronous motor static complete auto-tuning (F1-37 = 3).
Set the command source.	F0-02 (Command source selection)	-

Procedure	Parameters	Description
Set the torque control parameters.	A0-00 (Speed/Torque control selection), A0-01 (Torque reference source in torque control), A0-03 (Torque digital setting), A0-05 (Speed limit digital setting)	-
Perform a trial run.	-	-

2) FVC loop setting

■ Speed loop setting

If the motor oscillates or generates abnormal noise when running below the rated frequency, the speed loop gains are too high and must be lowered by reducing the values of F2-00 (Speed loop proportional gain Kp at low speed) and F2-03 (Speed loop proportional gain Kp at high speed), and increasing the values of F2-01 (Speed loop integral time Ti at low speed) and F2-04 (Speed loop integral time Ti at high speed).

If the system speed overshoot is high during rapid acceleration, increase the speed loop proportional gain Kp by increasing the values of F2-00 (Speed loop proportional gain Kp at low speed) and F2-03 (Speed loop proportional gain Kp at high speed) and reduce the speed loop integral gain Ki by increasing the values of F2-01 (Speed loop integral time Ti at low speed) and F2-04 (Speed loop integral time Ti at high speed).

In a winding/unwinding scenario, the winding diameter changes in inverse proportion to the motor rotation speed. Therefore, when the winding diameter is large, you need to increase the speed loop gain at low speed to ensure dynamic response of the system by increasing the value of F2-00 (Speed loop proportional gain Kp at low speed) and reducing the value of F2-01 (Speed loop integral time Ti at low speed).

For a load running at an extremely low speed (for example, a milling machine running at 0.01 Hz), ensure smooth running by increasing the speed loop gains, especially the integral gain. That is, increase the value of F2-00 (Speed loop proportional gain Kp at low speed) and reduce the value of F2-01 (Speed loop integral time Ti at low speed).

NOTE

◆ In scenarios with poor encoder feedback signals, the speed loop gains cannot be too high. Otherwise, the dynamic response speed of the system is adversely affected. However, you need to take measures to improve the quality of encoder feedback signals (for example, separate power cables of the motor from signal cables of the encoder and reliably ground the system) before reducing the speed loop gains. Otherwise, reducing the speed loop gains directly will slow down dynamic response of the system, degrading the system operation performance.

■ Current loop setting

Current loop parameters can be automatically obtained after asynchronous motor complete auto-tuning and can be retained generally. However, you can fine tune these parameters in the following conditions:

When a motor running in FVC mode oscillates or generates abnormal noise, and the oscillation or noise cannot be completely removed by reducing the speed loop gains, you can appropriately reduce the current loop gains by reducing the values of F2-13 (Current loop proportional again Kp at low speed), F2-14 (Current loop integral again Ki at low speed), F2-15 (Current loop proportional gain Kp at high speed), and F2-16 (Current loop integral again Ki at high speed).

The system requires a low overshoot, and the speed loop gains cannot be too small. If the motor oscillates or generates abnormal noise when running in FVC mode, you can appropriately reduce the current loop gains by reducing the values of F2-13 (Current loop proportional again Kp at low speed), F2-14 (Current loop integral again Ki at low speed), F2-15 (Current loop proportional gain Kp at high speed), and F2-16 (Current loop integral again Ki at high speed).

■ Solutions to FVC exceptions during high-speed running

FVC oscillation or running exceptions may occur when a motor runs at a high frequency (for example, more than 200 Hz). When this occurs, use the V/F control mode at the same frequency and check whether U0-29 (Encoder feedback speed) is the same as the frequency reference. If there is a large difference (more than 4 Hz) between the two frequency values, the problem may be caused by encoder signal distortion (non-orthogonal or abnormal duty ratio) or signal filtering on the PG card. Take the following measures:

Replace the encoder. Check whether the original encoder is damaged or installed incorrectly, and whether this encoder model supports the current pulse frequency.

If measures have been taken to prevent encoder signal distortion, high filter capacitance of the PG card may cause signal receiving errors. In this case, set F1-27 (Encoder pulses per revolution) properly for PG signal filtering.

■ Shortening the acceleration/deceleration time in FVC mode

During rapid acceleration/deceleration, the actual acceleration/deceleration time is longer than the preset value. To shorten the acceleration/deceleration time, take the following measures:

To shorten the motor acceleration time, increase the torque limit in FVC mode by increasing the value of F2-10 [Digital setting of torque limit in speed control (motoring)] to a maximum of 180%. Note: Although increasing the torque limit shortens the motor acceleration time, this operation leads to an increase of the motor current, which may cause faults such as overload.

Use appropriate braking resistors to shorten the deceleration time.

■ Limiting the bus voltage to prevent overvoltage in FVC mode

In high inertia or rapid deceleration scenarios, overvoltage faults often occur during deceleration. (The optimization measures are the same as those used in V/F control mode. The same parameters are used in the two modes.)

6.5.13 Auxiliary Control Parameters

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A5-00	DPWM switchover frequency upper limit	12.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	Setting A5-00 to the maximum frequency reduces noise of the motor.
A5-01	PWM modulation mode	0	0: Asynchronous modulation 1: Synchronous modulation	If the product of carrier frequency divided by running frequency is smaller than 10, the output current may fluctuate or have high harmonics. In this case, you can change the PWM modulation mode to synchronous modulation to reduce current harmonics.
A5-03	Random PWM depth	0	0: Random PWM depth disabled 1–10: Random PWM depth values	If this parameter is set to 0, the random PWM depth is disabled. If the motor generates large noise, increase the random PWM depth by 1 each time to lower the noise.

6.5.14 Encoder Signal Processing

The PG card in an MD810 drive supports programmable filter for encoder signals.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-29	PG signal filter	1	0 to 3	This parameter is used to set the filter mode.

0: Non-adaptive filter. The PG card has a fixed filter coefficient, which is very small value. This filter mode is applicable to scenarios with no interference, low interference, or high-speed applications.

1: Adaptive filter. The PG card automatically adjusts the filter coefficient and has a strong interference-resistant capability, especially when the encoder feedback frequency is lower than 100 kHz. This mode is applicable to the scenarios with high interference. This mode is a factory default.

2: Fixed interlock. This mode adds the capability to eliminate encoder feedback signal edge jitter on the basis of adaptive. It is applicable to the scenarios where encoder feedback signals have jitter at the boundary.

3: Automatic interlock. The PG card automatically switches between adaptive filter and fixed interlock to adapt to zero-speed operation and non-zero-speed operation. This mode prevents the fixed interlock function from eliminating the valid signals as boundary jitter during zero-speed operation.

■ Encoder wire-breaking detection

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-36	PG card wire-breaking detection	0	0: Disabled 1: Enabled	-

The PG card of an MD810 drive supports encoder wire-breaking detection. This function takes effect only for encoders with differential interfaces, and enables signal detection of phase A, phase B, and phase Z simultaneously. If the PG card is connected only to phase A and phase B, the drive reports Err. 20.00. In this case, disable encoder wire-breaking detection. Otherwise, the drive keeps reporting this error.

6.6 Protection Functions

6.6.1 Startup Protection

Startup protection is one of security protection functions provided by an MD810 drive. When F8-18 (Startup protection) is set to 1, the drive provides startup protection in the following conditions:

Condition 1: If the RUN command is valid upon power-on of the drive (for example, the terminals used as the command source are ON before power-on), the drive does not respond to this RUN command. It responds only after the RUN command is withdrawn and then issued again.

Condition 2: If the RUN command is valid upon a reset of the drive due to a failure, the drive does not respond to this RUN command. It responds only after the RUN command is withdrawn and then issued again.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-18	Startup protection	0	0: Disabled 1: Enabled	When this parameter is set to 1, startup protection is enabled to prevent risks of mistakenly issued RUN command upon power-on or reset of the drive.

6.6.2 Motor Overload Protection

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-00	Drive overload protection	0	0: Disabled 1: Enabled	This parameter determines the action that the drive takes upon a motor overload. If the parameter is set to 0, the drive reports an alarm and locks the output when it is overloaded. If the parameter is set to 1, the drive automatically reduces the output current approximately to its rated current when it is about to be overloaded. This prevents overload of the drive but may reduce the motor rotation speed or cause the motor to stop running. Set this parameter to 0 for lifting loads.
F9-01	Motor overload protection gain	1.00	0.20 to 10.00	Set F9-01 to adjust the motor overload current and time.
F9-02	Motor overload pre-warning coefficient	80%	50% to 100%	The pre-warning coefficient determines when the drive triggers a pre-warning ahead of motor overload protection. The greater the value is, the later the drive will trigger a pre-warning.

To provide effective protection for motors with different loads, set the motor overload protection gain properly based on the overload capacity of a motor. The motor overload protection curve is inversely proportional to the time, as shown in the following figure.

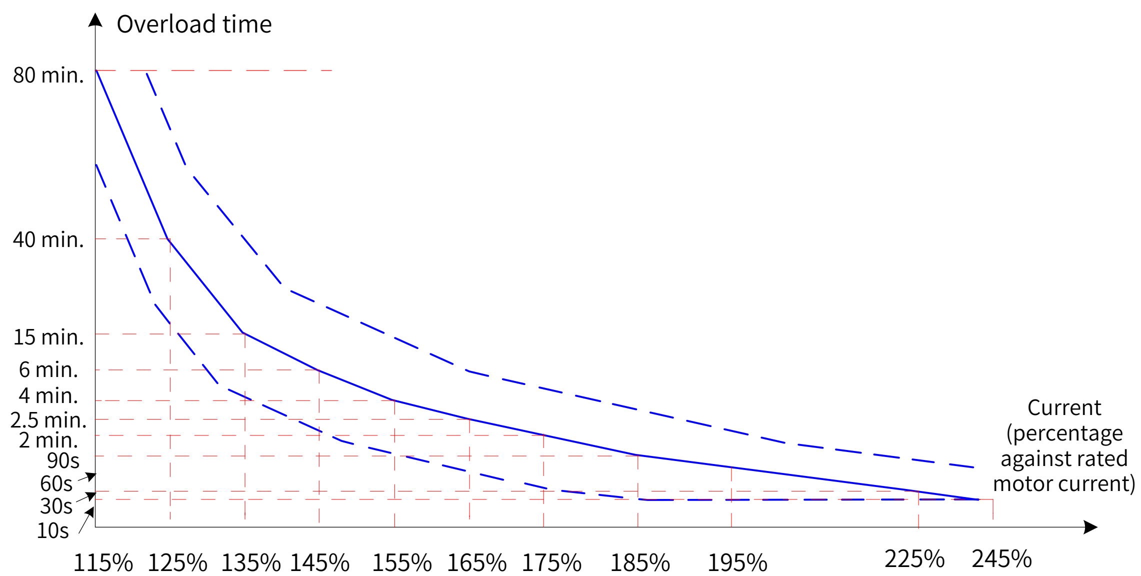


Figure 6-44 Inverse time-lag curve

The drive reports a motor overload alarm (Err. 11.00) after the motor runs at 175% of the rated motor current continuously for two minutes, or after the motor runs at 115% of the rated motor current continuously for 80 minutes.

Example: The rated motor current is 100 A.

If F9-01 (Motor overload protection gain) is set to 1.00, the drive reports a motor overload alarm (Err. 11.00) after the motor runs at 125% of 100 A (125 A) continuously for 40 minutes according to the preceding figure.

If F9-01 (Motor overload protection gain) is set to 1.20, the drive reports a motor overload alarm (Err. 11.00) after the motor runs at 125% of 100 A (125 A) continuously for 48 minutes (40 x 1.2) according to the preceding figure.

NOTE

◆ The overload time is in the range of 10 seconds to 80 minutes.

Example of adjusting the motor overload protection parameters: A motor overload alarm needs to be reported after the motor runs at 150% of rated motor current for two minutes.

Seen from the motor overload protection curve, 150% (I) of the rated motor current is between 145% (I1) and 155% (I2) of the rated motor current. As the overload time is six minutes (T1) at the 145% point and four minutes (T2) at the 155% point, the overload time at 150% of the rated motor current is five minutes under the default settings. The overload time is calculated using the following formula:

T = T1 + (T2 - T1) x (I - I1)/(I2 - I1) = 6 + (4 - 6) x (150% - 145%)/(155% - 145%) = 5 (minutes)

Therefore, to change the overload time at 150% of the rated motor current to two minutes, you need to set the motor overload protection gain to 0.4 (F9-01 = 2/5 = 0.4).

WARNING

◆ Set F9-01 (Motor overload protection gain) properly based on the actual overload capacity of the motor. If the value is too large, the drive may not report an alarm when the motor is damaged due to overheating.

■ Motor overload pre-warning coefficient: When the motor overload detection level reaches the value of this parameter, the corresponding multifunctional output terminal (DO) or fault relay indicates a motor overload pre-warning signal. The value of this parameter is a percentage against the time during which the motor runs continuously at an overload point without reporting an overload alarm.

For example, the motor overload protection gain is set to 1.00, and the motor overload pre-warning coefficient is set to 80%. After the motor runs at 145% of the rated motor current continuously for 4.8 minutes (80% x 6 minutes), the DO terminal or fault relay sends a motor overload pre-warning signal.

■ The motor overload pre-warning function enables the control system to receive a pre-warning signal from a DO terminal before motor overload protection is triggered. The pre-warning coefficient determines when the drive triggers a pre-warning ahead of motor overload protection. The greater the value is, the later the drive will trigger a pre-warning. When the accumulative output current of the drive exceeds the product of overload time (value Y on the inversely proportional to the time curve of motor overload protection) multiplied by F9-02 (Motor overload pre-warning coefficient), the DO terminal of the drive sends a motor overload pre-warning signal. In a special case where F9-02 (Motor overload pre-warning coefficient) is set to 100%, a pre-warning signal is sent at the same time when overload protection is triggered.

6.6.3 Phase Loss Protection

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-06	Output phase loss detection before startup	0	0: Disabled 1: Enabled	Output phase loss detection takes several seconds during running of the drive. If a startup with phase loss brings risks or the motor needs to run at a low frequency, you can enable this function to quickly detect phase loss before a startup. This function is not recommended for scenarios with rigid requirements on the startup time.
F9-48	Fault protection action selection 1	10050	-	The hundreds position of F9-48 is used to set the action taken for phase loss method. The value 0 indicates coast to stop, and the value 1 indicates decelerate to stop. To disable phase loss detection, set the hundreds position to 5.

6.6.4 Reset upon Fault

NOTE

- In the case of an undervoltage fault (Err. 09.00), the drive resets automatically when the bus voltage restores to the normal range. This reset is not counted in the number of automatic resets.
- In the case of a short circuit to the ground (Err. 23.00), the drive does not support automatic or manual reset. You need to reset the drive by powering it off and then powering it on again.
- After the automatic reset times is reached, the selected protection action is taken.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-09	Fault auto reset times	0	0 to 20	This parameter is used to set the number of automatic resets for the drive if the fault protection action is set to automatic reset. If the fault persists after the specified number of automatic resets, the drive retains the fault state.
F9-10	DO action during auto fault reset	1	0: Not act 1: Act	If the drive is enabled to reset automatically upon faults, F9-10 can be used to determine whether the DO terminal (function 2) acts during an automatic reset.
F9-11	Auto fault reset interval	1.0s	0.1s to 100.0s	This parameter is used to set the time that the drive waits before an automatic reset after reporting a fault alarm.

6.6.5 Fault Protection Action Selection

MD810 defines four fault protection actions: coast to stop, decelerate to stop, warning, and canceled, listed in descending order of fault severity.

When the fault protection action is set to warning, the panel shows Axx.xx when a fault occurs, for example, A16.13 .

When the fault protection action is set to canceled, no message is displayed on the panel when a fault occurs. Exercise caution when setting this action.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-48	Fault protection action selection 1	10050	Ones position: Motor overload (E11) Tens position: Reserved Hundreds position: Output phase loss (E13) Thousands position: Heatsink overheat (E14) Ten thousands position: External fault (E15)	The actions of decelerate to stop and warning take effect for phase loss only in V/F control mode.
F9-49	Fault protection action selection 2	00050	Ones position: Communication timeout (E16) Tens position: External DC soft charge unit fault (E17) (only for 90 kW and above models) Hundreds position: Reserved Thousands position: Motor auto-tuning abnormal (E19) Ten thousands position: Encoder abnormal (E20)	Encoder fault: In some scenarios, the control mode needs to change from FVC to SVC in the case of encoder wire breaking. In this case, set the action for this fault to warning so that the control mode can change automatically when encoder wire breaking is detected.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-50	Fault protection action selection 3	25000	Ones position: EEPROM read/write error Tens position: Motor auto-tuning abnormal (E22) Hundreds position: Motor short circuit to ground (E23) Thousands position: Inter-phase short-circuit (E24) Ten thousands position: Reserved	
F9-51	Fault protection action selection 4	51111	Ones position: Accumulative running time reached (E26) Tens position: User-defined fault 1 (E27) Hundreds position: User-defined fault 2 (E28) Thousands position: Accumulative power-on time reached (E29) Ten thousands position: Load loss (E30)	-
F9-52	Fault protection action selection 5	00101	Ones position: PID feedback loss during running (E31) Tens position: Reserved Hundreds position: Reserved Thousands position: Speed deviation excessive (E42) Ten thousands position: Motor overspeed (E43)	
F9-53	Fault protection action selection 6	05500	Ones position: Motor overtemperature (E45) Tens position: Reserved Hundreds position: Reserved Thousands position: Reserved Ten thousands position: Fan fault (E80)	
F9-54	Frequency selection for continuing to run upon fault	0	0: Current running frequency 1: Frequency reference 2: Frequency upper limit 3: Frequency lower limit 4: Backup frequency upon abnormality	If the running drive experiences a fault and the fault protection action is set to continue running, the drive displays A** and continues running at the frequency selected by F9-54.
F9-55	Backup frequency upon abnormality	100.0%	0.0 to 100.0% (F0-10, Maximum frequency)	

6.6.6 Overheat Protection

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-56	Type of motor temperature sensor	0	0: No sensor (AI1 input) 1: PT100 2: PT1000	A motor temperature sensor is connected to AI and GND terminals. The drive supports PT100 and PT1000 motor temperature sensors. Select an appropriate sensor type for the motor. The motor temperature is indicated by U0-34 (Motor temperature).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-57	Motor overheat protection threshold	110°C	0°C to 200°C	When the motor temperature exceeds the value of F9-57, the drive generates an alarm (Err. 45.00) and responds based on the fault protection action selection (F9-53).
F9-58	Motor overheat pre-warning threshold	90°C	0°C to 200°C	When the motor temperature exceeds the value of F9-58, the DO terminal of function 39 (motor overheat pre-warning) indicates a pre-warning signal.

6.6.7 Power Dip Ride-Through

Power dip ride-through enables the system to continue running upon an instantaneous power failure. When the system experiences a power failure, the drive makes the motor work in generating state to keep the bus voltage around the threshold of power dip ride-through function enabled. This function prevents the drive from stopping due to input undervoltage. See the following figure.

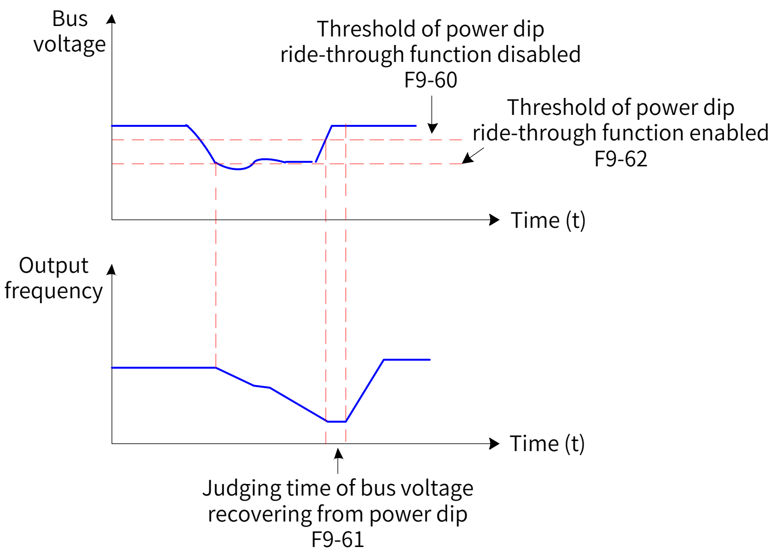


Figure 6-45 Power dip ride-through

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-59	Power dip ride-through function selection	0	0: Disabled 1: Constant bus voltage control 2: Decelerate to stop	The constant bus voltage control mode is recommended for high-inertia loads such as fans, water pumps, and centrifuges, and the decelerate-to-stop mode is recommended for textile systems.
F9-60	Threshold of power dip ride-through function disabled	85%	80% to 100%	The value 100% corresponds to 540 V voltage.
F9-61	Judging time of bus voltage recovering from power dip	0.5s	0.0 to 100.0s	This parameter takes effect only for constant bus voltage control (F9-59 = 1).
F9-62	Threshold of power dip ride-through function enabled	80%	60% to 100% (Standard bus voltage)	The value 100% corresponds to 540 V voltage.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-71	Power dip ride-through gain Kp	0 to 100	40	This parameter takes effect only for constant bus voltage control (F9-59 = 1). If the system is subject to undervoltage during power dip ride-through, increase the values of Kp and Ki.
F9-72	Power dip ride-through integral coefficient	0 to 100	30	
F9-73	Deceleration time of power dip ride-through	0s to 300.0s	20.0s	This parameter takes effect only for the decelerate-to-stop mode (F9-59 = 2).

NOTE

- ◆ Constant bus voltage control: When the power grid resumes power supply, the drive restores the output frequency to the target frequency in the acceleration time.
- ◆ Decelerate to stop: When the power grid resumes power supply, the drive continues decelerating to 0 Hz and stops. It starts again only after receiving a RUN command.

6.6.8 Load Loss Protection

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-51	Fault protection action selection 4	51111	-	You can set the ten thousands position of F9-51 to enable load loss detection. The drive takes the load loss protection action after running at an output current below the load loss detection level (F9-64) continuously during the load loss detection time (F9-65). If the load restores during load loss protection, the drive automatically runs at the preset frequency.
F9-64	Load loss detection level	10.0%	0.0% to 100.0%	
F9-65	Load loss detection time	1.0s	0.1s to 60.0s	

6.6.9 Overspeed Protection

This function takes effect only when the drive runs in feedback vector control (FVC) mode (F0-01 = 1).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-67	Overspeed detection level	20.0%	0.0% to 50.0% (maximum frequency) 0.0%: No detection	When the drive detects that the actual motor running frequency exceeds F0-10 (Maximum frequency) and the difference stays above F9-67 for a period longer than F9-68, the drive generates an alarm of Err. 43.00 and takes an action based on the setting of F9-52 (Fault protection action selection 5). When F9-68 is set to 0.0s, overspeed detection is disabled.
F9-68	Overspeed detection time	1.0s	0.0s to 60.0s	

6.6.10 Excessive Speed Deviation Protection

This function takes effect only when the drive runs in vector control mode.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-69	Detection level of speed deviation excessive	20.0%	0.0% to 50.0% (maximum frequency)	When the drive detects that the deviation between the actual motor running frequency and frequency reference stays above F9-69 for a period longer than F9-70, the drive generates an alarm of Err. 42.00 and takes an action based on the setting of F9-52 (Fault protection action selection 5). When F9-70 is set to 0.0s, excessive speed deviation detection is disabled.
F9-70	Detection time of speed deviation excessive	5.0s	0.0s to 60.0s	

6.6.11 Undervoltage and Overvoltage Thresholds Setting and Fast Current Limit Protection

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A5-06	Undervoltage threshold	100%	60% to 140%	When the bus voltage is below the value set by A5-06, the drive generates an alarm of Err. 09 or Err. 05–07.
A5-04	Fast current limit	1	0: Disabled 1: Enabled	The default value is 0 in SVC mode and 1 in other control modes. It is recommended that you disable this function for lifting systems such as cranes.

6.6.12 Detection of Short-Circuit to Ground

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F9-07	Detection of short-circuit to ground	1	0: No detection 1: Detection before running 2: Detection during running 3: Detection before running and during running	-

6.7 Monitoring

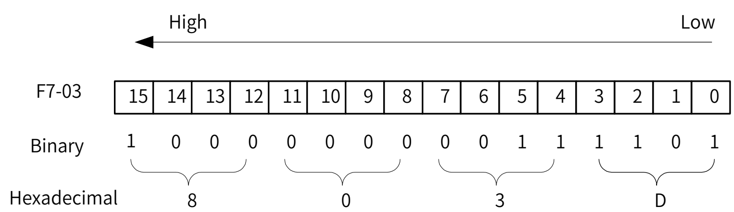
With the monitoring function, a drive displays state information on its LED panel. Use either of the following methods to view the state parameters:

1) When the drive is in stop or running state, press the key on the operating panel to switch between bytes of F7-03 (LED display running parameter 1), F7-04 (LED display running parameter 2), and F7-05 (LED display stop parameters). Multiple state parameters can be displayed on the panel.

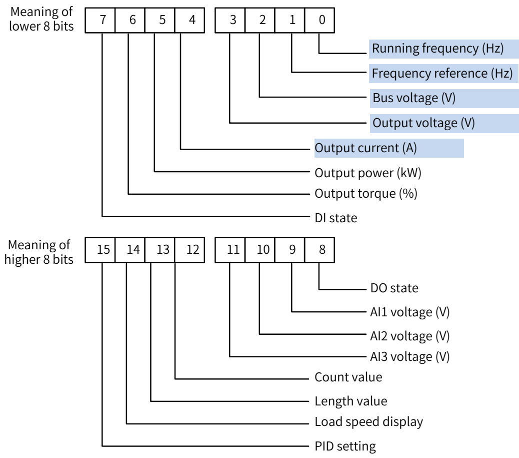
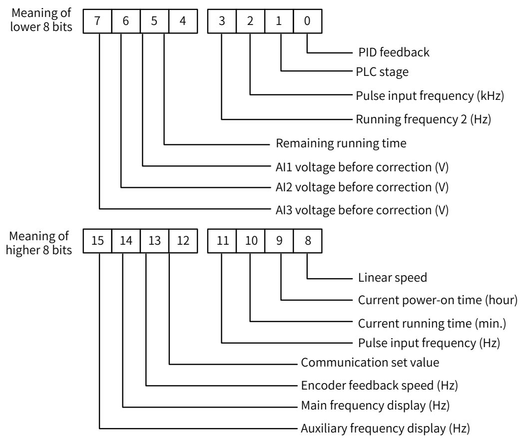
In running state, 32 running state parameters are available. The parameters to be displayed are determined by the bits of F7-03 (LED display running parameter 1) and F7-04 (LED display running parameter 2). In stop state, 13 stop state parameters are available. The parameters to be displayed are determined by the bits of F7-05 (LED display stop parameters).

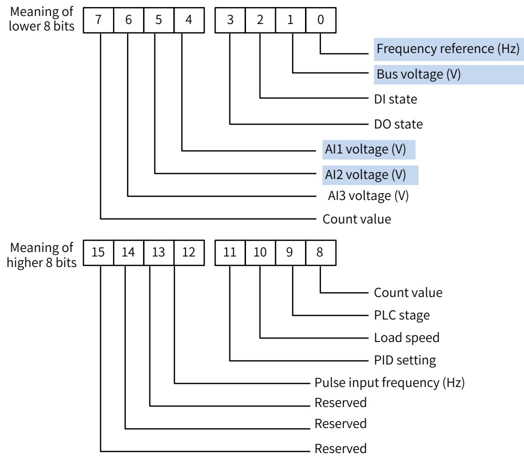
For example, to view running state parameters on the panel (running frequency, bus voltage, output voltage, output current, output power, and PID reference):

- Set the bits of F7-03 (LED display running parameter 1) corresponding to the required parameters to 1.
- Convert this binary number to a hexadecimal number, and set F7-03 (LED display running parameter 1) to this hexadecimal number. (The method of converting a binary number to a hexadecimal number is described later in this section.)
- View values of related parameters by pressing the key on the operating panel to switch between bytes of F7-03 (LED display running parameter 1). The following figure shows the setting of F7-03.



Other state parameters can be checked in the same way. The following table describes the mappings between state parameters and bytes of F7-03 (LED display running parameter 1), F7-04 (LED display running parameter 2), and F7-05 (LED display stop parameters).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F7-03	LED display running parameter 1	1F	0000 to FFFF	If the following parameters need to be displayed during running of the drive, set the corresponding bits to 1. After converting this binary number to a hexadecimal number, set F7-03 to this hexadecimal number.  Note: The part with shading is the default display.
F7-04	LED display running parameter 2	0	0000 to FFFF	If the following parameters need to be displayed during running of the drive, set the corresponding bits to 1. After converting this binary number to a hexadecimal number, set F7-04 to this hexadecimal number. 

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F7-05	LED display stop parameters	33	0000 to FFFF	If the following parameters need to be displayed upon stop, set the corresponding bits to 1. After converting this binary number to a hexadecimal number, set F7-05 to this hexadecimal number.  Note: The part with shading is the default display.

NOTE

- If the drive is powered on again after power-off, the parameters selected before the power-off are displayed by default.
- The bits of F7-03, F7-04, and F7-05 do not map to all state parameters in group U0. If the state parameters you want to monitor are not mapped to any bytes of F7-03, F7-04, and F7-05, use method 2 to find these parameters in group U0 on the operating panel.

Convert a binary number to a hexadecimal number in the following way:

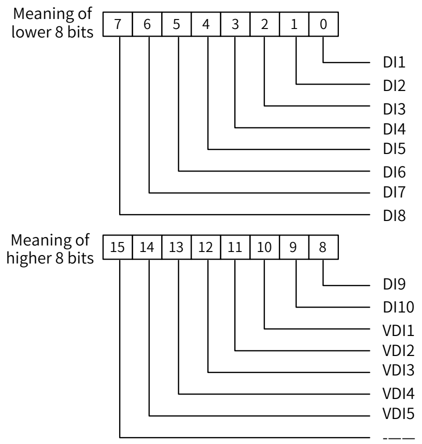
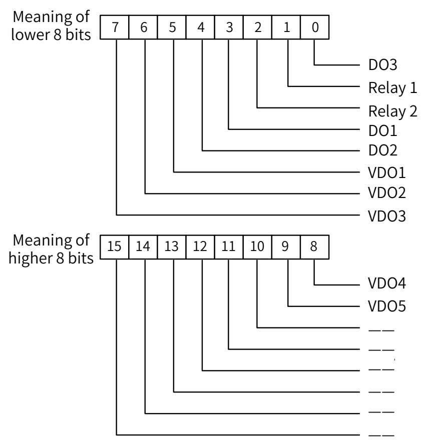
Counted from right to left, every four bits of a binary number maps to one hexadecimal digit. If any of the highest four bits are missing, pad them with 0s. Convert every four binary bits into a decimal number. Binary numbers 0000–1111 map to decimal numbers 0–15 and hexadecimal number 0–F. Convert each decimal number to a hexadecimal according to the following decimal-hexadecimal mapping table.

For example, binary number 011 1101 1111 1001 is divided into four parts: 0011,1101, 1111, and 1001. According to the following table, it can be converted into the hexadecimal number 3DF9.

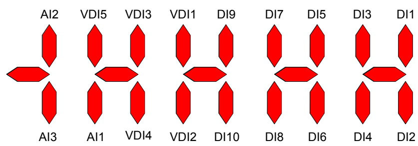
Binary	1111	1110	1101	1100	1011	1010	1001	1000	0111	0110	0101	0100	0011	0010	0001	0000
Decimal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Hexadecimal	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0

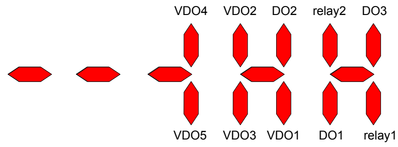
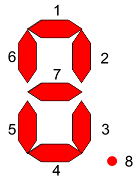
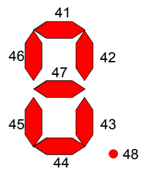
2) Select group U0 directly on the operating panel to view related state parameters. (For details on how to use the operating panel, see "4 Commissioning Tools".) Parameters in the following table are read-only.

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-00	Running frequency	0.01 Hz	0.00 Hz to 500.00 Hz	Display the absolute value of the drive's running frequency.
U0-01	Frequency reference	0.01 Hz		Display the absolute value of the frequency reference for the drive.
U0-02	Bus voltage	0.1 V	0.0 V to 3000.0 V	Display the bus voltage of the drive.
U0-03	Output voltage	1 V	0 V to 1140 V	Display the output voltage of the running drive.

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-04	Output current	0.01 A	0.00 A to 655.35 A (Drive power ≤ 55 kW) 0.0 A to 6553.5 A (Drive power > 55 kW)	Display the output current of the running drive.
U0-05	Output power	0.1 kW	0 to 32767	Display the output power of the running drive.
U0-06	Output torque	0.1%	-200.0% to +200.0%	Display the output torque of the running drive. The value is a percentage against the rated motor torque.
U0-07	DI state	1	0x0000 to 0x7FFF	Display the input state value of the current DI terminal. After it is converted into a binary value, each bit maps to one DI signal. The value 1 indicates that the input is high level. The value 0 indicates that the input is low level. The mappings between bits and input terminals are as follows: 
U0-08	DO state	1	0x0000 to 0x03FF	Display the output state value of the current DO terminal. After it is converted into binary data, each bit maps to one DO signal. The value 1 indicates that the output is high level. The value 0 indicates that the output is low level. The mappings between bits and output terminals are as follows: 
U0-09	AI1 voltage	0.01 V	0.00 V to 10.57 V	
U0-10	AI2 voltage	0.01 V	0.00 V to 10.57 V	You can set F4-40 (AI2 input type) to select voltage input.

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-11	Motor rotation speed	1 RPM	0 RPM to 65535 RPM	-
U0-12	Count value	1	1 to 65535	Display the count value in the counting function.
U0-13	Length value	1	1 to 65535	Display the length in the fixed-length function.
U0-14	Load speed display	Determined by ones position of F7-12 (Number of decimal places for load speed display)	0 to rated motor rotation speed	Display the load speed.
U0-15	PID reference	1	0 to 65535	PID reference value = PID reference (percentage) x FA-04 (PID reference and feedback range)
U0-16	PID feedback	1	0 to 65535	PID feedback value = PID feedback reference (percentage) x FA-04 (PID reference and feedback range)
U0-17	PLC stage	1	0 to 15	There are a total of 16 stages.
U0-18	Pulse input frequency	0.01 kHz	0.00 kHz to 100.00 kHz	Display the high-speed pulse frequency of DI5.
U0-19	Feedback frequency	0.01 Hz	-500.0 Hz to 500.0 Hz (Tens position of F7-12 set to 1)	When the tens position of F7-12 (Number of decimal places for load speed display) is set to 1, U0-19 has one decimal place and displays values in the range of -500.0 Hz to 500.0 Hz.
			-320.00 Hz to +320.00 Hz (Tens position of F7-12 set to 2)	When the tens position of F7-12 (Number of decimal places for load speed display) is set to 2, U0-19 has two decimal places and displays values in the range of -320.00 Hz to +320.00 Hz.
U0-20	Remaining running time	0.1 min.	0.0 min. to 6500.0 min.	Display the running time left in scheduled running mode.
U0-21	AI1 voltage before correction	0.001 V	0.000 V to 10.570 V	Display the actual AI sample voltage value. Linear correction is performed to reduce the deviation between the sample voltage and the actual voltage used. U0-09 and U0-10 display the voltage after correction.
U0-22	AI2 voltage before correction	0.001 V	0.000 V to 10.570 V	
U0-25	Accumulative power-on time	1 min.	0 min. to 65000 min.	-
U0-26	Accumulative running time	0.1 min.	0.0 min. to 6500.0 min	-
U0-27	Pulse input frequency	1 Hz	0 Hz to 65535 Hz	Display the high-speed pulse frequency of DI5. This parameter displays the same data as U0-18, but in a different unit.
U0-28	Communication setting	0.01%	-100.00% to +100.00%	Display the data written in communication address 0x1000. The base value of the percentage is determined by the value of communication address 0x1000.

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-29	Encoder feedback speed	0.01 Hz	-320.00 Hz to +320.00 Hz (Tens position of F7-12 set to 2)	Display the actual motor running frequency measured by the encoder. When the tens position of F7-12 (Number of decimal places for load speed display) is set to 2, U0-29 has two decimal places and displays values in the range of -320.00 Hz to +320.00 Hz.
			-500.0 Hz to 500.0 Hz (Tens position of F7-12 set to 1)	When the tens position of F7-12 (Number of decimal places for load speed display) is set to 1, U0-29 has one decimal place and displays values in the range of -500.0 Hz to 500.0 Hz.
U0-30	Main frequency X display	0.01 Hz	0.00 Hz to 500.00 Hz	Display the main frequency reference.
U0-31	Auxiliary frequency Y display	0.01 Hz	0.00 Hz to 500.00 Hz	Display the auxiliary frequency reference.
U0-34	Motor temperature	1°C	0°C to 200°C	Display the sample motor temperature obtained through AI3. For details about motor temperature measurement, see the description of F9-56 (Type of motor temperature sensor).
U0-35	Target torque	0.1%	-200.0% to +200.0%	Display the current torque limit, which is a percentage against the rated motor torque.
U0-37	Power factor angle	0.1°	-	Display the current power factor angle.
U0-38	ABZ position	1	0 to 65535	Display the number of phase-A and phase-B pulses of the ABZ encoder. The displayed value is four times the actual number of pulses. For example, if the displayed value is 4000, the actual number of phases is 4000/4 = 1000. When the encoder is running in forward direction, the value increases automatically. When the encoder is running in reverse direction, the value decreases automatically. When the number increases to 65535, it is reset to 0. When the number decreases to 0, it is counted down from 65535 again. You can check the value of this parameter to determine whether the encoder is installed properly.
U0-39	Target voltage upon V/F separation	1 V	0 V to rated motor voltage	Display the target output voltage when the drive runs in V/F separation state.
U0-40	Output voltage upon V/F separation	1 V	0 V to rated motor voltage	Display the actual output voltage when the drive runs in V/F separation state.
U0-41	DI state display	1	-	DI terminal state display: ON indicates high level; OFF indicates low level. 

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-42	DO state display	1	-	DO terminal state display: ON indicates high level; OFF indicates low level. 
U0-43	DI function state display 1 (functions 01 to 40)	1	-	Display validity of terminal functions 1 to 40. There are five 7-segment digits on the operating panel, representing the following functions from right to left: functions 1–8, 9–16, 17–24, 25–32, and 33–40, respectively. Each 7-segment digit represents eight functions, as shown in the following figure. The 7-segment digits display states of DI terminal functions. ON indicates high level; OFF indicates low level. 
U0-44	DI function state display 2 (functions 41 to 80)	1	-	Display validity of terminal functions 41 to 59. There are five 7-segment digits on the operating panel, representing the following functions from right to left: functions 41–48, 49–56, and 57–59, respectively. Each 7-segment digit represents eight functions, as shown in the following figure. The 7-segment digits display states of DI terminal functions. ON indicates high level; OFF indicates low level. 
U0-45	Fault subcode	1	0 to 51	Display fault subcodes.
U0-58	Z signal count	1	0 to 65535	Display the number of phase-Z pulses of the current ABZ or UVW encoder. The count increases or decreases by 1 every time the encoder rotates a round in forward or reverse direction.
U0-59	Frequency reference	0.01%	-100.00% to +100.00%	Display the current frequency reference. The value is a percentage against F0-10 (Maximum frequency) of the drive.
U0-60	Running frequency	0.01%	-100.00% to +100.00%	Display the current running frequency. The value is a percentage against F0-10 (Maximum frequency) of the drive.
U0-61	Drive state	1	Bit 1 Bit 0	0: Stop; 1: Forward run; 2: Reverse run
			Bit 3 Bit 2	0: Constant speed; 1: Accelerate; 2: Decelerate
			Bit 4	0: Normal bus voltage; 1: Undervoltage

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-68	AC drive state on the PROFIBUS-DP card	1	Bit 0	0: Stop; 1: Running
			Bit 1	0: Forward run; 1: Reverse run
			Bit 2	Whether the drive is faulty 0: No; 1: Yes
			Bit 3	Whether the running frequency reaches the frequency reference 0: No; 1: Yes
			Bit 4	Whether PROFIBUS-DP communication is normal 0: Normal; 1: Abnormal
			Bit 5	Communication control as the reference source for the drive
			Bit 6	Communication control as the command source for the drive
			Bit 7	Speed control/Torque control
			Bit 8 to bit 15	Fault code (main code), see specific fault description
U0-69	PROFIBUS-DP communication rotation speed	0.01 Hz	-320.00 Hz to +320.00 Hz	FVC: Trial run speed as feedback Other: Synchronous motor rotation speed as feedback
U0-74	Target torque in torque mode (after filter time A0-04)	0.1%	-200.0% to +200.0%	Base value: rated motor torque
U0-75	Real-time target torque in torque mode (after acceleration and deceleration time A0-07 and A0-08)	0.1%	-200.0% to +200.0%	Base value: rated motor torque
U0-76	Motoring torque upper limit	0.1%	0.0% to 200.0%	Base value: rated motor torque
U0-77	Generation torque upper limit	0.1%	0.0% to 200.2%	Base value: rated motor torque

6.8 Input and Output Terminals

This section describes the functions of the digital input (DI) and digital output (DO) terminals, virtual DI and DO terminals, and analog input (AI) and analog output (AO) terminals.

6.8.1 DI Terminal Functions

By default, the MD810 series drives are equipped with a number of DI terminals (DIO1 can be used as the input terminal of high-speed pulses). You can select any DI function for each DI terminal.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-00	DI1 function selection	1	0 to 62	For details, see the following table.
F4-01	DI2 function selection	4		
F4-03	DIO1 function selection	12		
F4-04	DIO2 function selection	13		

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-35	DI1 delay	0.0s	0.0s to 3600.0s	Specifies the delay of a DI status change. Only DI1 and DI2 support delay setting.
F4-36	DI2 delay	0.0s	0.0s to 3600.0s	
F4-38	DI active mode selection 1	00000	0: High level active 1: Low level active Ones position: DI1 Tens position: DI2 Hundreds position: Reserved Thousands position: DIO1 Ten thousands position: DIO2	When it is set to **0**, the DI terminal is active when it is connected to the COM and inactive when it is disconnected from the COM. When it is set to **1**, the DI terminal is inactive when it is connected to the COM and active when it is disconnected from the COM.

Description of DI function selection:

Setting Value	Function	Detailed Description
0	No function	Set the value to 0 for reserved terminals to avoid misoperation.
1	Forward (FWD) or run command	FWD in two-wire mode 1 (F4-11 = 0) and three-wire mode 1 (F4-11 = 2) Run command in two-wire mode 2 (F4-11 = 1) and three-wire mode 2 (F4-11 = 3)
2	Reverse (REV) or FWD/REV direction	REV in two-wire mode 1 (F4-11 = 0) and three-wire mode 1 (F4-11 = 2) FWD/REV direction in two-wire mode 2 (F4-11 =1) and three-wire mode 2 (F4-11 = 3)
3	Three-wire control	Ensures that the drive runs in three-wire control mode. To set the command source through a terminal, set F4-11 (Terminal I/O control mode) to 2 (Three-wire mode 1) or 3 (Three-wire mode 2), and select this function for the terminal.
4	Forward JOG (FJOG)	The drive running mode is FJOG. For the jog running frequency and jog acceleration/deceleration time, see the description of F8-00 (Jog running frequency), F8-01 (Jog acceleration time), and F8-02 (Jog deceleration time) in "6.9.1 Jog".
5	Reverse JOG (RJOG)	The drive running mode is RJOG. For the jog running frequency and jog acceleration/deceleration time, see the description of F8-00 (Jog running frequency), F8-01 (Jog acceleration time), and F8-02 (Jog deceleration time) in "6.9.1 Jog".
6	Terminal UP	Frequency increase command when you use the terminal to set the frequency. If the terminal is active, the effect is equivalent to holding down the  key; if the terminal is inactive, the effect is equivalent to releasing the  key.
7	Terminal DOWN	Frequency decrease command when you use the terminal to set the frequency. If the terminal is active, the effect is equivalent to holding down the  key; if the terminal is inactive, the effect is equivalent to releasing the  key.
8	Coast to stop	After the drive stops, the motor stops when its kinetic energy is consumed.
9	Fault reset (RESET)	Resets the drive fault. This function can be used to remotely reset a fault.
10	Running pause	The drive decelerates to stop. If the terminal is active, all the running parameters, such as the PLC, wobble, and PID parameters, are saved. If the terminal is inactive, the drive restores the saved running status.

Setting Value	Function	Detailed Description
11	External fault normally open (NO) input	When an external signal is sent to the drive, the drive reports the E15.00 fault.
12	Multi-reference terminal 1	You can set the 16 states by the four terminals to select 16 speeds or 16 other references. For details, see the multi-reference function description in "Table 6-1 Multi-reference function description".
13	Multi-reference terminal 2	
14	Multi-reference terminal 3	
15	Multi-reference terminal 4	
16	Terminal 1 for acceleration/ deceleration time selection	You can set the four states by the two terminals to select four acceleration/ deceleration time periods. For details, see "Table 6-2 Acceleration/Deceleration time selection by DI terminals".
17	Terminal 2 for acceleration/ deceleration time selection	
18	Frequency reference switchover	Switches the frequency reference input method. Switches between two frequency references according to F0-07 (Final frequency reference setting selection).
19	Clear UP and DOWN setting (terminal, operating panel)	If you set the main frequency on the panel, you can select this function for the terminal to clear the frequency change made through the ▲ or ▼ key on the operating panel or the UP or DOWN terminals (6 or 7) and resume the main frequency specified by F0-08 (Preset frequency).
20	Running command switchover terminal 1	If you set the command source through a terminal (set F0-02 to 1), select this function for the terminal to switch between terminal control and operating panel control. If you set the command source through communication (set F0-02 to 2), select this function for the terminal to switch between communication control and operating panel control.
21	Acceleration/ Deceleration inhibited	The drive keeps the current frequency regardless of external input frequency changes (unless the stop command is received).
22	PID pause	The PID is temporarily invalid, and the drive keeps the current output frequency and does not update the PID frequency source.
23	Simple PLC status reset	Brings the drive back to the initial state of simple PLC.
24	Wobble pause	In the wobble function, select this function for the terminal to disable the wobble function (the drive setpoint is kept at the central frequency).
25	Counter input	In the counter function, select this function for the terminal to input the counter pulse.
26	Counter reset	In the count function, select this function for the terminal to reset the counter status.
27	Length count input	In the fixed length function, select this function for the terminal to input the length count.
28	Length reset	In the fixed length technology function, select this function for the terminal to reset the length.
29	Torque control inhibited	Switches torque control to speed control in the torque control mode. When the terminal is inactive, the torque control mode is resumed.
31	Reserved	Reserved
32	Immediate DC injection braking	Directly switches the drive to the DC injection braking state.

Setting Value	Function	Detailed Description
33	External fault normally closed (NC) input	When an external signal is sent to the drive, the drive reports the E15.01 fault.
34	Frequency modification enabled	If the terminal is active, the frequency can be adjusted; otherwise, the frequency cannot be adjusted.
35	Inverse PID operation direction	The PID operation direction is inverse to the direction specified by the FA-03 (PID operation direction) parameter.
36	External stop terminal 1	Stops the drive when the operating panel is selected as the command source (set F0-02 to 0).
37	Control command switchover terminal 2	Switches between the terminal control mode and the communication control mode for the command source. If the command source is controlled by the terminal, switch to the communication control mode if this function is selected for the terminal and the terminal is active; if the command source is controlled by communication, switch to the terminal control mode if this function is selected for the terminal and the terminal is active.
38	PID integral disabled	Disables the PID integral adjustment function. The PID proportion adjustment and differential adjustment functions are still available.
39	Switchover between main frequency and preset frequency	Switches the main frequency to F0-08 (Preset frequency).
40	Switchover between auxiliary frequency and preset frequency	Switches the auxiliary frequency to F0-08 (Preset frequency).
42	Position lock enabled	The drive decelerates to 0 Hz and then enters the position lock state.
43	PID parameter switchover	When FA-18 (PID parameter switchover condition) is set to 1 (switchover through the terminal), the PID parameters are FA-05 (Proportional gain Kp1) to FA-07 (Differential time Td1) if the terminal is inactive and FA-15 (Proportional gain Kp2) to FA-17 (Differential time Td2) if the terminal is active.
44	User-defined fault 1	The drive reports the E27.00 alarm and proceeds according to the value of F9-51 (Fault protection action selection 4).
45	User-defined fault 2	The drive reports the E28.01 alarm and proceeds according to the F9-51 (Fault protection action selection 4) parameter.
46	Speed control/Torque control switchover	The drive switches between the speed control mode and the torque control mode. When A0-00 (Speed/Torque control mode) is set to 0 (Speed control), the torque control mode is used if the terminal is active, and the speed control mode is used if the terminal is inactive. When A0-00 (Speed/Torque control mode) is set to 1 (Torque control), the speed control mode is used if the terminal is active, and the torque control mode is used if the terminal is inactive.
47	Emergency stop	During an emergency, the drive decelerates within the emergency stop deceleration time specified by F8-55 (Emergency stop deceleration time). In the V/F mode, if the emergency stop deceleration time is 0, the drive decelerates within the minimum unit time. This input terminal does not need to remain closed. Even if it is closed for a short time, emergency stop is triggered. When you disconnect the emergency stop input terminal after the emergency stop deceleration time, the drive does not start if the terminal running signal of the drive remains closed. This is different from what happens at the end of common deceleration time. To start the drive, you need to disconnect the running terminal and input the terminal running signal again.
48	External stop terminal 2	The drive decelerates and stops regardless of the command source (operating panel, terminal, or communication). The fixed deceleration time is F8-08 (Deceleration time 4).
49	Deceleration DC injection braking	The drive decelerates to the value of F6-11 (Shutdown DC injection braking/Position lock start frequency) and then starts DC injection braking.

Setting Value	Function	Detailed Description
50	Clear the current running time	Clears the current running time of the drive. If the current running time is less than the value of F8-53 (Current running time threshold), if the terminal is active the current running time is cleared. If the current running time is greater than the value of F8-53 (Current running time threshold), if the terminal is active the current running time is not cleared.
51	Two-wire/Three-wire control switchover	Switches the control mode between two-wire and three-wire. If F4-11 (Terminal I/O control mode) is set to 0 (Two-wire mode 1), the mode is switched to three-wire mode 1 when the terminal, for which this function is selected, is active. If F4-11 (Terminal I/O control mode) is set to 1 (Two-wire mode 2), the mode is switched to three-wire mode 2 when the terminal, for which this function is selected, is active. If F4-11 (Terminal I/O control mode) is set to 2 (Three-wire mode 1), the mode is switched to two-wire mode 1 when the terminal, for which this function is selected, is active. If F4-11 (Terminal I/O control mode) is set to 3 (Three-wire mode 2), the mode is switched to two-wire mode 2 when the terminal, for which this function is selected, is active.
52	Reverse frequency inhibited	When the terminal is active, the actual set frequency of the drive is constrained to 0 when a reverse (negative) frequency is set. This function is the same as F8-13 (Reverse run control).
54	Winding diameter reset	In case tension mode is used it resets to the initial winding diameter.
55	Initial winding diameter 1	Switches the initial winding diameter in the range of B0-11 (Initial winding diameter 1) to B0-13 (Initial winding diameter 3) when B0-10 (Setting channel of initial winding diameter) is set to 0.
56	Initial winding diameter 2	
57	Pre-drive	Synchronizes the linear speed for the axis that requires automatic winding change when the tension mode is used.
58	Winding/Unwinding switchover	Switches between winding and unwinding when the tension mode is used.
59	Winding diameter calculation disabled	Disables winding diameter calculation to prevent automatic winding change and pre-drive from affecting winding diameter calculation when the tension mode is used.
60	Exiting tension mode	Exits the tension control mode.

6.8.2 DO Terminal Functions

By default, the MD810-series drives are equipped with multi-functional DIO terminals, which can be configured as DO terminals.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F5-00	DIO2 terminal output mode	0	0: Pulse output (FMP) 1: Switch output (FMR)	The FM terminal is a programmable multifunctional terminal. It can be used as a high-speed pulse output terminal (FMP) or as a open collector output (FMR). When it is used as a pulse output terminal (FMP), the maximum output pulse frequency is 100 kHz. For details about the FMP-related functions, see the description of F5-06.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F5-01	FMR output function selection (collector open circuit output terminal)	0	0 to 43	Selects five DO functions. T/A-T/B-T/C and P/A-P/B-P/C are the relays on the control board and extension card, respectively.
F5-02	Control board relay output function selection (T/A-T/B-T/C)	2		
F5-04	DIO1 function selection	1		
F5-17	FMR output delay	0.0s	0.0s to 3600.0s	-
F5-18	Relay output delay	0.0s	0.0s to 3600.0s	-
F5-20	DIO1 output delay	0.0s	0.0s to 3600.0s	-
F5-21	DIO2 output delay	0.0s	0.0s to 3600.0s	-
F5-22	DO active mode selection	00000	0: Positive logic active 1: Negative logic active Ones position: FMR (DIO2) Tens position: RELAY1 Hundreds position: Reserved Thousands position: DIO1 Ten thousands position: Reserved	0: Positive logic active (equivalent to a normally open contact) Active: The DO terminal and COM terminal are connected inside the drive. Inactive: The DO terminal and COM terminal are disconnected. 1: Negative logic active (equivalent to a normally closed contact) Active: The DO terminal and COM terminal are disconnected. Inactive: The DO terminal and COM terminal are connected inside the drive.

Description of output terminal function selection:

Setting Value	Function	Description
0	No output	Output terminals have no function.
1	Drive running	Outputs the ON signal when the drive is in running state and has output frequency, which can be zero.
2	Fault output (coast-to-stop upon fault)	Outputs the ON signal when the drive stops due to a fault.
3	Frequency-level detection 1 output	The DO terminal outputs the ON signal when the running frequency exceeds the frequency detection threshold and stops outputting the ON signal when the running frequency is lower than the resulting value of detection threshold minus the frequency detection hysteresis (FDT), which equals the value of F8-19 [Frequency detection value (FDT1)] times the value of F8-20 [Frequency detection hysteresis (FDT1)]. For details about F8-19 and F8-20, see "Appendix C Parameter Table".
4	Frequency reached	The DO terminal outputs the ON signal when the running frequency of the drive is within a range [target frequency ± product of the F8-21 (Detection width of target frequency reached) value times the maximum frequency].
5	Zero-speed running (no output at stop)	Outputs the ON signal when the drive is running, and the output frequency is 0. Outputs the OFF signal when the drive is stopped.
6	Motor overload pre-warning	Outputs the ON signal when detecting that the motor load exceeds the pre-warning threshold according to F9-02 (Motor overload pre-warning coefficient) before the overload protection action is taken. (For details about how to calculate the pre-warning threshold, see "6.6 Protection Functions".)
7	Drive overload pre-warning	Outputs the ON signal 10 seconds before drive overload protection is performed.
8	Set count value reached	Outputs the ON signal when the count reaches the value of FB-08 (Set count value) in the count function.

Setting Value	Function	Description
9	Designated count value reached	Outputs the ON signal when the count reaches the value of FB-09 (Designated count value) in the count function. Outputs the ON signal when the count reaches the value of FB-09 (Designated count value) in the count function. For details about the count function, see "7.4 Counting Function"
10	Length reached	Outputs the ON signal when the detected length exceeds the value of FB-05 (Set length) in the fixed length function.
11	Simple PLC cycle completed	Outputs a pulse signal with a duration of 250 ms when a simple PLC cycle is complete.
12	Accumulative running time reached	Outputs the ON signal when the accumulative running time of the drive exceeds the value of F8-17 (Accumulative running time threshold).
13	Frequency limited	Outputs the ON signal when the set frequency exceeds the upper or lower limit and the output frequency of the drive reaches the upper or lower limit.
14	Torque limited	Outputs the ON signal when the output torque reaches the torque limit if the drive works in speed control mode.
15	Ready for run	Outputs the ON signal if no exception occurs after the drive is powered on.
16	AI1 > AI2	Outputs the ON signal when the value of analog input AI1 is greater than that of AI2.
17	Frequency upper limit reached	Outputs the ON signal when the running frequency reaches the value of F0-12 (Frequency reference upper limit).
18	Frequency lower limit reached (no output at stop)	Outputs the OFF signal regardless of whether the running frequency has reached the lower limit when F8-14 (Running mode when the frequency reference is lower than the frequency lower limit) is set to 1 (stop). Outputs the ON signal when the F8-14 parameter (Running mode when frequency reference lower than frequency lower limit) is set to 0 (Run at the frequency lower limit) or 2 (Run at zero speed) and the running frequency has reached the lower limit.
19	Undervoltage state output	Outputs the ON signal when the drive is in undervoltage state.
20	Communication setting	Whether the terminal is active or inactive is controlled by the value of the 0x2001 communication address.
21	Reserved	Reserved
22	Reserved	Reserved
23	Zero-speed running 2 (output at stop)	Outputs the ON signal when the drive is running, and the output frequency is 0. Outputs the ON signal when the drive is stopped.
24	Accumulative power-on time reached	Outputs the ON signal when F7-13 (Accumulative power-on time) of the drive exceeds the value of F8-16 (Accumulative power-on time threshold).
25	Frequency-level detection 2 output	The DO terminal outputs the ON signal when the running frequency exceeds the frequency detection threshold and stops outputting the ON signal when the running frequency is lower than the resulting value of the detection threshold minus the frequency detection hysteresis, which equals the value of F8-28 (Frequency detection value 2) times the value of F8-29 [Frequency detection hysteresis (FDT2)]. For details about F8-28 and F8-29, see "Appendix C Parameter Table".
26	Frequency 1 reached	The DO terminal outputs the ON signal when the running frequency of the drive is within the frequency detection range of F8-30 (Detection of frequency 1). Frequency detection range: F8-30 (Detection of frequency 1) - F8-31 (Detection width of frequency 1) x F0-10 (Maximum frequency) to F8-30 (Detection of frequency 1) + F8-31 (Detection width of frequency 1) x F0-10 (Maximum frequency)
27	Frequency 2 reached	The DO terminal outputs the ON signal when the running frequency of the drive is within the frequency detection range of F8-32 (Detection of frequency 2). Frequency detection range: F8-32 (Detection of frequency 2) - F8-33 (Detection width of frequency 2) x F0-10 (Maximum frequency) to F8-32 (Detection of frequency 2) + F8-33 (Detection width of frequency 2) x F0-10 (Maximum frequency)

Setting Value	Function	Description
28	Current 1 reached	The DO terminal outputs the ON signal when the output current of the drive is within the current detection range of F8-38 (Detection level of current 1). Current detection range: F8-38 (Detection level of current 1) - F8-39 (Detection width of current 1) x F1-03 (Rated motor current) to F8-38 (Detection level of current 1) + F8-39 (Detection width of current 1) x F1-03 (Rated motor current)
29	Current 2 reached	The DO terminal outputs the ON signal when the output current of the drive is within the current detection range of F8-40 (Detection level of current 2). Current detection range: F8-40 (Detection level of current 2) - F8-41 (Detection width of current 2) x F1-03 (rated motor current) to F8-40 (Detection level of current 2) + F8-41 (Detection width of current 2) x F1-03 (Rated motor current)
30	Timing reached	Outputs the ON signal when the current running time of the drive reaches the set time if F8-42 (Timing function) is set to 1 (Enabled). The timing duration is set by F8-43 (Timing duration source) and F8-44 (Timing duration).
31	AI1 input limit exceeded	Outputs the ON signal when the value of AI1 is greater than that of F8-46 (AI1 input voltage upper limit) or smaller than that of F8-45 (AI1 input voltage lower limit).
32	Drive output load loss	Outputs the ON signal when the drive is in load loss state.
33	Reverse running	Outputs the ON signal when the drive is in reverse running state.
34	Zero current state	The DO terminal outputs the ON signal when the output current of the drive remains in the zero current range for longer than the value of F8-35 (Zero current detection delay). Zero current detection range: 0 to F8-34 (Zero current detection level) x F1-03 (Rated motor current)
35	IGBT temperature reached	Outputs the ON signal when F7-07 (Heatsink temperature of IGBT) reaches F8-47 (IGBT temperature threshold).
36	Output current limit exceeded	The DO terminal outputs the ON signal when the output current of the drive remains higher than the value of F8-36 (Output overcurrent threshold) for longer than the value of F8-37 (Output overcurrent detection delay).
37	Frequency lower limit reached (output at stop)	Outputs the ON signal when the running frequency reaches the value of F0-14 (Frequency reference lower limit). Outputs the ON signal even when the drive is stopped.
38	Warning	The DO terminal outputs the ON signal when the drive is faulty, and the fault protection action is to continue running. For details about fault protection actions, see the parameters F9-48 (Fault protection action selection 1) to F9-50 (Fault protection action selection 3).
39	Motor overheat	Outputs the ON signal when the motor temperature reaches the value of F9-58 (Motor overheat pre-warning threshold). You can check the motor temperature through U0-34 (Motor temperature).
40	Current running time reached	Outputs the ON signal when the current running time of the drive exceeds the value of F8-53 (Current running time threshold).
41	Fault output (coast-to-stop upon fault and no output for undervoltage)	The DO terminal outputs the ON signal when a drive fault (except the undervoltage fault) occurs.
43	Position lock enabled	The number of offset pulses of position lock is smaller than the value of F6-25 (Position lock end amplitude).

6.8.3 VDI Terminal Functions

The virtual digital input (VDI) function can be used as multi-functional digital input, which is similar to the DI function of the control board.

There are three VDI sources:

- A1-06 (Selection of VDI active state): Enable DIs by setting A1-06. This mode is used in communication scenarios, where physical DIs are not used. The mappings between the digits of A1-06 and the VDIs are as follows: ones position of A1-06 corresponds to VDI1...ten thousands position of A1-06 corresponds to VDI5.

- DO status: MD810 has two DO terminals. DIO1 corresponds to VDI1, and DIO2 corresponds to VDI2.
- DI status: The mappings between the MD810 DIs and the VDIs are as follows: DI1 - VDI1, DI2 - VDI2, DIO1 - VDI4, and DIO2 - VDI5.

The following examples show how to use VDIs:

Example 1: To generate a fault warning and stop the drive when the AI1 input exceeds the upper or lower limit, perform the following settings.

Step	Parameter Setting
1	Set the VDI1 function to "User-defined fault 1" (set A1-00 to 44).
2	Set the DIO1 function to "AI input exceeds limit" (set F5-04 to 31).
3	Set the VDI1 status to be specified by DO (set A1-05 to 00001).

After the preceding steps, when the AI1 input exceeds the upper or lower limit the DIO1 output changes to ON state so the VDI1 terminal becomes active. If VDI1 becomes active, the drive receives user-defined fault 1, and the drive generates fault warning E27.00 and stops.

Example 2: In a communication scenario, implement emergency stop through the VDI without connecting to the physical DI.

Step	Parameter setting
1	Set the VDI1 function to "Emergency stop" (set A1-00 to 47).
2	Set the VDI1 active status to be specified by a parameter (set A1-05 to 00000).
3	Modify the ones position of A1-06 (Selection of VDI active state) through communication.

After the preceding steps, emergency stop can be implemented by setting the ones position of A1-06 (Selection of VDI active state) to 1 through communication.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A1-00	VDI1 function selection	0	0 to 60	Terminals VDI1 to VDI5 can be used as multi-functional DI input. Functions 0 to 52 are similar to those of common DIs, and functions 53 to 59 are reserved. For details about their settings, see the description of F4-00 (DI1 function selection) to F4-04 (DIO2 function selection) in "6.9.1 Jog".
A1-01	VDI2 function selection	0	0 to 60	
A1-02	VDI3 function selection	0	0 to 60	
A1-03	VDI4 function selection	0	0 to 60	
A1-04	VDI5 function selection	0	0 to 60	
A1-05	VDI active state setting mode	00000	Ones position: VDI1 0: Set by A1-06 1: Set by DO status 2: Set by DI status Tens position: VDI2 (the options are the same as the preceding) Hundreds position: VDI3 (the options are the same as the preceding) Thousands position: VDI4 (the options are the same as the preceding) Ten thousands position: VDI5 (the options are the same as the preceding)	VDI status can be set in three modes, which can be selected through A1-05. 0: VDI terminal status is set by the binary bits of A1-06. 1: Whether the VDI is active depends on whether the DO is active. VDIx and DOx (x ranges from 1 to 5) are one-to-one mapped. 2: Whether the VDI is active depends on whether the DI is active. VDIx and DIx (x ranges from 1 to 5) are one-to-one mapped.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A1-06	Selection of VDI active state	00000	Ones position: VDI1 0: Inactive 1: Active Tens position: VDI2 (the options are the same as the preceding) Hundreds position: VDI3 (the options are the same as the preceding) Thousands position: VDI4 (the options are the same as the preceding) Ten thousands position: VDI5 (the options are the same as the preceding)	-

6.8.4 Analog Input Terminals

The MD810 series drives are equipped with two multi-functional AI terminals by default. To use AIs as DIs, set the following parameters. For details about AI functions, see "6.2.3 Setting the Main Frequency Using Analog Input Terminals". When an AI terminal is used as a DI terminal, the AI terminal status is high level if the AI voltage is higher than 7 V, low level if the AI input voltage is lower than 3 V, and hysteresis when the AI input voltage is in the range of 3 V to 7 V. The following figure shows the mapping between AI input voltage and DI status:

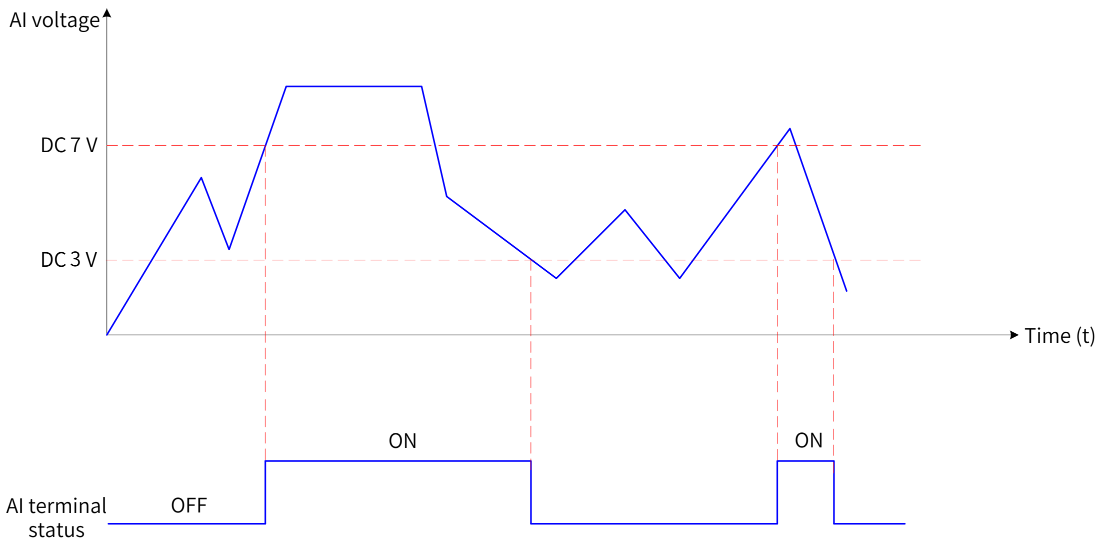


Figure 6-46 Mapping between AI input voltage and DI status

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A1-07	Function selection for AI1 used as DI	0	0 to 60	Function settings when the AI is used as a DI. The settings of function 0 to 52 are the same as common DIs, and function 53 to 59 are reserved. For details, see the DI setting description of the F4 group in "6.9.1 Jog".
A1-08	Function selection for AI2 used as DI	0	0 to 60	
A1-10	Active state selection for AI used as DI	00	Ones position: AI1 0: High level active 1: Low level active Tens position: AI2 (the options are the same as the ones position)	When the AI terminal level is high, and the corresponding digit of A1-10 is set to 0, the AI terminal is active. If the corresponding digit of A1-10 is set to 1, the AI terminal is inactive. When the AI terminal level is low, and the corresponding digit of A1-10 is set to 0, the AI terminal is inactive. If the corresponding digit of A1-10 is set to 1, the AI terminal is active.

6.8.5 Analog and Pulse Output Terminals

The MD810 series drives are equipped with an analog output (AO) terminal as standard. The following parameters are used to adjust the zero drift of analog output and the error of output amplitude. They can also be used to define the AO curve as required.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F5-00	DIO2 terminal output mode	0	0: Pulse output (FMP) 1: Digital output (FMR)	The DIO2 terminal is a programmable multifunctional terminal. It can be used as the high-speed pulse output terminal (FMP) or the open collector output (FMR). When it is used as the pulse output terminal (FMP), the maximum output pulse frequency is 100 kHz. For details about the FMP-related functions, see the description of F5-06.
F5-06	FMP output function selection (pulse output terminal)	0	0 to 19	For details, see "Table 6-5 Mappings between pulse output/AO functions and ranges".
F5-07	AO function selection	0	0 to 19	
F5-09	Maximum FMP output frequency	50.00 kHz	0.01 kHz to 100.00 kHz	When the DIO2 terminal is used as the pulse output, this parameter specifies the maximum frequency of the output pulse.
F5-10	AO1 zero offset coefficient	0.0%	-100.0% to +100.0%	The 100% zero offset coefficient of AO corresponds to 10 V or 20 mA. Zero offset = Zero offset coefficient x 10 V (or 20 mA)
F5-11	AO1 gain	1.00	-10.00 to +10.00	-
F5-23	AO mode selection	0	0: Voltage output 1: Current output	-

The AO ranges from 0 V to 10 V (corresponding to 0% to 100%). When the AO output function is set to 1 (frequency setting), and the drive frequency is set to 50% of the maximum frequency, the output voltage of the AO terminal is 5 V (50% x 10 V).

The FM (pulse output) ranges from 0 to 100 kHz (corresponding to 0% to 100%). When the FM output function is set to 1 (frequency setting), the drive frequency is set to 50% of the maximum frequency, and F5-09 (Maximum FMP output frequency) is set to 100 kHz, the output frequency of the FM terminal is 50 kHz (50% x 100 kHz).

Table 6-5 Mappings between pulse output/AO functions and ranges

Setting Value	Function	Function Range
0	Running frequency	0 to maximum output frequency
1	Frequency reference	0 to maximum output frequency
2	Output current	0% to 200% of the rated motor current
3	Motor output torque (absolute value, percentage of the rated motor torque)	0% to 200% of the rated motor torque
4	Output power	0% to 200% of the rated power
5	Output voltage	0% to 120% of the rated drive voltage
6	Pulse input (100% corresponds to 100.00 kHz)	0.01 kHz to 100.00 kHz
7	AI1	0 V to 10 V
8	AI2	0 to 10 V (or 0 to 20 mA)
9	AI3	0 V to 10 V
10	Length	0 to maximum set length
11	Count value	0 to maximum count value
12	Communication setting	0.0% to 100.0%
13	Motor rotation speed	0 to rotation speed corresponding to the maximum output frequency
14	Output current	0.0 A to 1000.0 A
15	Bus voltage	0.0 V to 1000.0 V
16	Motor output torque (actual value, percentage of the rated motor torque)	- 200% to 200% of the rated motor torque

The following is an example of how to calculate F5-10 (AO1 zero offset coefficient) and F5-11 (AO1 gain):

For example, the AO is the running frequency, and you need the modified output to be 8 V (Y1) when frequency is 0 Hz (X1) and 4 V (Y2) when the frequency is 40 Hz (X2).

Gain formula:

$$K = \frac{(Y1-Y2) * Xmax}{(X1-X2) * Ymax}$$

Zero offset coefficient formula:

$$b = \frac{(X1*Y2) - (X2*Y1)}{(X1-X2) * Ymax} \times 100\%$$

According to Table 6-6 and Table 6-7, Xmax (maximum output frequency) is 50 Hz (assuming that the maximum frequency F0-10 is 50 Hz), and Ymax (maximum voltage) is 10 V.

Then, set F5-11 (AO1 gain) to -0.5 and F5-10 (AO1 zero offset coefficient) to 80%.

Table 6-6 Mappings between AO signal types and maximum values (Ymax)

AO Signal Type	Max. Signal Value (Ymax)
Voltage	10 V
Current	20 mA

Table 6-7 Mappings between AO contents and maximum values (Xmax)

AO Content	Max. Value of AO Content (Xmax)
Running frequency	Maximum output frequency
Frequency reference	Maximum output frequency

AO Content	Max. Value of AO Content (Xmax)
Output current	200% of the rated motor current
Output torque (absolute value)	200% of the rated motor torque
Output power	200% of the rated power
Output voltage	120% of the rated drive voltage
Pulse input	100.00kHz
AI1	10 V
AI2	10 V or 20 mA
AI3	10 V
Length	Maximum set length
Count value	Maximum count value
Communication setting	100.0%
Motor rotation speed	Rotation speed corresponding to the maximum output frequency
Output current	1000.0 A
Output voltage	1000.0 V
Output torque (actual value)	200% of the rated motor torque

6.9 Auxiliary Functions

6.9.1 Jog

In certain scenarios, the drive needs to run in jog mode for device testing. In the jog running mode, the startup mode is direct startup (set F6-00 to 0), and the stop mode is deceleration to stop (set F6-10 to 0).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-25	Acceleration/ Deceleration time base frequency	0	0: F0-10 (Maximum frequency) 1: Frequency reference 2: 100 Hz	-
F8-00	Jog running frequency	2.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-
F8-01	Jog acceleration time	20.0s	0.0s to 6500.0s	The jog acceleration time is the time that a drive needs to accelerate from zero frequency to the value of F0-25 (Acceleration/Deceleration time base frequency).
F8-02	Jog deceleration time	20.0s	0.0s to 6500.0s	The jog deceleration time is the time that a drive needs to decelerate from the value of F0-25 (Acceleration/Deceleration time base frequency) to zero frequency.
F8-27	Set highest priority to JOG function	0	0: Disabled 1: Enabled	Specifies whether the jog function of the terminal has the highest priority. If this parameter is set to 1, the drive immediately enters the jog running mode when a DI terminal function (F4-00 to F4-04) is set to 4 (Forward jog) or 5 (Reverse jog) during running.
F8-56	Jog by LED panel	0	-	The LED operating panel of the drive does not provide a running button. Therefore, to perform jog running, you need to set F8-56.

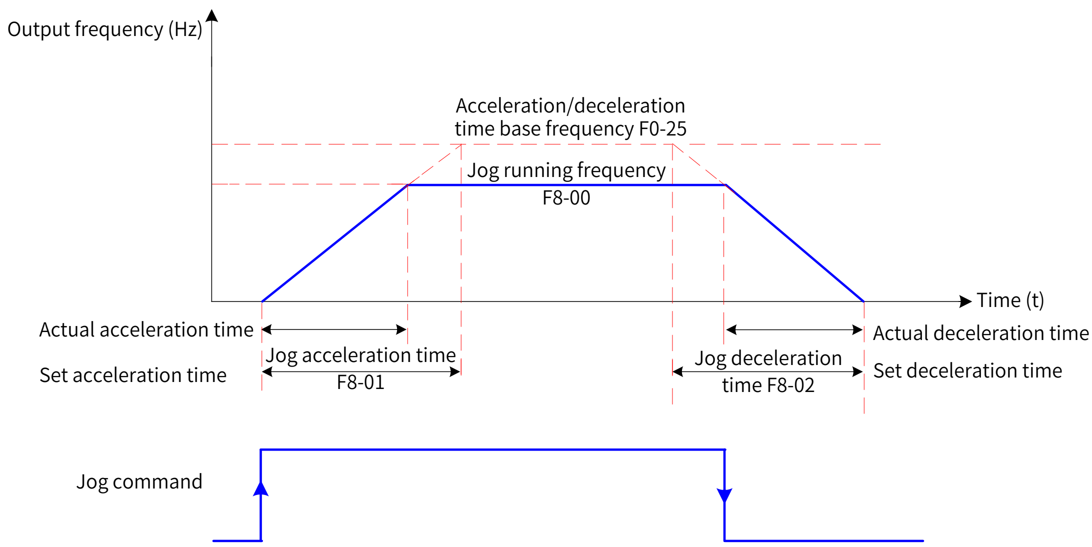


Figure 6-47 Jog running

Table 6-8 Parameter settings for enabling jog running on the LED operating panel

Step	Forward jog	Reverse jog
1	Select the operating panel as the command source (set F0-02 to 0).	Select the operating panel as the command source (set F0-02 to 0). Set F8-13 (Reverse run control) to 0 (Enabled) to enable reverse running.
2	Set F8-00 (Jog running frequency), F8-01 (Jog acceleration time), and F8-02 (Jog deceleration time).	Set F8-00 (Jog running frequency), F8-01 (Jog acceleration time), and F8-02 (Jog deceleration time).
3	Access the F8-56 (Jog by LED panel) menu. The set jog frequency is displayed. To adjust the jog frequency, press the UP or DOWN buttons.	Access the F8-56 (Jog by LED panel) menu. The set jog frequency is displayed. To adjust the jog frequency, press the UP or DOWN keys.
4	Press Enter. "JOG" is displayed, indicating that the drive has started jog running. Press and hold down UP to start forward running and release the key to enable the drive to decelerate to stop.	Press Enter. "JOG" is displayed, indicating that the drive has started jog running. Press and hold down DOWN to start reverse running and release the key to enable the drive to decelerate to stop.

6.9.2 Jump Frequency, Forward/Reverse Run Switchover Dead-Zone Time, and Reverse Frequency Prohibited

■ Jump frequency setting

You can avoid the mechanical resonance point of load by setting the jump frequency. The MD810 series support two jump frequencies. If both of them are set to 0, the jump frequency function is disabled.

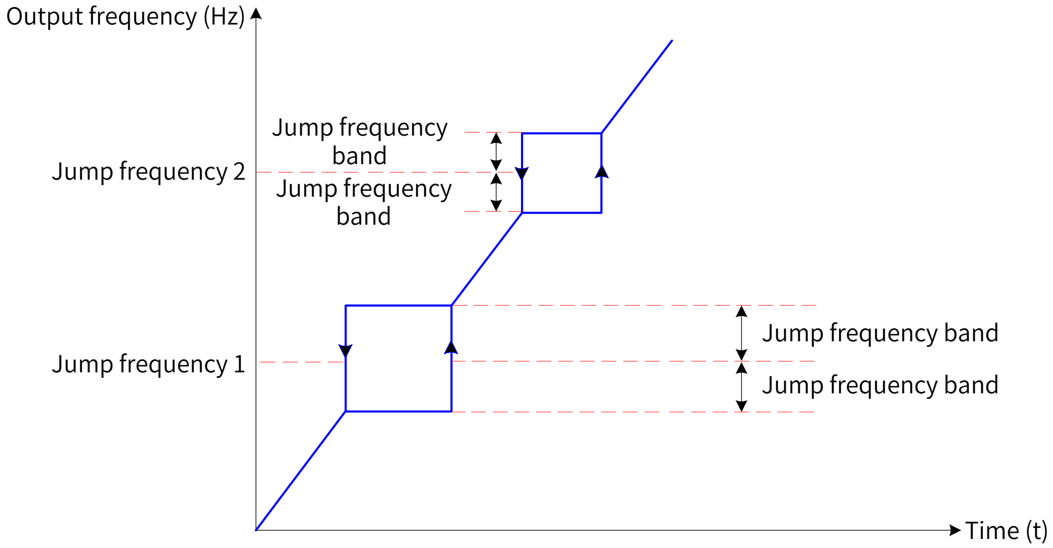


Figure 6-48 Jump frequency

In the figure above, when the running frequency approaches the jump frequency during acceleration, the drive runs at the current frequency for some time and then jumps over the jump frequency by twice of the value of F8-11 (Jump frequency band).

When the running frequency approaches the jump frequency during deceleration, the drive runs at the current frequency for some time and then jumps over the jump frequency by twice of the value of F8-11 (Jump frequency band).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-09	Jump frequency 1	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-
F8-10	Jump frequency 2	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-
F8-11	Jump frequency band	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-
F8-22	Jump frequency during acceleration/ deceleration	0	0: Disabled 1: Enabled	Specifies whether the jump frequency is effective during acceleration and deceleration. If this parameter is set to 1, when the running frequency approaches the jump frequency during acceleration or deceleration, the drive jumps over the jump frequency by twice of the value of F8-11 (Jump frequency band). If this parameter is set to 0, when the running frequency approaches the jump frequency during acceleration or deceleration, the drive operates at the frequency set by the acceleration/deceleration ramp.

■ Forward/Reverse run switchover dead-zone time

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-12	Forward/reverse run switchover dead-zone time	0.0s	0.0s to 3000.0s	Specifies the transition period when the output is 0 Hz during forward/reverse running switchover of the drive.

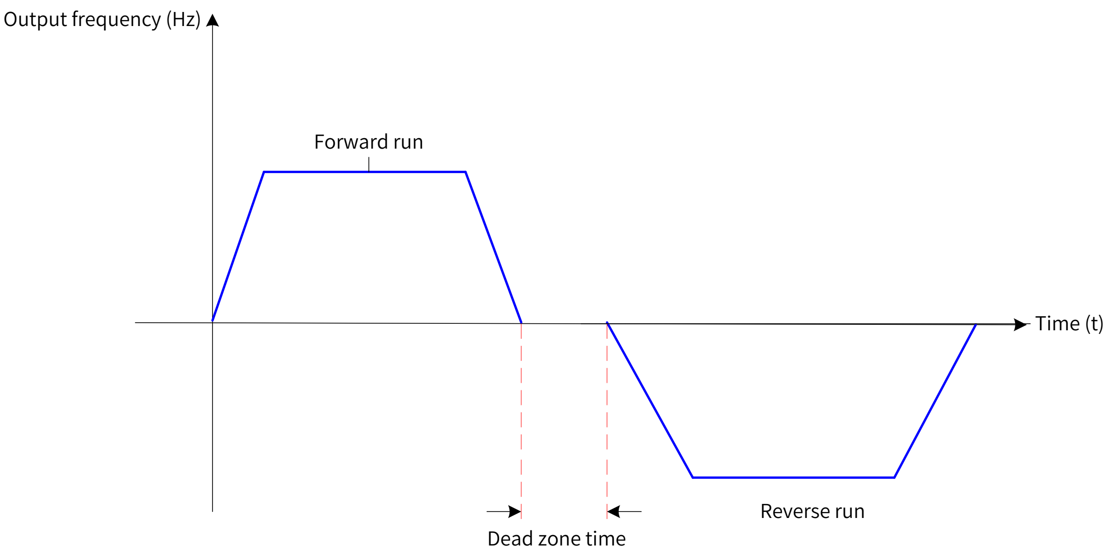


Figure 6-49 Forward/reverse run switchover dead-zone time

■ Reverse frequency prohibition

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-13	Reverse run control	0	0: Disabled 1: Enabled	-

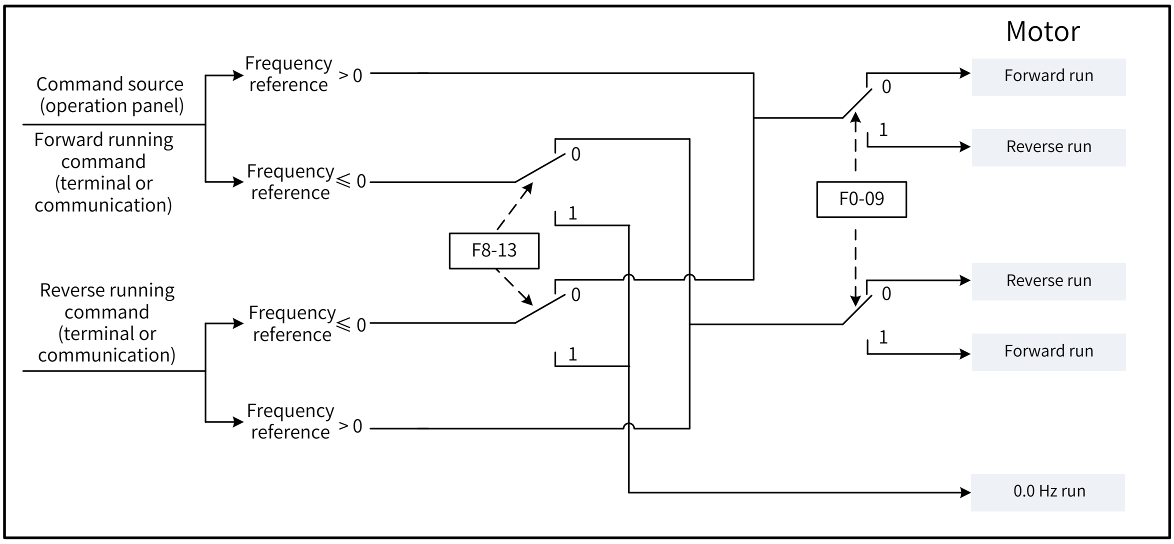


Figure 6-50 Reverse frequency prohibition

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-09	Running direction	0	0: Run in the same direction 1: Run in the reverse direction	-

By modifying this parameter, you can change the motor rotation direction without changing motor wiring. The effect is equivalent to changing two of the U, V, and W wires of the motor.

NOTE

◆ After the parameters are initialized, the original rotation direction is resumed. Exercise cautions when using this function if motor rotation direction change is prohibited after system commissioning is complete.

6.9.3 User-defined Parameters

FE-00 (User-defined parameter 0) to FE-29 (User-defined parameter 29): These parameters are user-defined. You can select required parameters and add them to the FE (user-defined) parameter group, so you can query or modify them easily.

The FE parameter group can include a maximum of 30 user-defined parameters. If the displayed value is F0-00 (G/P type display), the parameter is empty. When the user-defined parameter mode is used, the displayed parameters and their sequence are defined by FE-00 (User-defined parameter 0) to FE-31 (User-defined parameter 31).

6.9.4 Frequency Detection Signal (FDT)

This function is used to set the detection value of output frequency and the hysteresis for turning OFF the output. The hysteresis is effective only during deceleration. FDT has no hysteresis during acceleration. The following figure shows the FDT function.

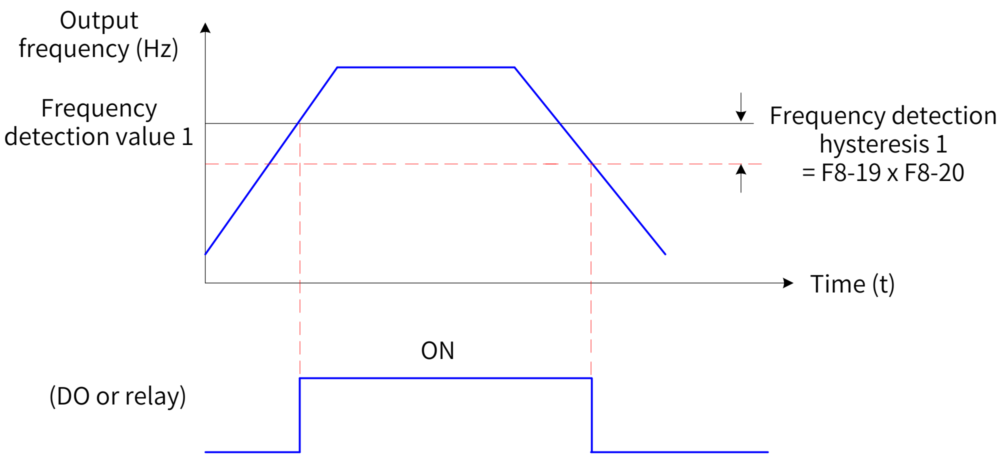


Figure 6-51 FDT signal

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-19	Frequency detection value 1 (FDT1)	50.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	The DO terminal outputs the ON signal when the running frequency is higher than the frequency detection value. The DO terminal outputs the OFF signal when the running frequency is lower than the resulting value of frequency detection value minus the frequency detection hysteresis.
F8-20	Frequency detection hysteresis 1 (FDT1)	5.0%	0.0% to 100.0% (FDT1 level)	The base of frequency detection hysteresis percentage is the value of F8-19 (Frequency detection value 1).
F8-28	Frequency detection value 2	50.00Hz	0.00 Hz to F0-10 (Maximum frequency)	-

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-29	Frequency detection hysteresis 2 (FDT1)	5.0%	0.0% to 100.0% (FDT2 level)	The base of frequency detection hysteresis percentage is the value of F8-29 (Frequency detection value 2).

6.9.5 Detection Width of Target Frequency Reached Signal

This function is used to set the detection width of the target frequency reached signal. The following figure shows the function:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-21	Detection width of target frequency reached	0.00%	0.00 to 100% (maximum frequency)	The base of the percentage is the maximum frequency. The DO terminal outputs the ON signal when the running frequency of the drive is within the range of Set frequency ± Maximum frequency x Value of F8-21.

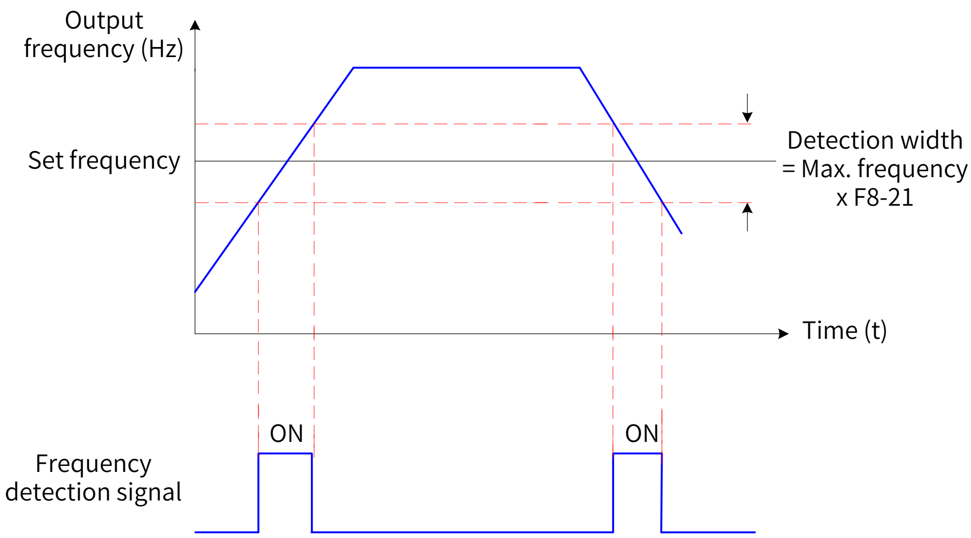


Figure 6-52 Time sequence of detection width of target frequency reached signal

6.9.6 Switchover Frequency of Acceleration and Deceleration Time

This function is used to set the acceleration/deceleration time based on the running frequency range when the drive is running. This function is effective only when motor 1 is selected (set F0-24 to 0), and the DI terminal function is not set to 16 (acceleration/deceleration time selection terminal 1) or 17 (acceleration/deceleration time selection terminal 2).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-25	Switchover frequency of acceleration time 1 and acceleration time 2	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-
F8-26	Switchover frequency of deceleration time 1 and deceleration time 2	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	-

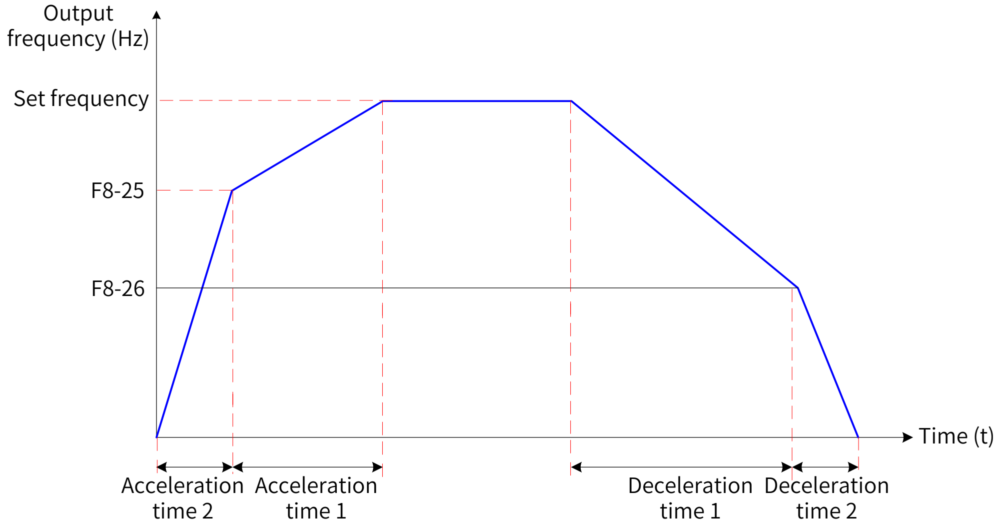


Figure 6-53 Switchover frequency of acceleration/deceleration time

As shown in the figure above, during acceleration, acceleration time 2 is selected if the running frequency is lower than the value of F8-25 (Switchover frequency of acceleration time 1 and acceleration time 2), and acceleration time 1 is selected if the running frequency is higher than the value of F8-25. During deceleration, deceleration time 1 is selected if the running frequency is higher than the value of F8-26 (Switchover frequency of deceleration time 1 and deceleration time 2), and deceleration time 2 is selected if the running frequency is lower than the value of F8-26.

6.9.7 Detection of Frequency Signal

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-30	Detection of frequency 1	50.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	The DO terminal outputs the ON signal when the running frequency of the drive is within the range of detection of frequency 1 ± detection width of frequency 1.
F8-31	Detection width of frequency 1	0.0%	0.0% to 100.0% (maximum frequency)	
F8-32	Detection of frequency 2	50.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	The DO terminal outputs the ON signal when the running frequency of the drive is within the range of detection of frequency 2 ± detection width of frequency 2.
F8-33	Detection width of frequency 2	0.0%	0.0% to 100.0% (maximum frequency)	

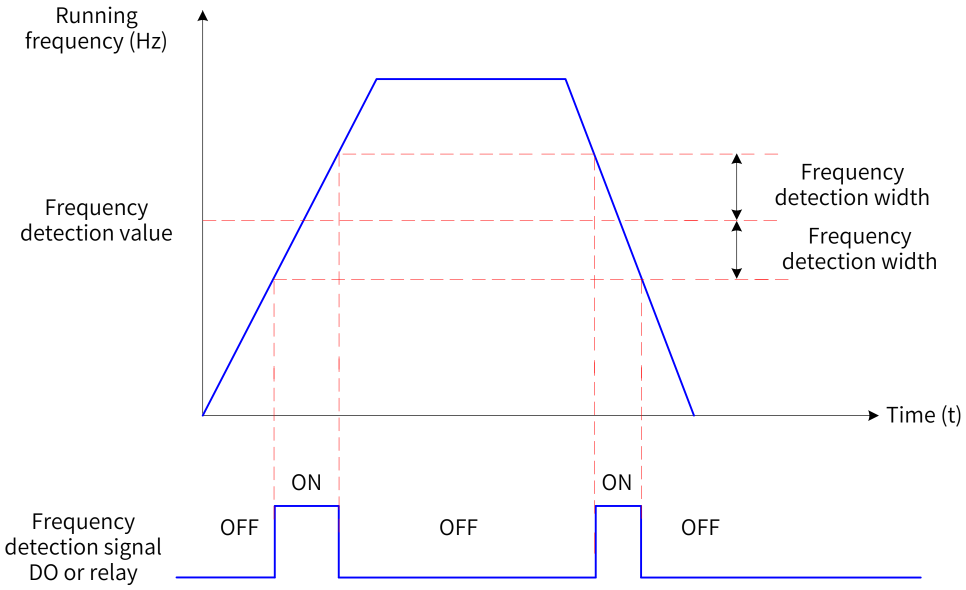


Figure 6-54 Detection of frequency signal

6.9.8 Zero Current Detection Signal

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-34	Zero current detection level	5.0%	0.0% to 300.0% (rated motor current)	The DO outputs the ON signal when the output current of the drive remains equal to or lower than the value of F8-34 (Zero current detection level) for longer than the value of F8-35 (Zero current detection delay).
F8-35	Zero current detection delay	0.10s	0.00s to 600.00s	

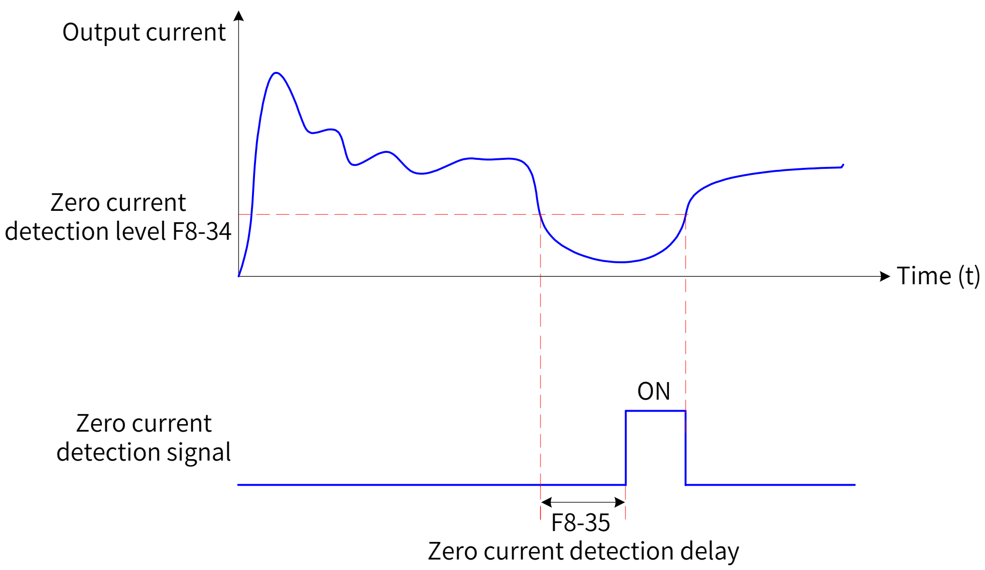


Figure 6-55 Zero current detection signal

6.9.9 Output Current Limit Exceeded Signal

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-36	Output overcurrent threshold	200.0%	0.0% (no detection) 0.1% to 300.0% (rated motor current)	The DO terminal outputs the ON signal when the output current of the drive remains higher than the value of F8-36 (output overcurrent threshold) for longer than the value of F8-37 (output overcurrent detection delay).
F8-37	Output overcurrent detection delay	0.00s	0.00s to 600.00s	-

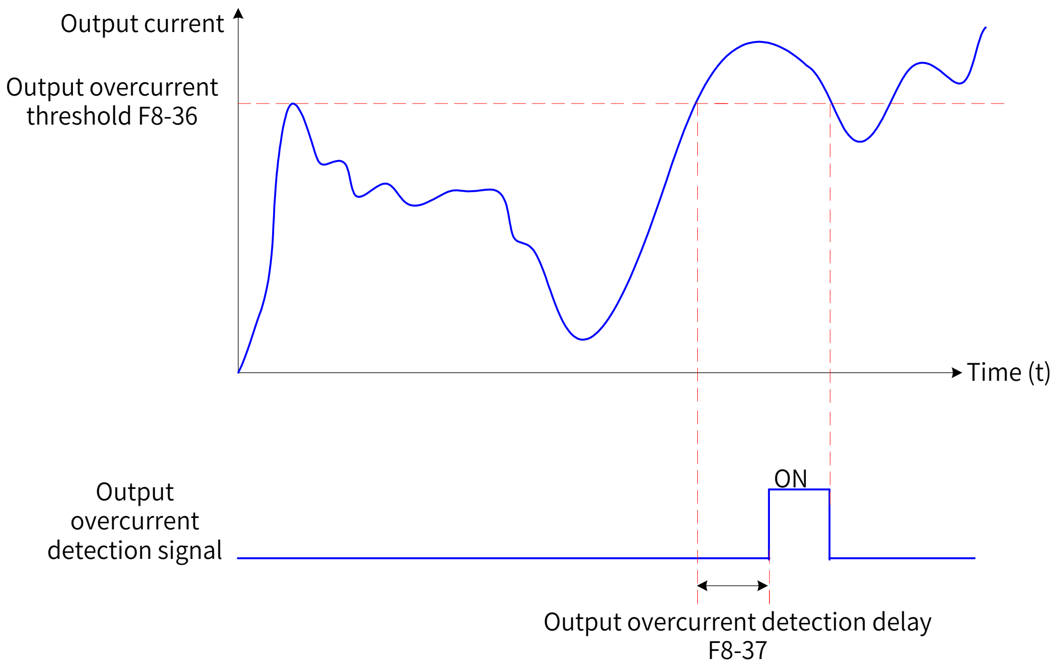


Figure 6-56 Output overcurrent detection signal

6.9.10 Detection Level of Current Signal

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-38	Detection level of current 1	100.0%	0.0% to 300.0% (rated motor current)	The DO terminal outputs the ON signal when the output current of the drive is within the range of (Detection level of current 1 ± Detection width of current 1) x Rated motor current.
F8-39	Detection width of current 1	0.0%	0.0% to 300.0% (rated motor current)	
F8-40	Detection level of current 2	100.0%	0.0% to 300.0% (rated motor current)	The DO terminal outputs the ON signal when the output current of the drive is within the range of (Detection level of current 2 ± Detection width of current 2) x Rated motor current.
F8-41	Detection width of current 2	0.0%	0.0% to 300.0% (rated motor current)	

The MD810 series provides two sets of detection level of current and detection width of current parameters. The following figure shows the function:

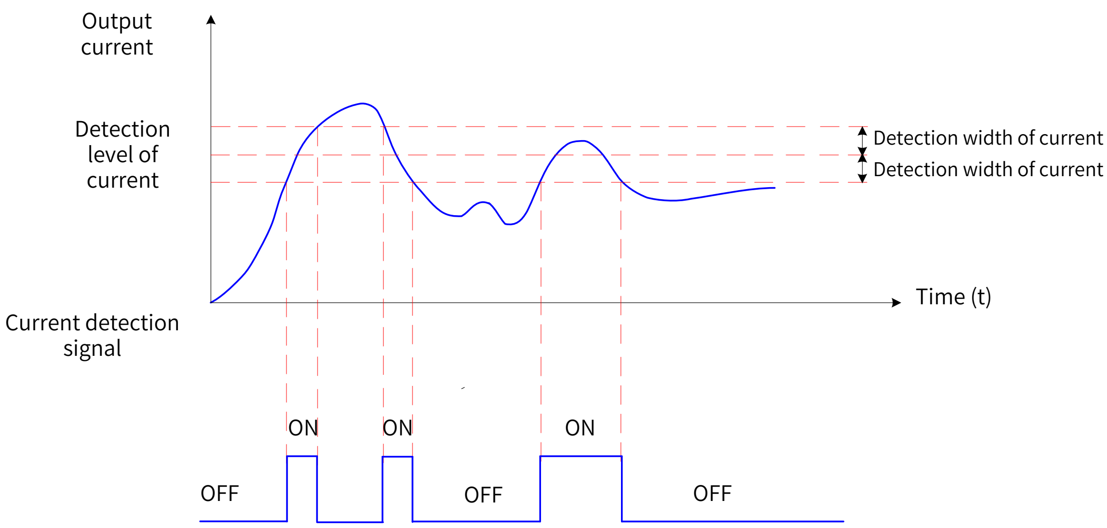


Figure 6-57 Time sequence of detection level of current

6.9.11 Timing Functions

This function is used to start the drive as scheduled. The timer starts from 0 when the drive starts running. The remaining running time can be viewed using U0-20 (Remaining running time).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-42	Timing function	0	0: Disabled 1: Enabled	When F8-42 (timing function) is set to 1 (enabled), the timer starts when the drive starts running. When F8-44 (timing duration) is reached, the drive automatically stops, and the DO terminal outputs the ON signal.
F8-43	Timing duration source	0	0: Set by F8-44 (Timing duration) 1: AI1 2: AI2	If this parameter is set to 1, the scheduled running time can be calculated through the following formula: Running time = (AI1 voltage/10 V) x Value of F8-44 (Timing duration). 100% of AI corresponds to the value of F8-44 (Timing duration).
F8-44	Timing duration	0.0	0.0 minute to 6500.0 minutes	The scheduled running time is set by F8-43 (Timing duration source) and F8-44 (Timing duration).

Power-on time threshold

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-16	Accumulative power-on time threshold	0	0 to 65000 hours	The DO terminal outputs the ON signal when F7-13 (Accumulative power-on time) reaches the value of F8-16.

Running time threshold

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-17	Accumulative running time threshold	0	0 to 65000 hours	The DO terminal outputs the ON signal when F7-09 (Accumulative running time) exceeds the value of F8-17.

6.9.12 AI1 Voltage Upper and Lower Limits

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-45	AI1 input voltage lower limit	3.10 V	0.00 V to F8-46 (AI1 input voltage upper limit)	The DO terminal outputs the ON signal of "AI1 input limit exceeded" when AI1 is greater than the value of F8-46 or smaller than the value of F8-45.
F8-46	AI1 input voltage upper limit	6.80 V	F8-45 (AI1 input voltage lower limit) to 11.00 V	

6.9.13 IGBT Temperature

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-47	IGBT temperature threshold	75°C	0°C to 100°C	The DO terminal outputs the ON signal when the heatsink temperature of the IGBT reaches the value of F8-47.

6.9.14 Cooling Fans

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-48	Cooling fan working mode	0	0: Working during drive running	If this parameter is set to 0, the fan runs when the drive is running; If the drive is stopped, the fan runs if the heatsink temperature exceeds 40°C and stops if the heatsink temperature does not exceed 40°C .
			1: Working continuously	If this parameter is set to 1, the fan keeps running after the drive is powered on.

6.9.15 Hibernating and Wakeup

This function is used to hibernate and wake up the drive in water supply applications. Generally, set F8-49 (Wakeup frequency) to a value equal to or greater than that of F8-51 (Hibernating frequency). If the wakeup frequency and hibernating frequency are both 0.00 Hz, the hibernating and wakeup functions are disabled.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-49	Wakeup frequency	0.00 Hz	F8-51 (Hibernating frequency) to F0-10 (Maximum frequency)	If the drive is in hibernating state, and the current running command is valid, the drive starts after F8-50 (Wakeup delay) when the set frequency is equal to or higher than the value of F8-49 (Wakeup frequency).
F8-50	Wakeup delay	0.0s	0.0s to 6500.0s	
F8-51	Hibernating frequency	0.00 Hz	0.00 Hz to F8-49 (Wakeup frequency)	When the set frequency is equal to or lower than F8-51 (Hibernating frequency), the running drive enters the hibernating state and decelerates to stop after F8-52 (Hibernating delay).
F8-52	Hibernating delay	0.0s	0.0s to 6500.0s	

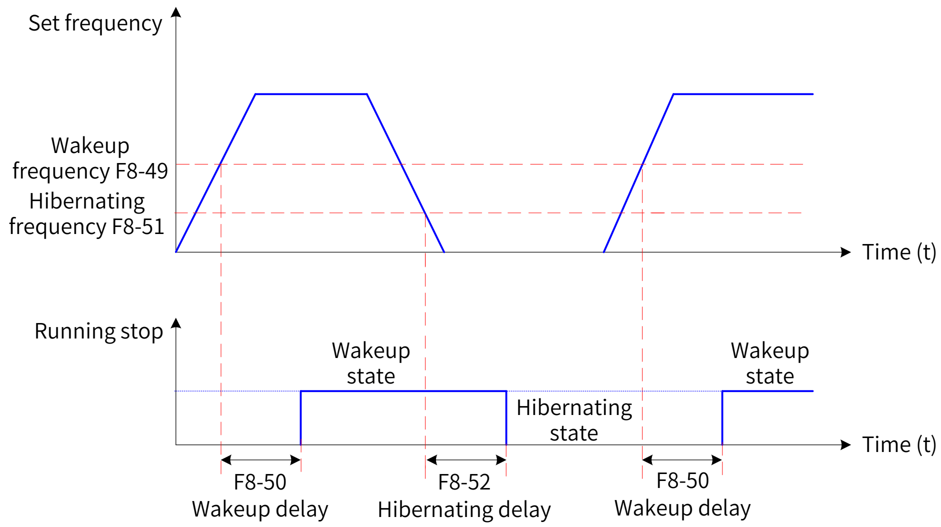


Figure 6-58 Hibernating and wakeup function settings

6.9.16 Current Running Time Threshold

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-53	Current running time threshold	0.0 minute	0.0 min to 6500.0 min	The DO terminal outputs the ON signal when the current running time reaches the value of F8-53. This parameter is effective only for the current running time (previous running time excluded).

6.9.17 Emergency Stop Deceleration Time

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F8-55	Emergency stop deceleration time	Model dependent	0 to 6553.5	F8-55 specifies the emergency stop deceleration time. The emergency stop function decelerates the drive within the specified deceleration time. In the V/F mode, the deceleration time is 0, the emergency stop function decelerates the drive within the minimum unit time.

6.10 Position Control

The effective position control modes are as follows:

R: Incremental positioning

A: Absolute positioning

I: Rotative positioning

RI: Fixed angle rotative positioning

ALL: All position modes

6.10.1 Group B3 Pulse Synchronization Function Parameters

The pulse synchronization function can be only used for the EtherCAT version.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-00	Pulse synchronization mode	0: Speed synchronization 1: Position synchronization 2: Pulse positioning	0	★	-

1) B3-00 is used for setting the pulse synchronization mode.

When the frequency source is pulse synchronization, select the pulse synchronization mode. This parameter must be used with DI function 87 (pulse synchronization mode switchover).

When DI function 87 (pulse synchronization mode switchover) is inactive, the pulse shychronization mode is determined by the value of B3-00.

When DI function 87 (pulse synchronization mode switchover) is active, the pulse synchronization mode is reverse to the value of B3-00.

When DI function 88 [pulse position synchronization control switchover (with forward command)] is active and the command source is terminal control, the drive enters the pulse synchronization mode no matter which mode is selected.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-01	Pulse mode selection	0: Pulse + Direction 1: Two quadrature pulses	1	★	
B3-02	Quadrature pulse AB phase sequence	0: Forward 1: Reverse	0	★	-

2) B3-00 and B3-01 are used for seeting the pulse sending mode of the host controller and quadrature pulse phase sequence.

0 (Pulse + direction): This mode only supports differential signal input. The differential direction signal must be connected to the positioning card A+/A- and the pulse signal must be connected to the positioning card B+/B-. The jumper of the positioning expansion card must be processed. The signal is frequency doubled inside the card.

1 (Two quadrature pulses): This mode only supports differential signal input. The differential signal must be connected to A+/A-/B+/B-. The jumper of the positioning expansion card must be processed. The signal is frequency quadrupled inside the card.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-03	Acceleration time (position synchronization)	0.0–6500.0s 0	0	☆	
B3-04	Deceleration time (position synchronization)	0.0–6500.0s	0	☆	

3) B3-03 and B3-04 are used for setting the accelertion time and deceleration time of pulse synchronization.

If the pulse synchronization mode is pulse speed synchronization, the standard acceleration time and deceleration time (acceleration/deceleration time 1/2/3/4) of the drive is used.

If the pulse synchronization mode is pulse position synchronization, values of B3-03 and B3-04 are used as the acceleration time and deceleration time.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-05	Feedforward gain (position synchronization)	0.00–600.00	1.00	☆	B3-05

4) B3-05 is used for setting the position loop feedward gain for pulse synchronization.

This parameter can be modified as required. Reduce the parameter value if the overshoot is too large.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-06	Proportional gain 1 (position synchronization)	0: Forward 1: Reverse	0	☆	-
B3-11	Proportional gain switchover (position synchronization)	0: No switchover 1: Automatic switchover based on deviation	0	★	
B3-12	Proportional gain 2 (position synchronization)	0.00–100.00	1500	☆	
B3-13	Proportional gain switchover position deviation 1 (position synchronization)	0–30000	0.010s	☆	
B3-14	Proportional gain switchover position deviation 2 (position synchronization)	0–30000	0	☆	

5) B3-06, B3-11, B3-12, B3-13, and B3-14 are used for setting the position loop proportional gain for pulse position synchronization.

Increase the parameter value as high as possible under the condition that no system oscillation occurs. When B3-11 is set to 0, no switchover is performed. The value of B3-06 is used as the position loop proportional gain in the pulse position synchronization mode.

When B3-11is set to 1, automatic switchover is performed based on the deviation. The linear interpolation value of B3-06 and B3-12 is used as the position loop proportional gain in the pulse position synchronization mode.

You can observe the value of U2-00 during runing to correct the proportional gain based on the pulse position following error.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-07	Electronic gear ratio (numerator)	1–30000	1	☆	
B3-08	Electronic gear ratio (denominator)	1–30000	1	☆	

6) B3-07 and B3-08 are used for setting the electronic gear ratio for pulse synchronization.

When the pulse speed synchronization mode is used, the actual targe frequency of the drive is obtained according to the formula: Actual target frequency of drive = Sampling frequency x B3-07/B3-08.

When the pulse position synchronization mode is used, the actual target pulse quantity of the drive is obtained according to the formula: Actual target pulse quantity of drive = Sampling pulse quantity x B3-07/B3-08.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-09	Pulse frequency filter time	0–65536	0	☆	

7) B3-09 is used for setting the pulse sampling filter time.

When the pulse position synchronization mode is used, set B3-09 as small as possible. Its recommended value is 0. When the pulse speed synchronization mode is used, set B3-09 as required.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-15	Acceleration compensation gain	0.00–10.00	0.00	☆	

8) B3-15 is used for setting the acceleration compensation gain.

When the external frequency signal is in the acceleration/deceleration process, the adjustment of proportional gain may be insufficient. In this case, the acceleration/deceleration compensation gain can be added to reduce the deviation in the acceleration/deceleration process.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-16	Maximum pulse deviation	1–10000	5.00 Hz	☆	

9) B3-16 is used for setting the maximum deviation of position loop adjustment in the pulse position synchronization mode.

When the deviation exceeds the value of B3-16, the value of B3-16 is used as the position loop deviation calculation value to avoid improper position loop adjustment due to large deviation.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-18	Minimum pulse deviation	0–1000	2	☆	

10) B3-18 is used for setting the minimum devation of position loop adjustment in the pulse position synchronization mode.

When the deviation is lower than the value of B3-18, 0 is used as the position loop deviation calculation value to stop postion loop adjustment, avoiding motor vibration.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-19	Minimum frequency given in pulse synchronization	0.0010–5.0000 Hz	2	☆	

11) B3-19 is used for setting the minimum frequency given in the external pulse reference (that is, the target running frequency of the drive).

When the external given running frequency is very low, reduce B3-19 to a value lower than the minimum running frequency of the drive.

When the change rate of the external given running frequency is too large, increase the value of B3-19 to enable quicker response in the synchronization tracking mode.

Parameter No.	Parameter Name	Setting Range	Default	Property	Effective Mode
B3-21	Detection level of pulse deviation	0–20000	0	☆	
B3-22	Detection time of pulse deviation	0.00–10.00	1.00	☆	

12) B3-21 and B3-22 are used for setting the pulse deviation detetion value and time in the pulse position synchronization mode.

In the pulse position synchronization mode, when the pulse deviation is higher than the value of B3-20 and the deviation duration is larger than the value of B3-21, the drive reports Err55 (large pulse deviation).

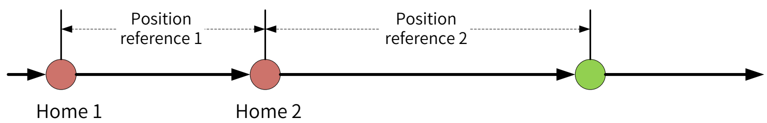
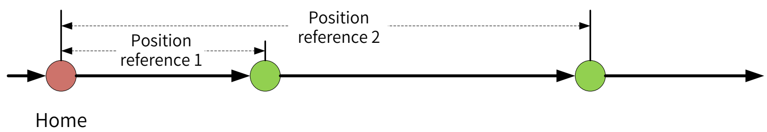
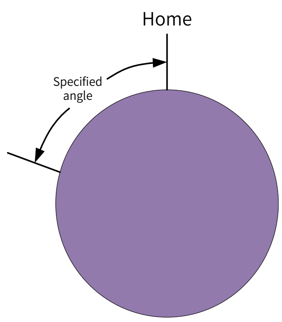
6.10.2 Group B4 Position Control Function Parameters

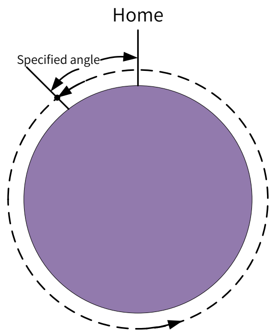
Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-00	Position control function	0: Disabled 1: Enabled	0	Used to enable or disable the position control function. The position control function must be enabled before performing position control.	-

The position control function can be enabled by setting B4-00 to 1 or allocating the DI function, as described below.

DI Function No.	Function	Description
71	Switched to position control	Switched to position control without running commands
72	Switched to position control (forward running command)	Switched to position control with forward running commands
73	Switched to position control (reverse running command)	When this function is valid, the AC drive switches to the position control mode with the reverse running command.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-01	Position control mode	0: Incremental 1: Absolute 2: Degree 3: Fixed length degree	0	Used to set the position control mode. 0: Incremental, moving the specified length with the current position as the home 1: Absolute, moving the specified length starting from the mechanical home 2: Rotative, moving the specified degree (angle) with the Z signal of the encoder or the fixed angular position as the home 3: Fixed angle rotative, rotating for one revolution and stopping at the specified degree (angle) with the Z signal of the encoder or the fixed angular position as the home	-

Position Mode	Diagram
Incremental	
Absolute	
Rotative	

Position Mode	Diagram
Fixed angle rotative	

The position control mode can be set by B4-01 or switched by the DI terminal. The setting of DI terminal has higher priority to that of B4-01. During running, the position control mode cannot be switched by the DI terminal. If the DI terminal mode is changed, the position control mode before changing the state of DI continues.

DI Function No.	Function	Description
82	Switched to incremental position control	Switched to relative position control under position control mode
83	Switched to absolute position control	Switched to absolute position control under position control mode
84	Switched to rotative position control	Switched to rotative position control under position control mode
85	Switched to fixed angle rotative position control	Switched to fixed angle rotative position control under position control mode

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-02	Electronic gear ratio (numerator)	1 to 30000	1	In the incremental or absolute position mode, the conversion relationship between the position reference and pulse position reference is set by B4-02 and B4-03. In the rotative or fixed angle rotative positioning mode with the DI terminal as the home, the conversion relationship between the pulses per revolution of the shaft and that of the encoder is set by B4-02 and B4-03. B4-02 and B4-03 are invalid when the Z signal of the encoder is used as the home.	ALL
B4-03	Electronic gear ratio (denominator)	1 to 30000	1		ALL

For example, the PPR of encoder is 1000. The encoder and motor are installed in the same shaft.

(1) Incremental or absolute positioning, with a position reference of 80, corresponding to eight motor revolutions

Pulses for one motor revolution = 1000 x 4 = 4000 (frequency quadrupled)

Pulses for a position reference of 80 = 4000 x 8 = 32000 (frequency quadrupled)

Pulses for one motor revolution : for a position reference of 80 = 32000:80 = 400:1

Therefore, set B4-02 to 400 and B4-03 to 1.

(2) Degree or fixed length degree positioning with the DI terminal as the home, where one revolution of the shaft corresponds to three revolutions of the motor

Pulses for one motor revolution = 1000 x 4 = 4000 (frequency quadrupled)

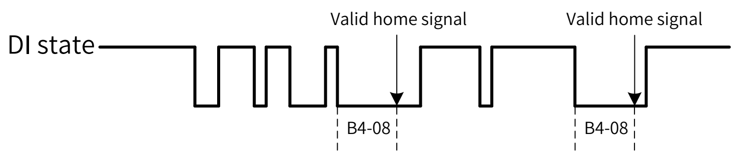
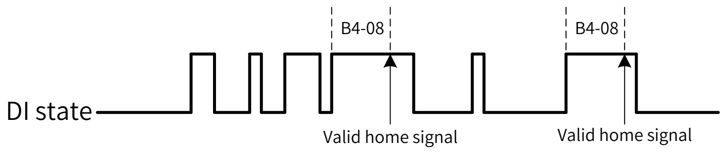
Pulses for one shaft revolution = 4000 x 3 = 12000 (frequency quadrupled)

Pulses for one shaft revolution: Pulses for one motor revolution = 12000:4000 = 3:1

Therefore, set B4-02 to 3 and B4-03 to 1.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-05	Position control home signal source	Ones position: Incremental 2: Current position Tens position: Absolute 1: DI terminal Hundreds position: Degree 0: Encoder Z signal 1: DI terminal Thousands position: Fixed length degree 0: Encoder Z signal 1: DI terminal	1012	Used to set the home signal source. The home source varies in different position control modes. If the home signal source changes, the home signal will be cleared. In this case, a new valid home signal needs to be given. When the DI terminal is used as the home signal, the edge detection is valid. The edge detection selection is set by B4-07. Incremental positioning: moving the specified length with the current position as the home. Absolute positioning: home signal given by the DI terminal with the fixed mechanical position as the home. Degree or fixed length degree positioning: Z signal of the encoder and DI terminal available as the home signal.	-

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-07	DI home signal active mode	0: Active at falling edge 1: Active at rising edge	1	Used to set the effective mode of edge detection when the DI terminal is used as the home signal.	A, I, RI
B4-08	DI home signal filter time	0 to 5.000s	0.010s	Used to set the filter time when the DI terminal is used as the home.	A, I, RI

Setting	Effective Mode	Diagram
B4-07 = 0	Valid at falling edge	
B4-07 = 1	Valid at rising edge	

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-09	Home enabling control	0: No operation 1: Immediate home searching 2: Current position used as home 3: Clear home 4: No home, auto home searching after startup	0	Used to control home searching. The home signal will be cleared during home searching no matter whether a valid home signal exists. 0: Home searching is not performed and it can be enabled by the DI terminal. The value 0 is retentive. 1: Home searching is performed immediately for once when the AC drive is running. The value 1 is not retentive. 2: The current encoder position is used as the home in any AC drive state. The value 2 is not retentive. 3: The home is cleared. The value 3 is not retentive. 4: Home searching is performed after the AC drive is started if no home is available. The value 4 is retentive.	ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-10	Home searching mode	Ones position: Incremental 0: No operation Tens position: Absolute 0: Forward searching 1: Reverse searching 2: Forward searching, direction changed automatically in limit switch active mode 3: Reverse searching, direction changed automatically in limit switch active mode Hundreds position: Degree 0: Forward searching 1: Reverse searching Thousands position: Fixed length degree 0: Forward searching 1: Reverse searching	0020	Used to set the home searching mode. Ones position: Home searching mode in incremental position mode In incremental position mode, home searching is not required and the current position is used as the valid home continuously. Tens position: Home searching mode in absolute position mode 0: Forward home searching performed until the valid home signal is obtained 1: Reverse home searching performed until the valid home signal is obtained 2: Forward home searching at the beginning For home searching during forward running, if forward limit is valid, the running direction changes to reverse. For reverse running, if reverse limit is valid, the running direction changes to forward. This process repeats until the valid home signal is obtained, as shown in "Figure 6-59 Forward home searching at the beginning". 3: Reverse home searching at the beginning For home searching during reverse running, if reverse limit is valid, the running direction changes to forward. For forward running, if forward limit is valid, the running direction changes to reverse. This process repeats until the valid home signal is obtained, as shown in "Figure 6-60 Reverse home searching at the beginning". Hundreds position: Home searching mode in rotative position mode 0: Forward home searching performed until the valid home signal is obtained 1: Reverse home searching performed until the valid home signal is obtained Thousands position: Home searching mode in fixed angle rotative position mode 0: Forward home searching performed until the valid home signal is obtained 1: Reverse home searching performed until the valid home signal is obtained Note: The DI limit must be set correctly to ensure normal home searching.	-

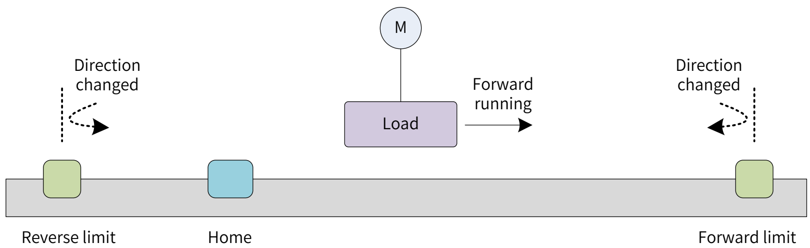


Figure 6-59 Forward home searching at the beginning

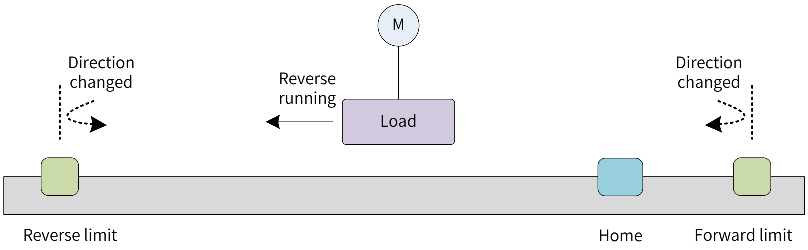


Figure 6-60 Reverse home searching at the beginning

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-11	Home searching speed	0.10 Hz to 50.00 Hz	5.00 Hz	Used to set the home searching speed.	ALL
B4-12	Home searching acceleration time	0.10s to 600.00s	10.00s	Used to set the acceleration and deceleration time for home searching.	ALL
B4-13	Home searching deceleration time	0.10s to 600.00s	10.00s		ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-14	Action after home searching	0: Decelerate to 0 1: Decelerate to 0 and start position control 2: Return to mechanical home 3: Return to the offset position relative to the home	2	Used to set the action after the home is obtained. 0: Position lock enabled after decelerating to 0 1: Position control started after decelerating to 0 2: Returned to the home after decelerating to 0 3: Returned to the position offset (set by B4-15, B4-16, and B4-17) to the relative home position after decelerating to 0 Note: If position control is not enabled after the home is obtained, the time set by B4-12 and B4-13 is adopted as the acceleration and deceleration time.	ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-15	Home offset (low bits)	0 to 65535	0	Used to set the stopping position after the home is obtained. They are valid when B4-14 is set to 3.	A, I, RI
B4-16	Home offset (high bits)	0 to 16384	0		A, I, RI
B4-17	Home offset direction	0: Forward 1: Reverse	0		A, I, RI

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-18	Home searching time limit	1.00s to 600.00s	30.00s	Used to set the maximum home searching time. If the setting of B4-18 is too small or the home is not obtained within the time set by B4-18, the AC drive reports the fault E54.01 (home searching timeout).	A, I, RI

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-19	Home deviation threshold	4 to 60000 pulses	100 pulses	Used to set the allowed position deviation between adjacent homes.	A, I, RI

In the rotative positioning or fixed angle rotative positioning mode, if the position deviation between adjacent Z signals exceeds the value of B4-19 when the Z signal of the encoder is used as the home signal, the Z signal of the encoder is abnormal. The AC drive reports the fault E54.02 (home position deviation excess).

In the absolute positioning or fixed angle rotative positioning mode, when the DI terminal is used as the home signal and home correction is valid (tens position of B4-61 set to 1), the home signal is determined as lost if the valid home signal is not received within the range set by B4-19 around the home. In this case, the value of U2-92 (Home loss counting during home correction) is incremented by 1. When U2-92 is greater than B4-67, the AC drive reports the fault E54.03 (excessive home loss times).

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-20	Home update mode for incremental positioning	0: Update home at zero speed 1: Update home when repositioning triggered 2: Save unexecuted position reference during running	1	Used to set the home update mode control for incremental positioning. When the AC drive stops, B4-20 is invalid. The incremental home position is updated continuously with the current position as the home. When the AC drive is running, the update mode set by B4-20 takes effect. 0: Update home at zero speed 1: Current position used as home when a re-positioning signal is received 2: Save unexecuted position reference when re-positioning signal is received during positioning	R

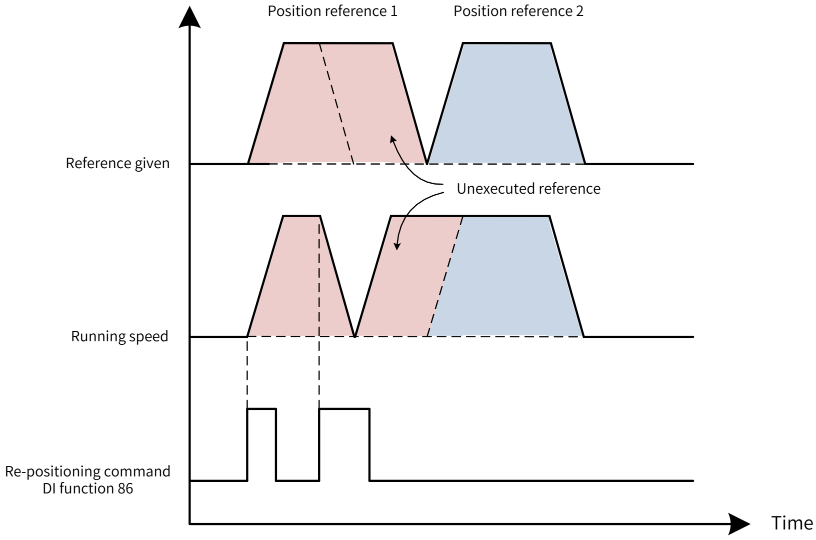
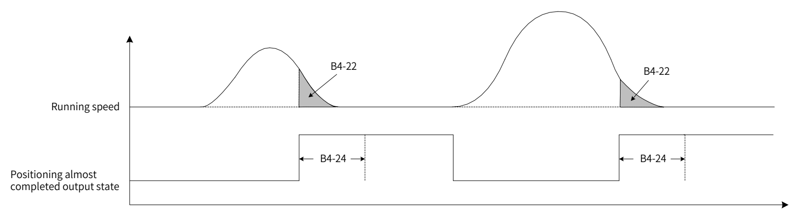
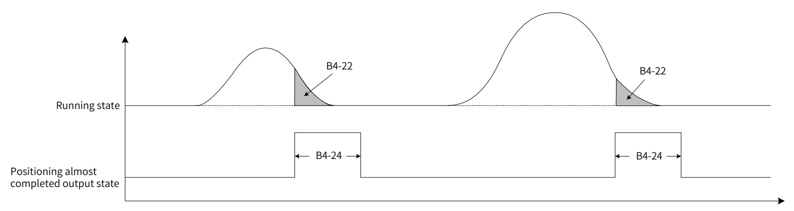


Figure 6-61 Incremental positioning when B4-20 is set to 2

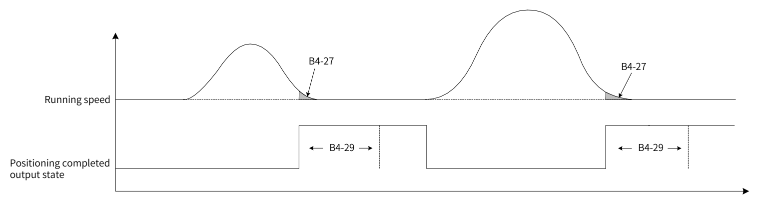
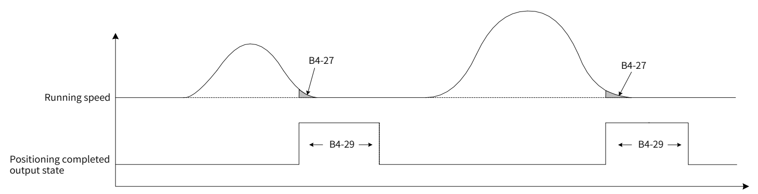
Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-21	Judge of positioning almost completed	0: Deviation to the target position less than B4-22 (unit: quadrupled encoder resolution) for the time set by B4-23 and its output time is not less than B4-24 1: Deviation to the target position less than B4-22 (unit: determined by B5-26) for the time set by B4-23 and its output time is not less than B4-24 2: Deviation to the target position less than B4-22 (unit: quadrupled encoder resolution) for the time set by B4-23 and its output time is equal to B4-24 3: Deviation to the target position less than B4-22 (unit: determined by B5-26) for the time set by B4-23 and its output time is equal to B4-24	0	Used to set the judge criteria of positioning almost completed.	ALL
B4-22	Threshold of positioning almost completed	0 to 60000	500	-	ALL
B4-23	Judge time of positioning almost completed	0 to 5.000s	0.005s	-	ALL
B4-24	Output time of positioning almost completed	0 to 600.00s	0.05s	-	ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-25	Output target position reference for positioning almost completed	0 to 24	0	Used to set the target position reference for positioning almost completed output. The positioning almost completed output is valid only when the target position reference segment is the one set in B4-25 and the conditions of positioning almost completed are met. When B4-25 is set to 0, the positioning almost completed output is valid for any position reference.	ALL

B4-21	Threshold	Unit	DO Output Time	Diagram
0	B4-22	Pulse	Not less than B4-24	
1	B4-22	B5-26	Not less than B4-24	
2	B4-22	Pulse	B4-24	
3	B4-22	B5-26	B4-24	

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-26	Judge of positioning completed	0: Deviation to the target position less than B4-27 (unit: quadrupled encoder resolution) for the time set by B4-28 and its output time is not less than B4-29 1: Deviation to the target position less than B4-27 (unit: determined by B5-26) for the time set by B4-28 and its output time is not less than B4-29 2: Deviation to the target position less than B4-27 (unit: quadrupled encoder resolution) for the time set by B4-28 and its output time is equal to B4-29 3: Deviation to the target position less than B4-27 (unit: determined by B5-26) for the time set by B4-28 and its output time is equal to B4-29	0	Used to set the judge criteria of positioning completed.	ALL
B4-27	Threshold of positioning completed	0 to 60000	50	-	ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-28	Judge time of positioning completed	0 to 5.000s	0.005s	-	ALL
B4-29	Output time of positioning completed	0 to 600.00s	0.05s	-	ALL
B4-30	Output target position reference for positioning completed	0 to 24	0	Used to set the target position reference for positioning completed output. The positioning completed output is valid only when the target position reference segment is the one set in B4-30 and the conditions of positioning completed are met. When B4-30 is set to 0, the positioning completed output is valid for any position reference.	ALL

B4-26	Threshold	Unit	DO Output Time	Diagram
0	B4-27	Pulse	Not less than B4-29	
1	B4-27	B5-26	Not less than B4-29	
2	B4-27	Pulse	B4-29	
3	B4-27	B5-26	B4-29	

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-31	Rotative position reference unit	0: Encoder resolution (quadrupled) 1: 0.1° (1 revolution corresponding to 360.0°)	0	Used to set the position reference unit for rotative positioning and fixed angle rotational positioning. The position reference unit set by B5-26 is invalid for rotative positioning and fixed angle rotational positioning.	I, RI

For example, if the encoder and motor are installed in the same shaft and the PPR of encoder is 1000, the PPR of motor is 1000 x 4 = 4000.

If B4-31 is set to 0, the position reference unit is pulse and the maximum resolution is 1:4000. One revolution of the motor is equivalent to 4000 degrees, and the position range is from 0 to 3999.

If B4-31 is set to 1, the position reference unit is 0.1 degree (0.1°). One revolution of a motor corresponds to 360° , and the angle range is 0 to 359.9° .

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-32	Rotative position reference source selection	0: Set by B4-33 (Rotative position reference digital setting) 1: Multi-position reference	0	Used to set the degree position reference and valid for degree positioning and fixed length degree positioning. When B4-32 is set to 0, the rotational position reference is set by B4-33. When B4-32 is set to 1, the rotational position reference is set by multi-position reference. When the rotational position reference exceeds the maximum degree of one revolution, residue calculation is performed for the degree reference.	I, RI
B4-33	Rotative position reference digital setting	0 to 60000	0		I, RI

For example, if the PPR of encoder is 1000, the rotational position reference range is 0 to 3999 (pulse) or 0 to 359.9 (degree).

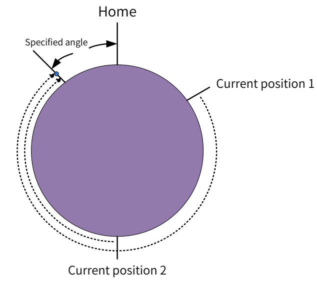
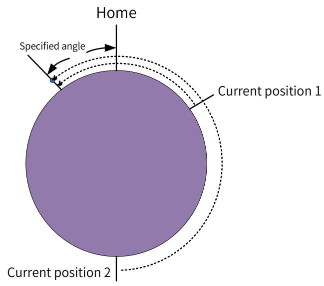
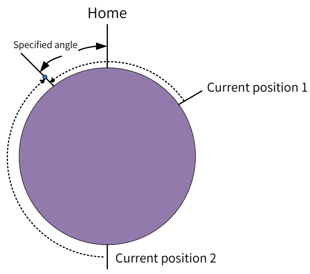
When B4-32 and B4-33 are set to 0 and 2430 respectively, the rotational position reference is 2430 (pulse).

When B4-32 and B4-33 are set to 0 and 5430 respectively, the rotational position reference is 5430%4000 = 1430 (pulse).

When B4-32 and B4-33 are set to 1 and 1325 respectively, the rotational position reference is 1325 = 132.5 (degree).

When B4-32 and B4-33 are set to 1 and 5325 respectively, the rotational position reference is 5325%3600 = 1725 = 172.5 (degree).

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-34	Positioning direction	0: Forward 1: Reverse	0	-	I, RI
B4-35	Rotative positioning direction setting channel	0: Set by B4-34 (Positioning direction) 1: Nearby positioning	1	Used to set the positioning direction for rotativel positioning and fixed rotational position positioning. When B4-35 is set to 0, the positioning direction is set by B4-34. When B4-35 is set to 1, B4-34 is invalid. The device moves to the specified position using the shortest path based on the current position.	I

B4-35	B4-34	Diagram
0	0	
	1	
1	-	

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-36	Positioning speed when shaft is moving	0.10 to 10.00 Hz	2.00 Hz	In rotative positioning or fixed angle rotative positioning mode, if the encoder feedback speed is greater than the speed set by B4-36 when a positioning reference is received, the AC drive will perform position control using the current speed. In this case, B4-34 and B4-35 are invalid.	I, RI
B4-37	Speed feedforward gain	0.00 to 100.00 %	100.00%	In the position control mode, speed feedforward is obtained by multiplying the speed signal corresponding to the position reference by the value of B4-37. The speed feedforward is used as a part of the speed reference. Increasing the speed feedforward gain improves the position reference response and reduces the position deviation at fixed speed. If the speed feedforward gain is too large, speed overshoot or fluctuation may occur and even an overvoltage fault may be reported during acceleration, and reverse speed adjustment may occur during deceleration. During commissioning, gradually adjust the value of B4-37 until a proper value is obtained, as shown in "Figure 6-62 Speed feedforward control".	

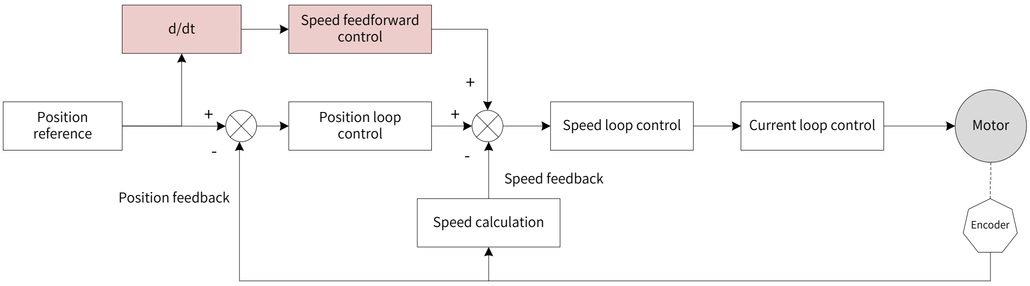


Figure 6-62 Speed feedforward control

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-38	Speed loop proportional gain 1	0.01 to 100.00	1.50	In the position control mode, the larger the position loop proportional gain is, the greater the position loop regulating intensity is. If the position loop proportional gain is too large, vibration may be caused. Therefore, gradually adjust the position loop proportional gain to get a proper value.	ALL
B4-39	Speed loop proportional gain 2	0.01 to 100.00	10.00		ALL
B4-40	Position loop proportional gain switchover condition	0: No switchover, fixed to position loop proportional gain 1 1: Switchover based on position deviation 2: Switchover based on speed	0	When B4-40 is set to 0, the position loop proportional gain is fixed to B4-38 (Speed loop proportional gain 1). When B4-40 is set to 1, the position loop proportional gain automatically changes based on the position tracking deviation (following error). If the absolute value of position tracking deviation is less than B4-41, the value of B4-38 is used as the position loop proportional gain. If the absolute value of position tracking deviation is greater than B4-42, the value of B4-39 is used as the position loop proportional gain. If the absolute value of position tracking deviation falls between B4-41 and B4-42, the position loop proportional gain changes linearly based on the position tracking deviation, as shown in "Figure 6-63 Position loop proportional gain changing linearly based on the position tracking deviation" below. When B4-40 is set to 2, the position loop proportional gain automatically changes based on the setpoint. If the setpoint frequency is less than B4-43, the value of B4-38 is used as the position loop proportional gain. If the setpoint frequency is greater than B4-44, the value of B4-39 is used as the position loop proportional gain. If the setpoint frequency falls between B4-43 and B4-44, the position loop proportional gain changes linearly based on the setpoint frequency, as shown in "Figure 6-64 Position loop proportional gain changing linearly based on the specified frequency" below.	ALL
B4-41	Deviation 1 for position loop proportional gain switchover	0 to B4-42	20	-	ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-42	Deviation 2 for position loop proportional gain switchover	B4-41 to 60000	100	-	ALL
B4-43	Frequency 1 for position loop proportional gain switchover	0.00 Hz to B4-44	5.00 Hz	-	ALL
B4-44	Frequency 2 for position loop proportional gain switchover	B4-43 to 500.00 Hz	20.00 Hz	-	ALL

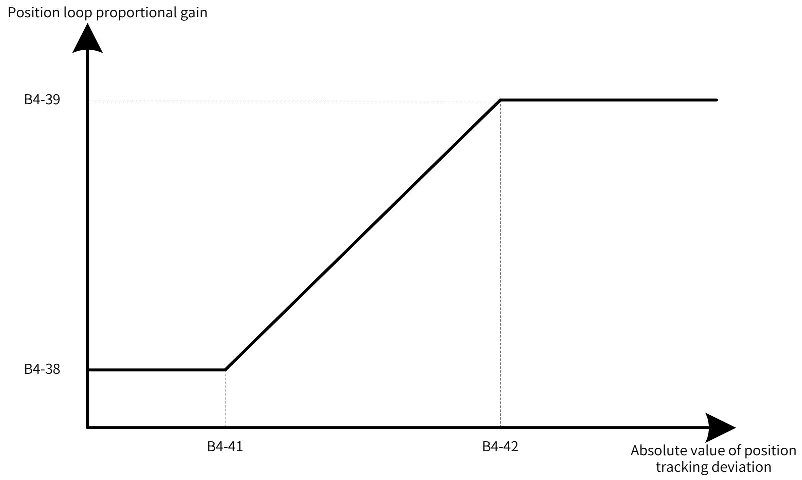


Figure 6-63 Position loop proportional gain changing linearly based on the position tracking deviation

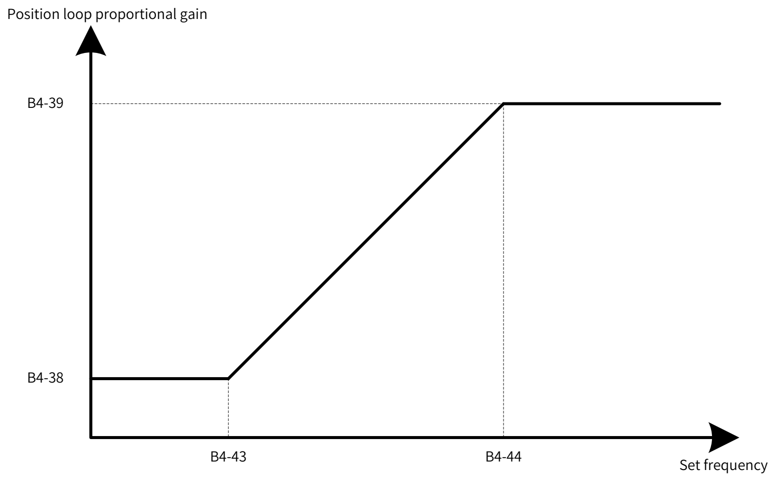


Figure 6-64 Position loop proportional gain changing linearly based on the setpoint frequency

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-46	Positioning deviation threshold	0 to 500	2	If the position deviation is less than B4-46 after positioning is finished, position loop adjustment is invalid. If the positioning accuracy is proper, adjusting B4-46 can reduce the vibration after positioning is finished. In scenarios that require fast system response and high accuracy, set B4-46 to a small value. In scenarios that require slow system response and low accuracy, increase B4-46 properly. Note that B4-46 must be set to a small value to avoid vibration, as shown in the following figure.	ALL

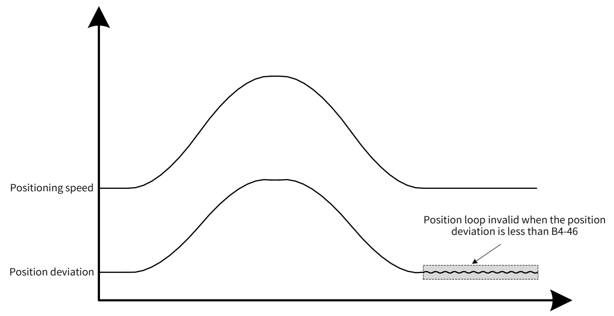


Figure 6-65 Positioning speed and position deviation

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-49	Multi-position reference digital setting	1 to 24	1	The AC drive supports a maximum of 24 position reference segments, each of which can be set with reference length and direction respectively. For settings related to the multi-position reference, see the description of parameters in group B5.	ALL

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-50	Multi-position reference running mode	0: No switchover, fixed to position reference segment set by B4-49 1: Switchover by DI 2: Single sequential running 3: Cyclic running 4: Communication setting	0	When B4-50 is set to 0, the position reference segment number fixed to the position reference segment number set by B4-49. When B4-50 is set to 1, the position reference segment number is selected by the DI terminals. When B4-50 is set to 2, the start segment number and end segment number are set by B4-51 and B4-52, respectively. The references are run from the initial segment number to the end segment number one time and after the segment number remains unchanged. When B4-50 is set to 3, the start segment number and end segment number are set by B4-51 and B4-52, respectively. The references are run from the initial segment number to the end segment number circularly. When B4-50 is set to 4, the position reference is set by communication and the multi-position reference setting is invalid. The acceleration time, deceleration time, and positioning completed waiting time are fixed to the value corresponding to multi-position reference 1.	ALL
B4-51	Start segment No. of multi-position reference	1 to B4-52	1	-	ALL
B4-52	End segment No. of multi-position reference	B4-51 to 24	1	-	ALL

NOTE

◆ When setting the position reference by communication, the high 16 bits (7321H) and low 16 bits (7322H) of the position reference must be set at the same time.

The following table describes the selection of position reference segments by DI terminals.

DI State					Corresponding Position Reference
79	78	77	76	75	
OFF	OFF	OFF	OFF	OFF	Position reference 1
OFF	OFF	OFF	OFF	ON	Position reference 2
OFF	OFF	OFF	ON	OFF	Position reference 3
OFF	OFF	OFF	ON	ON	Position reference 4
OFF	OFF	ON	OFF	OFF	Position reference 5
OFF	OFF	ON	OFF	ON	Position reference 6
OFF	OFF	ON	ON	OFF	Position reference 7
OFF	OFF	ON	ON	ON	Position reference 8
OFF	ON	OFF	OFF	OFF	Position reference 9

DI State					Corresponding Position Reference
79	78	77	76	75	
OFF	ON	OFF	OFF	ON	Position reference 10
OFF	ON	OFF	ON	OFF	Position reference 11
OFF	ON	OFF	ON	ON	Position reference 12
OFF	ON	ON	OFF	OFF	Position reference 13
OFF	ON	ON	OFF	ON	Position reference 14
OFF	ON	ON	ON	OFF	Position reference 15
OFF	ON	ON	ON	ON	Position reference 16
ON	OFF	OFF	OFF	OFF	Position reference 17
ON	OFF	OFF	OFF	ON	Position reference 18
ON	OFF	OFF	ON	OFF	Position reference 19
ON	OFF	OFF	ON	ON	Position reference 20
ON	OFF	ON	OFF	OFF	Position reference 21
ON	OFF	ON	OFF	ON	Position reference 22
ON	OFF	ON	ON	OFF	Position reference 23
ON	OFF	ON	ON	ON	Position reference 24
ON	ON	OFF	OFF	OFF	Invalid
ON	ON	OFF	OFF	ON	Invalid
ON	ON	OFF	ON	OFF	Invalid
ON	ON	OFF	ON	ON	Invalid
ON	ON	ON	OFF	OFF	Invalid
ON	ON	ON	OFF	ON	Invalid
ON	ON	ON	ON	OFF	Invalid
ON	ON	ON	ON	ON	Invalid

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-53	Whether to continue multi-position running mode	0: Restart from the startup segment 1: Continue uncompleted position reference segment	1	Used to set the start segment number when the multi-position reference is continued after the AC drive stops. When B4-53 is set to 0, the position references that have been run before stopping are not memorized. The references are run from the start segment number again. When B4-53 is set to 1, the position reference segment before stopping is used as the start position reference segment.	ALL
B4-55	Position control mode	0: Open-loop 1: Closed-loop	1	Used to set the position control mode. The open-loop position control mode can be adopted in special scenarios requiring low positioning accuracy and stable positioning. In other scenarios, the closed-loop position control mode must be adopted to ensure positioning accuracy and effect.	ALL
B4-56	Initial speed of position control switchover during running	0.50 Hz to 100.00 Hz	10.00 Hz	After the position control mode is switched over from the velocity mode, the AC drive decelerates. When both the given speed and the encoder feedback speed are lower than B4-56, the position control is enabled, as shown in "Figure 6-66 Position control". B4-56 is valid in rotative positioning and fixed angle rotative positioning modes. It is invalid in absolute positioning and incremental positioning modes. When the AC drive switches from the velocity mode to the position control mode, the AC drive decelerates to 0 and then starts positioning.	ALL

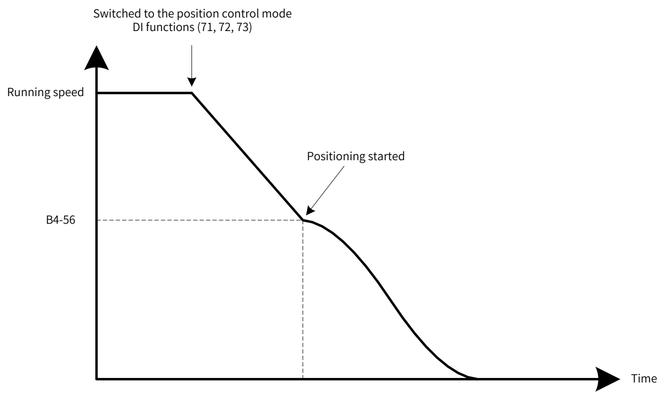


Figure 6-66 Position control

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-57	Position control source selection	0: Null (effective for position control) 1: DI terminal (DI-70) 2: Communication (731EH)	0	Used to set the position control source. In the position mode, the positioning can be started only when position control is enabled. If position control is disabled during positioning, the AC drive decelerates to 0 and starts the position lock mode. If position control is enabled, a new positioning command must be given. The position control pause function can be enabled using the position control enabling command. When B4-57 is set to 0, position control is enabled by default, and the AC drive starts positioning immediately when it switches to the position mode. When B4-57 is set to 1, position control is enabled by the DI terminal. The DI terminal level active mode is set by B4-58. When B4-57 is set to 2, position control is enabled through communication. If 1 is written to the communication address 7319H, the position control is enabled. If 0 is written to the communication address 7319H, the position control is disabled. If no data is written to the communication address 7319H, the current state is kept.	ALL
B4-58	DI terminal position control active mode	0: Low level active 1: High level active	1	-	ALL
B4-59	Repositioning command source selection	0: DI terminal 1: Communication (731EH)	0	The re-positioning command is mainly used for incremental and fixed angle rotative positioning. When this command is valid, positioning will be triggered at that instant. When B4-59 is set to 0, the rising edge of the DI terminal (function 86) triggers the position control at that instant. When B4-59 is set to 1 and 1 is written into the communication address 731EH, the position control is triggered at that instant, as shown in "Figure 6-67 Positioning triggered".	ALL

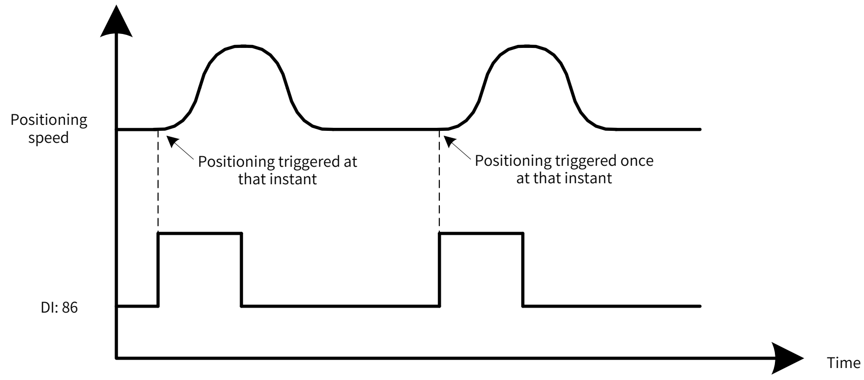


Figure 6-67 Positioning triggered

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-61	Position control function 1	Ones position: Home memorized at power failure 0: Disabled 1: Enabled Tens position: Home correction 0: Disabled 1: Enabled Hundreds position: Nearby positioning upon startup in fixed angle rotative mode 0: Disabled 1: Enabled Thousands position: Soft limit 0: Disabled 1: Enabled	0010	Used to enable or disable the auxiliary function related to position control.	-

Ones position: Home memorized at power failure

When home memorized at power failure is valid, the home position and current position will be memorized at the drive power failure. The home position and current position will be recovered upon the next power-on.

Note:

(1) Home memorized at power failure is valid only for absolute positioning.

(2) The home can be memorized only when the motor or shaft is static at power failure, that is, the encoder feedback position does not change within 100 ms.

(3) When home memorized at power failure is valid, the motor or shaft position is required to be unchanged after power failure. Otherwise, the home position and current position recovered upon the next power-on will be different from the actual position.

Tens position: Home correction

When the home correction is valid, the home position will be refreshed every time a home signal is detected.

When the home correction is invalid, the excessive home loss times fault (E54.03) is not detected.

Note:

(1) Home correction is valid only for absolute positioning. For fixed angle rotative positioning and rotative positioning, the home position is always refreshed when a home signal is detected.

(2) The home correction function can be enabled to avoid mechanical home position change after long-time running or position deviation caused by slip during running.

Hundreds position: Whether nearby rotative positioning is valid upon startup in fixed angle rotative mode

If nearby rotative positioning is valid upon startup, nearby positioning is performed after startup and the device stops at the specified position using the shortest path.

This function is generally used for cutter control during fixed angle rotative positioning. The cutter may be at any position other than the initial position upon startup, and this function can automatically adjust the cutter to the specified initial position.

Thousands position: Soft limit

The soft limit function allows you to set the limit position using the parameter. When the load position exceeds the specified limit position, the AC drive reports E58.03 or E58.04.

Note:

The soft limit is valid only when the AC drive is running and a valid home signal is given in the absolute position mode.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-63	Soft limit forward position (low bits)	0 to 65535	0	B4-63 and B4-64 are used to set the positive soft limit position (length to the home position) in the unit of pulse (frequency quadrupled). B4-65 and B4-66 are used to set the negative soft limit position and (length to the home position) in the unit of pulse (frequency quadrupled). Forward limit position = B4-64 x 65536 + B4-63 Reverse limit position = B4-66 x 65536 + B4-65 Note: (1) The soft limit function and DI limit function can be used at the same time. (2) The limit position must be set correctly when the soft limit function is enabled. Otherwise, the limit function may fail, affecting the device performance.	A
B4-64	Soft limit forward position (high bits)	0 to 16384	0		A
B4-65	Soft limit reverse position (low bits)	0 to 65535	0		A
B4-66	Soft limit reverse position (high bits)	0 to 16384	0		A
B4-67	Home loss threshold during home correction	0 to 1000	0	If home correction is valid (tens position of B4-61 set to 1), the AC drive reports the fault E54.03 when the detected home loss times is greater than B4-67. When B4-67 is set to 0, the excessive home loss times fault is not detected, and U2-92 displays the current home loss times.	A, RI

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B4-68	DI limit protection function	0: Coast to stop 1: Decelerate to stop 2: Lock shaft after decelerating to 0	0	Used to set the protection action of the AC drive when the DI limit function is valid. The values used in the speed mode and position mode are described as follows: 0: The AC drive reports a fault and the motor coasts to stop. When the forward limit is detected, the AC drive reports the fault E58.01. When the reverse limit is detected, the AC drive reports the fault E58.02. 1: The AC drive reports a fault and the motor decelerates to stop. When the forward limit is detected, the AC drive reports the fault E58.01. When the reverse limit is detected, the AC drive reports the fault E58.02. 2: The AC drive reports an alarm and the current position is locked when the speed reaches 0. When the forward limit is detected, the AC drive reports the alarm A58.01. When the reverse limit is detected, the AC drive reports the alarm A58.02. Note: In the torque mode, when B4-68 is set to 2, it is invalid. When the DI limit is detected, the AC drive reports a fault and coasts to stop. In the torque mode, when B4-68 is set to 1 and the DI limit is detected, the AC drive reports a fault and coasts to stop.	ALL
B4-69	Minimum direction change frequency upon detected DI limit	0.10 Hz to 10.00Hz	1.50Hz	Used to set the conditions for exiting the position locked at zero speed.	ALL
B4-70	Direction change frequency active time upon active DI limit	1 to 500 ms	1 ms		ALL

B4-69 and B4-70 are valid only when B4-68 is set to 2 in the speed mode.

B4-68 = 2: When the motor runs in the forward direction and the DI forward limit is detected, the AC drive reports the alarm A58.01 and decelerates to 0 with the current position locked. When the newly given target frequency is reverse, exceeds B4-69, and lasts for B4-70, the AC drive responds to the newly given reverse target frequency and the motor runs in the reverse direction. When the newly given target frequency is reverse but less than B4-69, the AC drive does not respond to the newly given target frequency. See "Figure 6-68 B4-68 = 2, forward limit".

B4-68 = 2: When the motor runs in the reverse direction and the DI reverse limit is detected, the AC drive reports the alarm A58.02 and decelerates to 0 with the current position locked. When the newly given target frequency is forward, exceeds B4-69, and lasts for B4-70, the AC drive responds to the newly given forward target frequency and the motor runs in the forward direction. When the newly given target frequency is forward but less than B4--69, the AC drive does not respond to the newly given target frequency. See "Figure 6-69 B4-68 = 2, reverse limit".

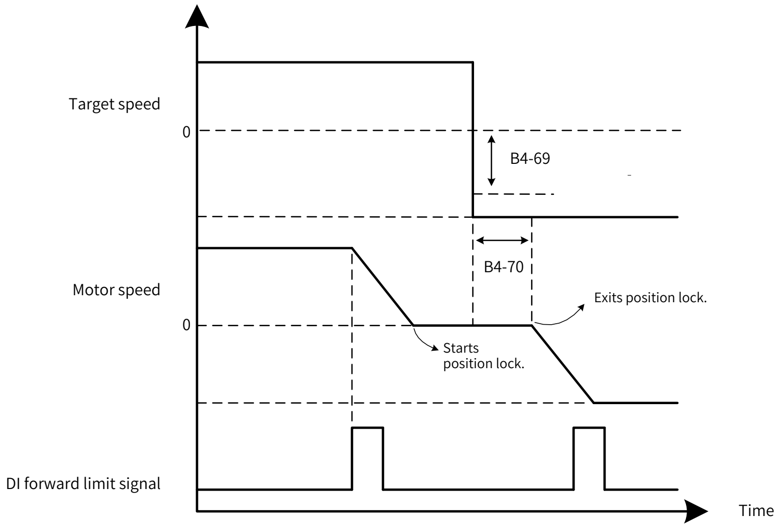


Figure 6-68 B4-68 = 2, forward limit

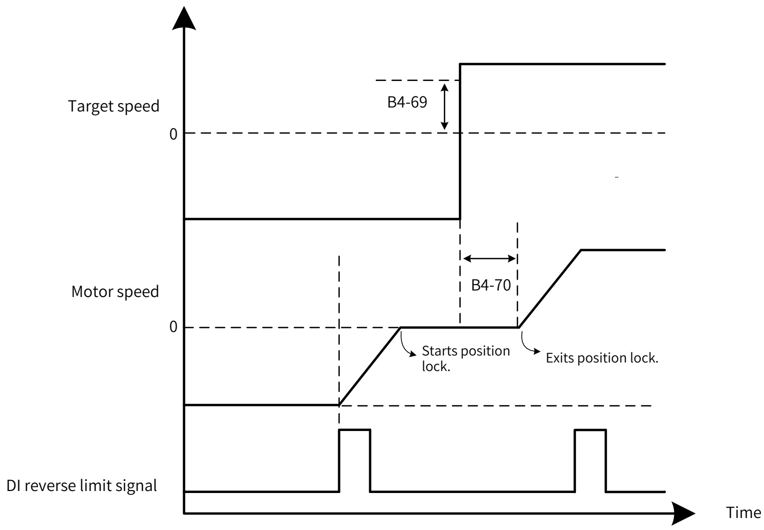


Figure 6-69 B4-68 = 2, reverse limit

NOTE

- If B4-68 is set to 2 in position control, when the motor runs in the forward direction and DI forward limit is detected, the AC drive reports the alarm A58.01 and decelerates to 0 with the current position locked. When a new reverse running position command is given, the position control is triggered again. The AC drive responds to the reverse running command and the motor runs in the reverse direction.
- If B4-68 is set to 2 in position control, when the motor runs in the reverse direction and DI reverse limit is detected, the AC drive reports the alarm A58.02 and decelerates to 0 with the current position locked. When a new forward running position command is given, the position control is triggered again. The AC drive responds to the forward running command and the motor runs in the forward direction.

6.10.3 Group B5 Multi-position Reference Parameters

A total of 24 position references are supported with the segment numbers ranging from 1 to 24.

The positioning length and direction, acceleration time, deceleration time, speed upper limit, and waiting time can be set independently for each position reference segment.

The range of the position reference length is -1073741824 to +1073741824 (pulse). If pulse is not used as the unit of the position reference, the pulse (frequency quadrupled) will be used as the unit after conversion. The reference length must be within -1073741824 to +1073741824 after electronic gear ratio conversion.

Four groups of acceleration/deceleration time can be set for position control. The corresponding acceleration/deceleration time can be selected independently for each position reference.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B5-00	Position control acceleration time 1	0.01 to 600.00s	10.00s		
B5-01	Position control deceleration time 1	0.01 to 600.00s	10.00s		
B5-02	Position control acceleration time 2	0.01 to 600.00s	10.00s		
B5-03	Position control deceleration time 2	0.01 to 600.00s	10.00s		
B5-04	Position control acceleration time 3	0.01 to 600.00s	10.00s		
B5-05	Position control deceleration time 3	0.01 to 600.00s	10.00s		
B5-06	Position control acceleration time 4	0.01 to 600.00s	10.00s		
B5-07	Position control deceleration time 4	0.01 to 600.00s	10.00s		

Four groups of waiting time can be set. The corresponding waiting time can be selected independently for each position reference.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B5-08	Waiting time of positioning completed 1	0.00 to 600.00s	0.01s		ALL
B5-09	Waiting time of positioning completed 2	0.00 to 600.00s	0.01s		ALL
B5-10	Waiting time of positioning completed 3	0.00 to 600.00s	0.01s		ALL
B5-11	Waiting time of positioning completed 4	0.00 to 600.00s	0.01s		ALL

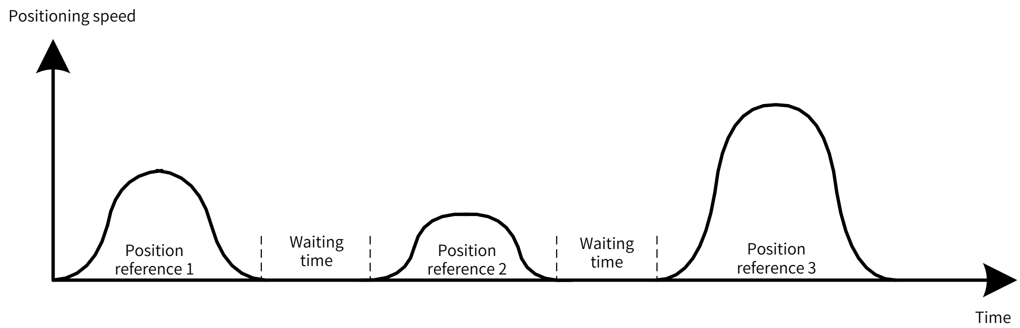


Figure 6-70 Positioning speed and position reference

Eight groups of frequency upper limits can be set. The corresponding frequency upper limit can be selected independently for each position reference.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B5-12	Maximum frequency reference selection for position control	0: 100.00% 1: AI1 2: AI2 3: Communication setting (7302H)	0	Used to set the maximum frequency source for position control in the unit of percentage. The base value is the frequency set by B5-13. When B5-12 is set to 0, the maximum frequency for position control is B5-13. When B5-12 is set to 1, the maximum frequency for position control is set by AI1. The relationship between the AI1 voltage and percentage is set through the AI curve of group F4. Its base value is the frequency set by B5-13. When B5-12 is set to 2, the maximum frequency for position control is set by AI2. The relationship between the AI2 voltage and percentage is set through the AI curve of group F4. Its base value is the frequency set by B5-13. When B5-12 is set to 3, the maximum frequency for position control is given through communication. The communication address is 7320H and the range is 0 to 65535 rpm.	ALL
B5-13	Maximum frequency digital setting for position control	1.00Hz to 600.00Hz	50.00 Hz	-	ALL
B5-14	Position control frequency upper limit 1	0 to 100.00%	50.00%	Used to set the frequency upper limit for position control in the unit of percentage. The base value is the maximum frequency for position control, which is determined by B5-12 and B5-13. Note: The frequency upper limit for position control is limited by the maximum frequency (F0-10) and frequency upper limit (F0-12).	ALL
B5-15	Position control frequency upper limit 2	0 to 100.00%	50.00%		ALL
B5-16	Position control frequency upper limit 3	0 to 100.00%	50.00%		ALL
B5-17	Position control frequency upper limit 4	0 to 100.00%	50.00%		ALL
B5-18	Position control frequency upper limit 5	0 to 100.00%	50.00%		ALL
B5-19	Position control frequency upper limit 6	0 to 100.00%	50.00%		ALL
B5-20	Position control frequency upper limit 7	0 to 100.00%	50.00%		ALL
B5-21	Position control frequency upper limit 8	0 to 100.00%	50.00%	-	ALL

Example:

1) B5-12 = 1, AI1 = 5 V, F4-13 = 0, F4-14 = 0.0%, F4-15 = 10 V, F4-16 = 100.0%, B5-13 = 50.00 Hz, B5-14 = 10.00%, B5-15 = 20.00%, B5-16 = 30.00%, B5-17 = 40.00%, B5-18 = 40.00%, B5-19 = 50.00%, B5-20 = 60.00%, B5-21 = 70.00%

That is, AI1 is used as the maximum frequency for position control, and 5 V corresponds to 50.0%.

Maximum frequency for position control = B5-13 x 50.0% = 25.00 Hz

Position control frequency upper limit 1 = Maximum frequency for position control x B5-14 = 25 x 10.00% = 2.50 Hz

Position control frequency upper limit 2 = Maximum frequency for position control x B5-15 = 25 x 20.00% = 5.00 Hz

Position control frequency upper limit 3 = Maximum frequency for position control x B5-16 = 25 x 30.00% = 7.50 Hz

Position control frequency upper limit 4 = Maximum frequency for position control x B5-17 = 25 x 40.00% = 10.00 Hz

Position control frequency upper limit 5 = Maximum frequency for position control x B5-18 = 25 x 50.00% = 12.50 Hz

Position control frequency upper limit 6 = Maximum frequency for position control x B5-19 = 25 x 60.00% = 15.00 Hz

Position control frequency upper limit 7 = Maximum frequency for position control x B5-20 = 25 x 70.00% = 17.50 Hz

Position control frequency upper limit 8 = Maximum frequency for position control x B5-21 = 25 x 80.00% = 20.00 Hz

2) B5-12 = 3, communication setting value = 5000, B5-13 = 100.00 Hz, B5-14 = 50.00%, B5-15 = 80.00%, F0-10 = 50.00 Hz, F0-12 = 30.00 Hz

That is, the maximum frequency for position control is set through communication, and 5000 corresponds to 50.00%.

Maximum frequency for position control = B5-13 x 50.00% = 50.00 Hz

Position control frequency upper limit 1 = Maximum frequency for position control x B5-14 = 50 x 50.00% = 25.00 Hz

Position control frequency upper limit 2 = Maximum frequency for position control x B5-15 = 50 x 80.00% = 40.00 Hz (> F0-12; effective position control frequency upper limit 2: 30.00 Hz)

The acceleration/deceleration base frequency for position control is set by B5-25.

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B5-25	Position control acceleration/ deceleration base frequency	0: F0-10 (Maximum frequency) 1: 50.00 Hz	1	When B5-25 is set to 0, the acceleration/ deceleration base frequency for position control is the maximum frequency (F0-10). When B5-25 is set to 1, the acceleration/ deceleration base frequency for position control is fixed to 50.00 Hz.	ALL

The acceleration/deceleration time indicates the time for the AC drive to increase from 0 Hz to the frequency set by B5-25 or decrease from the frequency set by B5-25 to 0 Hz, as shown in the following figure.

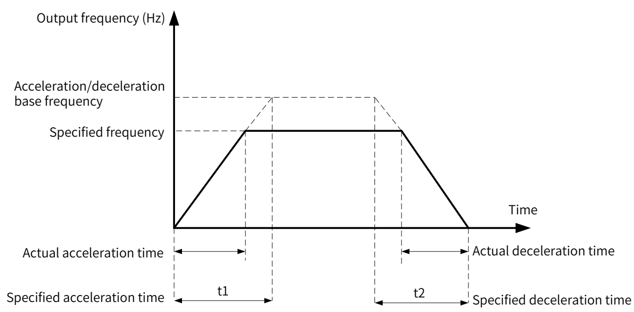
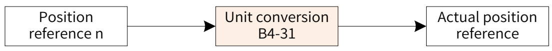


Figure 6-71 Acceleration/Deceleration time

Parameter No.	Parameter Name	Setting Range	Default Value	Parameter Description	Effective Mode
B5-26	Position reference unit	0: Pulse (encoder resolution quadrupled) 1: mm 2: cm	0	Used to set the position reference unit, which is valid for incremental and absolute positioning.	R, A
B5-27	Conversion coefficient between reference unit and pulse	0 to 6553.5	1.0	-	R, A

For incremental positioning and absolute positioning, the conversion of position reference is as follows:

For rotative positioning and fixed angle rotative positioning, the conversion of position reference is as follows:



For example, in case of using incremental positioning, the moving length is 500 mm, the PPR of encoder is 1000. The motor and encoder are installed in the same shaft, and the load moves for 2.5 mm after the motor rotates for one revolution.

Pulses for one revolution of the motor = 1000 x 4 = 4000 (pulse)

Pulses for the load moving for 1 mm = 4000/2.5 = 1600

Pulses corresponding to 500 mm reference = 1600 x 500 = 800000

Setting method 1:

The reference unit is pulse, with B5-26 set to 0.

The reference length is 800000 = 12 x 65536 + 13568. That is, the low bits and high bits of the position reference are 13568 and 12, respectively.

The electronic gear ratio is 1:1.

Setting method 2:

The reference unit is mm, with B5-26 set to 1.

The reference length is 500, with B5-27 set to 1600.

The electronic gear ratio is 1:1.

B5-28 to B5-99 are used for setting 24 position references.

Segment No.	Parameter Name	Relevant Parameter No.	Reference Length	Remarks
1	Position reference 1	B5-28 B5-29 B5-30	B5-29 x 65536 + B5-28	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-30.
2	Position reference 2	B5-31 B5-32 B5-33	B5-32 x 65536 + B5-31	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-33.
3	Position reference 3	B5-34 B5-35 B5-36	B5-35 x 65536 + B5-34	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-36.

Segment No.	Parameter Name	Relevant Parameter No.	Reference Length	Remarks
4	Position reference 4	B5-37 B5-38 B5-39	B5-38 x 65536 + B5-37	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-39.
5	Position reference 5	B5-40 B5-41 B5-42	B5-41 x 65536 + B5-40	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-42.
6	Position reference 6	B5-43 B5-44 B5-45	B5-44 x 65536 + B5-43	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-45.
7	Position reference 7	B5-46 B5-47 B5-48	B5-47 x 65536 + B5-46	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-48.
8	Position reference 8	B5-49 B5-50 B5-51	B5-50 x 65536 + B5-49	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-51.
9	Position reference 9	B5-52 B5-53 B5-54	B5-53 x 65536 + B5-52	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-54.
10	Position reference 10	B5-55 B5-56 B5-57	B5-56 x 65536 + B5-55	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-57.
11	Position reference 11	B5-58 B5-59 B5-60	B5-59 x 65536 + B5-58	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-60.
12	Position reference 12	B5-61 B5-62 B5-63	B5-62 x 65536 + B5-61	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-63.
13	Position reference 13	B5-64 B5-65 B5-66	B5-65 x 65536 + B5-64	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-66.
14	Position reference 14	B5-67 B5-68 B5-69	B5-68 x 65536 + B5-67	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-69.
15	Position reference 15	B5-70 B5-71 B5-72	B5-71 x 65536 + B5-70	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-72.
16	Position reference 16	B5-73 B5-74 B5-75	B5-74 x 65536 + B5-73	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-75.
17	Position reference 17	B5-76 B5-77 B5-78	B5-77 x 65536 + B5-76	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-78.
18	Position reference 18	B5-79 B5-80 B5-81	B5-80 x 65536 + B5-79	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-81.
19	Position reference 19	B5-82 B5-83 B5-84	B5-83 x 65536 + B5-82	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-84.
20	Position reference 20	B5-85 B5-86 B5-87	B5-86 x 65536 + B5-85	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-87.

Segment No.	Parameter Name	Relevant Parameter No.	Reference Length	Remarks
21	Position reference 21	B5-88 B5-89 B5-90	B5-89 x 65536 + B5-88	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-90.
22	Position reference 22	B5-91 B5-92 B5-93	B5-92 x 65536 + B5-91	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-93.
23	Position reference 23	B5-94 B5-95 B5-96	B5-95 x 65536 + B5-94	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-96.
24	Position reference 24	B5-97 B5-98 B5-99	B5-98 x 65536 + B5-97	The direction, acceleration/deceleration time, waiting time, and speed upper limit are set by B5-99.

6.10.4 Group U2 Position Control Monitoring Parameters

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-60	Real-time position deviation during position control	U2-60 and U2-79 display the real-time position deviation during positioning. U2-60 and U2-79 display the pulse deviation between the current feedback position and current given position, rather than the pulse deviation between the current feedback position and target position. Their values reflect the system following error.	-32768 to +32767	pulse	Frequency quadrupled
U2-79	Real-time position deviation during position control		-3276.8 to +3276.7	Reference unit	
U2-61	Valid home tag	U2-61 displays whether a valid home signal exists currently. Also, you can check the TUNE/TC indicator to see whether a home signal is given currently. U2-62 and U2-63 display the home position (U2-63 x 65536 + U2-62).	0 to 1	-	0: Home invalid 1: Home valid
U2-62	Home position (low 16 bits)		0 to 65535	-	
U2-63	Home position (high 16 bits)		0 to 65535	-	
U2-64	Z signal position (low 16 bits)	U2-64 and U2-65 display the encoder Z signal position (U2-65 x 65536 + U2-64).	0 to 65535	-	
U2-65	Z signal position (high 16 bits)		0 to 65535	-	
U2-66	Current position reference segment	U2-66 displays the target position reference during the current positioning.	1 to 24	-	
U2-67	Output flag of positioning almost completed	The conditions and output mode for positioning almost completed are set by B4-21, B4-22, B4-23, B4-24, and B4-25. When the output of positioning almost completed is valid, the value of U2-67 is 1.	0 to 1	-	0: Positioning almost completed invalid 1: Positioning almost completed valid

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-68	Output flag of positioning completed	The conditions and output mode for positioning completed are set by B4-26, B4-27, B4-28, B4-29, and B4-30. When the output of positioning almost completed is valid, the value of U2-68 is 1.	0 to 1	-	0: Positioning completed invalid 1: Positioning completed valid
U2-69	Position control mode	U2-69 displays the current position control mode. When the position control mode is switched over using the DI terminal, the actual position control mode may be different from that set by B4-01.	0 to 3	-	0: Incremental 1: Absolute 2: Degree 3: Fixed length degree
U2-70	Number of pulses per revolution of encoder	U2-70 displays the theoretical pulses (frequency quadrupled) corresponding to one revolution of the encoder.	0 to 65535	pulse	Frequency quadrupled
U2-71	Number of pulses per revolution of shaft	U2-71 displays the theoretical pulses (frequency quadrupled) corresponding to one revolution of the shaft, which corresponds to the encoder pulses	0 to 65535	pulse	Frequency quadrupled
U2-72	Number of pulses per revolution of motor	U2-72 displays the theoretical pulses (frequency quadrupled) corresponding to one revolution of the motor, which corresponds to the encoder pulses.	0 to 65535	pulse	Frequency quadrupled

For example, the PPR of the encoder is 1000, the transmission ratio of the motor and encoder is 1:2, and the transmission ratio of the motor and shaft is 4:1. That is, when the motor rotates for four revolutions, the shaft rotates for one revolution, and the encoder rotates for eight revolutions. In this case, the transmission ratio F1-32 is 1 and F1-33 is 2, and the electronic gear ratio B4-02 is 8 and B4-03 is 1.

U2-70 = 1000 x 4 = 4000

U2-71 = U2-70 x F1-33 / F1-32 = 24000

U2-72 = U2-70 x B4-02 / B4-03 = 8000

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-73	Current encoder position	U2-73 displays the current position of the encoder.	0 to 65535	pulse	Frequency quadrupled
U2-74	Current encoder position (angle)	U2-74 displays the current angular position of the encoder.	0 to 359.9	°	

For example, if the PPR of the encoder is 1000, one revolution of the encoder is divided in 4000 pulses. The range of U2-73 is 0 to 3999.

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-75	Adjacent home position distance (low 16 bits)	U2-75 and U2-76 display the distance between adjacent home positions. Distance between adjacent home positions = U2-76 x 65536 + U2-75	0 to 65535	pulse	
U2-76	Adjacent home position distance (high 16 bits)		0 to 65535	pulse	
U2-77	Home counter	U2-77 displays the counts of the home signals.	0 to 65535	-	
U2-78	Position control state	-	0 to 65535	-	

U2-78 displays the position control stages as follows:

Value	Stage	Value	Stage
0	Position control invalid	5	Acceleration
1	Initialize	6	Constant speed
2	Position control preparing	7	Deceleration
3	Home searching	8	Waiting for positioning completed
4	Position curve planning	9	Position control paused

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-80	Relative home position direction	U2-80 displays the current position direction relative to the home. U2-81 and U2-82 display the distance between the current position and the home position. Distance to the home = U2-82 x 65536 + U2-81	0 to 1	-	0: Forward 1: Reverse
U2-81	Relative home position distance (low 16 bits)		0 to 65535	pulse	
U2-82	Relative home position distance (high 16 bits)		0 to 65535	pulse	
U2-83	Position	U2-83 displays the real-time position output by the motion curve generator.	0 to 65535	-	
U2-84	Speed	U2-84 displays the real-time speed output by the motion curve generator.	0 to 655.35	0.01 Hz	Two decimal places fixed
U2-85	Current shaft position	U2-85 displays the current position of the shaft.	0 to 65535	pulse	
U2-86	Current shaft position (angle)	U2-86 displays the current angular position of the shaft.	0 to 359.9	°	

For example, if the PPR of the encoder is 1000 and the electronic gear ratio is 2:1, one revolution of the encoder and shaft is divided into 4000 pulses and 8000 pulses respectively. The range of U2-85 is 0 to 7999.

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-87	Position control enabling flag	U2-87 displays the enabling flag of position control. U2-87 displays the enabling flag of position control. 0 indicates that position control is disabled, and 1 indicates that position control is enabled.	0 to 1	-	0: Disabled 1: Enabled
U2-88	Position control enabling command set by communication	U2-88 displays the position control enabling command sent through communication. The communication address is 7318H. 0 indicates that position control is disabled, and 1 indicates that position control is enabled.	0 to 1	-	0: Disabled 1: Enabled
U2-89	Position lock operation flag in position control	U2-89 displays whether the AC drive is in the position lock state during position control. 0 indicates that the AC drive is not in the position lock state, and 1 indicates that the AC drive is in the position lock state. If the position control is disabled or the AC drive decelerates to 0 after home searching is complete, the AC drive enters the position lock state.	0 to 1	-	0: Disabled 1: Enabled

Parameter No.	Parameter Name	Meaning	Setting Range	Unit	Remarks
U2-90	Position control frequency upper limit	U2-90 displays the frequency upper limit set for position control. When the positioning travel distance is short, the actual frequency upper value may be less than U2-90.	0 to 655.35	0.01Hz	Two decimal places fixed
U2-91	Shaft stopping flag	U2-91 displays whether the shaft currently stops. If no encoder fault is reported in the FVC mode, the shaft is determined as static when the encoder feedback position does not change for 100 ms. If the shaft is not static when the AC drive is powered off, the home retentive at power failure function is invalid and the home will be cleared.	0 to 1	-	0: Not stopping 1: Stopping
U2-92	Home loss counting during home correction	U2-92 displays the home loss times during home correction. The AC drive will report the excessive home loss times fault (E54.03) when the home loss times exceeds the value of B4-67.	0 to 65535	-	
U2-93	Encoder Z signal counter	U2-93 displays the number of received encoder Z signals.	0 to 65535	-	
U2-95	Encoder pulse counting (low 16 bits)	U2-95 and U2-96 display the pulse counts of the encoder. Encoder pulse counts = U2-96 x 65536 + U2-95	0 to 65535	pulse	
U2-96	Encoder pulse counting (high 16 bits)		0 to 65535	pulse	

6.11 DI and DO Functions

6.11.1 Position Control DI Functions

DI Functions	Parameter Name	Description
63	Running enabling	When this function is invalid, the AC drive does not respond to the terminal running and jog commands. When this function is valid, the AC drive enters the position lock state when no running and jog command is given and runs normally according to the given command when a running or jog command is given. This function is valid when the command source is terminal control (F0-02 = 1).
64	Switchover between speed synchronization and position synchronization	When this function is valid, the synchronization mode is switched from speed synchronization to position synchronization or reversely, depending on the current synchronization mode.
65	Position incremental	When this function is valid, the position is incremental.
66	Position decremental	When this function is valid, the position is decremental.
67	Position synchronization deviation clearing	When this function is valid, the tracking deviation during position synchronization is cleared.
68	Home signal	Used to receive the DI terminal home signal.
69	Home searching	When this function is valid, home searching is performed.
70	Position control paused	

DI Functions	Parameter Name	Description
71	Switched to position control	When this function is valid, the AC drive switches to the position control mode.
72	Switched to position control (forward running command)	When this function is valid, the AC drive switches to the position control mode with the forward running command.
73	Switched to position control (reverse running command)	When this function is valid, the AC drive switches to the position control mode with the reverse running command.
74	Reserved	
75	Multi-position reference selection 1	Used to select the 24 multi-position references.
76	Multi-position reference selection 2	
77	Multi-position reference selection 3	
78	Multi-position reference selection 4	
79	Multi-position reference selection 5	
80	Forward limit switch	Used to connect the forward limit signal.
81	Reverse limit switch	Used to connect the reverse limit signal.
82	Switched to incremental position control	When this function is valid in the position control mode, the AC drive switches to the relative position control mode.
83	Switched to absolute position control	When this function is valid in the position control mode, the AC drive switches to the absolute position control mode.
84	Switched to rotative position control	When this function is valid in the position control mode, the AC drive switches to the rotative position control mode.
85	Switched to fixed angle rotative position control	When this function is valid in the position control mode, the AC drive switches to the fixed angle rotative position control mode.
86	Re-positioning	Position control is triggered again.

6.11.2 Position Control DO Functions

DO Functions	Parameter Name	Description
21	Positioning completed	
22	Positioning almost completed	
36	Positioning home valid	
37	Flag of home searching completed	
46	Running enabling state output (brake control)	The output is valid when the AC drive stops. If running enabling is invalid, the output is valid when the AC drive enters the position lock state. If running enabling is valid, the output is invalid when the AC drive is running or jogging. This function is used with the terminal function 63 to realize the simple brake control logic. For details about the control time sequence, see the description of B4-74.

7 Power Supply Unit Parameters

7.1 Basic Information

Basic information about the 810 series power supply unit includes the product model, software version and other information. Information has been determined during product delivery. Parameters in this group can be displayed, but cannot be modified.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-01	Product model	810	810	MD810
F0-02	Software version	xx.xx	uxx.xx	Software version
F0-03	Temporary software version	Lxx.xx	Lxx.xx	Temporary software version
F0-04	Customized No.	Fxx.xx	Fxx.xx	Customized software version

xx.xx in the software version indicates specific version figures when leaving the factory.

7.2 Parameter Settings of Basic Functions

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-00	Bus undervoltage threshold	350 V	300 V to 500 V	Undervoltage threshold of bus voltage

When the bus voltage is lower than the F1-00 setting value, the system judges it as undervoltage state. This parameter must be set according to the actual application.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-01	Bus overvoltage threshold	820 V	700 V to 850 V	Overvoltage threshold of bus voltage

When the bus voltage is higher than F1-01 setting value, the system judges it as overvoltage state. When the system is in overvoltage state, the operating panel of the power supply unit flashes. If the motor runs in generation state, it may result in continuous rise of the bus voltage. When the bus voltage is too high, there is a risk of damage to the system. This parameter must be correctly set according to the actual application.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-02	Start voltage of braking unit actuation	760 V	700 V to 800 V	When the bus voltage is higher than the setting value, the braking unit is actuated.

When the bus voltage is higher than the F1-02 setting value, the braking unit actuates, playing a role in reducing the bus voltage. When the braking transistor is turned ON, a large amount of energy is generated on the regenerative resistor instantaneously. A regenerative resistor shall be reasonably configured according to actual application to ensure good cooling of the regenerative resistor.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-03	Soft start of a single power supply unit	0	0: Soft start with drive units connected in parallel 1: Soft start without drive units connected in parallel	Used in the rectification mode.

If a power supply unit runs without a drive unit connected in parallel, set F1-03 to 1 to enable soft start of the power supply unit and switch to the rectification mode.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-09	Fan control mode	1	0: The fan runs automatically.	When the temperature is higher than 45°C , the fan runs. When the temperature is lower than 40°C , the fan stops.
			1: The fan always runs.	The fan always runs after the system is powered on.

If F1-09 is set to 0, when the heat sink or braking transistor temperature is higher than 45° C, the fan starts to run. When the temperature is lower than 40° C, the fan stops.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-10	Selection of braking unit fault protection	111	0: Disabled	The system forcedly enables braking unit fault protection.
			1: Enabled	

This parameter is unmodifiable. When overcurrent, overload or short circuit occurs in the braking unit, the system forcedly performs protection to avoid damage to the braking unit.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-11	Selection of three-phase input abnormality protection	111	0: Disabled	When three-phase input is abnormal, select whether to perform protection.
			1: Enabled	

Three-phase input abnormalities include phase loss, three-phase imbalance and power grid over voltage. When the ones position is set to 0, power grid phase loss is not protected. When the ones position is set to 1, power grid phase loss is protected. When the tens position is set to 0, power grid over voltage is not protected. When the tens position is set to 1, high power grid over voltage is protected. When the hundreds position is set to 0, three-phase imbalance is not protected. When the hundreds position is set to 1, three-phase imbalance is protected.

When F1-11 is set to 0, the power supply unit does not detect any fault. When the system continues to run, the risk of damage to the system will increase.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-13	Selection of communication abnormality protection	1	0: Disabled	The system forcedly performs protection in case of communication abnormality.
			1: Enabled	
F1-14	Selection of module overheat protection	1	0: Disabled	The system forcedly performs protection in case of module overheat.
			1: Enabled	
F1-15	Selection of EEPROM abnormality protection	1	0: Disabled	The system forcedly performs protection in case of EEPROM abnormality.
			1: Enabled	

The preceding three parameters are unmodifiable. When communication abnormality, module overheating or EEPROM abnormality occurs, the system forcedly performs protection to ensure system reliability.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-17	Selection of protection against communication abnormality between the power supply and drive units	1	0: Disabled	Select whether to perform protection in case of communication abnormality between the power supply and drive units.
			1: Enabled	

When communication of the power supply unit with the drive unit is abnormal, set F1-17 to 1 and the power supply unit gives an A16.13 alarm; set F1-17 to 0 and the power supply unit does not give an alarm.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F1-18	Timeout for communication between the power supply and drive units	5.00s	1.00s to 20.00s	When the time for the power supply failing to communicate with the drive unit exceeds this setting value, the power supply gives an alarm.

7.3 Information Exchange Setting Between the Power Supply and Drive Units

When the power supply unit is faulty, it transfers a message to the drive unit that then performs corresponding actions according to message contents.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-00	Drive unit protection action against power grid overvoltage	2	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any power grid overvoltage fault, it transfers "coast to stop" command to the drive unit.
F2-01	Drive unit protection action against power grid undervoltage	1	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any power grid undervoltage fault, it transfers the "run" command to the drive unit.
F2-02	Drive unit protection action against three-phase imbalance	3	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any three-phase imbalance, it transfers the "stop by a setting method" command to the drive unit.
F2-03	Drive unit protection action against input phase loss	3	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any input phase loss, it transfers the "stop by a setting method" command to the drive unit.
F2-04	Drive unit protection action against braking unit short circuit	2	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any braking unit short circuit, it transfers the "coast to stop" command to the drive unit.
F2-05	Drive unit protection action against braking unit overcurrent	1	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any braking unit overcurrent, it transfers the "run" command to the drive unit.
F2-06	Drive unit protection action against braking unit overload	1	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any braking unit overload, it transfers the "run" command to the drive unit.
F2-09	Drive unit protection action against communication fault	1	1: Run 2: Coast to stop 3: Stop by a setting method	When any communication fault occurs in the power supply unit, it transfers the "run" command to the drive unit.
F2-11	Drive unit protection action against EEPROM fault	3	1: Run 2: Coast to stop 3: Stop by a setting method	When any EEPROM fault occurs in the power supply unit, it transfers the "stop by a setting method" command to the drive unit.
F2-12	Drive unit protection action against module overheat	2	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects any module overheat, it transfers the "coast to stop" command to the drive unit.

All preceding parameters are unmodifiable. When the power supply unit is faulty, the drive unit performs related actions using the preceding parameters. The table shows specific meanings of parameters.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-13	Drive unit protection action against module overheat warning	3	1: Run 2: Coast to stop 3: Stop by a setting method	When the power supply unit detects that the module temperature reaches the warning temperature, it transfers "stop by a setting method" command to the drive unit.

When the power supply unit temperature reaches the warning temperature, the power supply unit transfers "stop by a setting method" command to the drive unit. You can change F2-13 setting values according to actual application. When the power supply unit temperature is higher than the warning temperature, the power supply unit transfers a command corresponding to a parameter.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F2-14	Power supply unit protection action against power grid overvoltage	1	0: Run 1: The power supply unit stops.	When the power grid voltage exceeds an input range, the power supply unit stops by default.

When the power grid voltage exceeds an input range, the power supply unit detects any power grid overvoltage fault, the power supply stops and the bus voltage is lowered. You can change F2-14 setting values according to actual application. Power grid overvoltage will result in rise in bus voltage, causing braking unit actuation or triggering drive unit overvoltage suppression. Excessive bus voltage may result in a risk of damage to the system.

7.4 Input Terminal Functions

The 810 series power supply unit is provided with five multi-functional DI terminals as standard configuration. You can set different functions for input terminals according to the actual application respectively.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-00	DI1 terminal function selection	5	0 to 9	For details, see the following table.
F4-01	DI2 terminal function selection	0		
F4-02	DI3 terminal function selection	0		
F4-03	DI4 terminal function selection	0		
F4-04	DI5 terminal function selection	0		

These parameters are used to set the functions of multi-functional DI terminals. The following table shows optional functions:

Setting Value	Function	Detailed Description
0	No function	Set 0 for reserved terminals to avoid malfunction.
1	Drive unit running	The power supply unit sends the "run" command to the drive unit.
2	Incoming line breaker feedback	The power supply unit sends the "run" command to the drive unit according to feedback signals.
3	Auxiliary breaker feedback	The power supply unit sends the "run" command to the drive unit according to feedback signals.
4	Leakage protection switch feedback	The power supply unit sends the "run" command to the drive unit according to feedback signals.
5	Fault reset	The terminal is used for fault reset function, the same as the function of RESET key on the operating panel. Remote fault reset is implemented by this function.
6	Drive unit running disabled	The power supply unit sends the "running disabled" command to the drive unit.
7	Drive unit coast to stop	The power supply unit sends the "coast to stop" command to the drive unit.
8	Drive unit stop by a setting method	The power supply unit sends the "stop by a setting method" command to the drive unit.

Setting Value	Function	Detailed Description
9	Power supply unit running enabled	Establish and keep the bus voltage constant.

If a missoperation is caused due to interference to an input terminal, the parameters shown in the following table can be modified to enhance anti-interference performance, However, increase of DI filter time will reduce the response of DI terminals.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-05	DI1 filter time	0.010s	0.010s to 5.000s	It is used to set the software filter time of DI terminal status.
F4-06	DI2 filter time	0.010s	0.010s to 5.000s	
F4-07	DI3 filter time	0.010s	0.010s to 5.000s	
F4-08	DI4 filter time	0.010s	0.010s to 5.000s	
F4-09	DI5 filter time	0.010s	0.010s to 5.000s	
F4-10	DI1 effective delay time	0.00s	0.00s to 600.00s	It is used to set the delay time of a DI terminal status change.
F4-11	DI2 effective delay time	0.00s	0.00s to 600.00s	
F4-12	DI3 effective delay time	0.00s	0.00s to 600.00s	
F4-13	DI4 effective delay time	0.00s	0.00s to 600.00s	
F4-14	DI5 effective delay time	0.00s	0.00s to 600.00s	
F4-15	DI1 ineffective delay time	0.00s	0.00s to 600.00s	
F4-16	DI2 ineffective delay time	0.00s	0.00s to 600.00s	
F4-17	DI3 ineffective delay time	0.00s	0.00s to 600.00s	
F4-18	DI4 ineffective delay time	0.00s	0.00s to 600.00s	
F4-19	DI5 ineffective delay time	0.00s	0.00s to 600.00s	

They are used to set the delay time of a DI terminal status change.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F4-20	DI active mode selection	0	0: Active at low level 1: Active at high level	Ones position: DI1 active mode Tens position: DI2 active mode Hundreds position: DI3 active mode Thousands position: DI4 active mode Ten thousands position: DI5 active mode

It is used to set an active status mode of a DI terminal.

When it is set to active at low level, a corresponding DI terminal is active when low voltage is applied between the DI terminal and COM.

When it is set to active at high level, a corresponding DI terminal is active when high voltage is applied between DI terminal an COM.

7.5 Relay Output Terminal Functions

The 810 series power supply unit is provided with three groups of multi-functional relay output terminals.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F5-00	T1A, T1B and T1C output function selection	0	0 to 15	For details, see the following table.
F5-01	T2A, T2B and T2C output function selection	0		
F5-02	T3A, T3B and T3C output function selection	0		

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F5-09	Relay DO active status selection	000	0: Active at high level 1: Active at low level	Ones position: T1A, T1B and T1C Tens position: T2A, T2B and T2C Hundreds position: T3A, T3B and T3C

Define output logic of output terminals T1A, T1B and T1C/T2A, T2B and T2C/T3A, T3B and T3C

0: Active at high level. The connection of a DO terminal to the corresponding common terminal is at high level.

1: Active at low level. The connection of a DO terminal to the corresponding common terminal is at low level.

Description of output terminal function selection:

Setting Value	Function	Description
0	No output	Output terminals have no function.
1	Run	The power supply unit is normal and outputs ON signal when it sends the "run" command to the drive unit.
2	Fault output	When the power supply unit fails, it outputs ON signal.
3	Warning output	When the power supply unit gives an alarm, it outputs ON signal.
4	Breaker actuation output	When three-phase input is too high or the braking transistor is short-circuited, ON signal is output to actuate the breaker.
5	Undervoltage output of bus voltage	When the power supply unit detects that the bus is in undervoltage state, ON signal is output.
6	Overvoltage output of bus voltage	When the power supply unit detects that the bus is in overvoltage state, ON signal is output.
7	Normal output of bus voltage	When the power supply unit detects that the bus voltage is normal, ON signal is output.
8	Bus voltage abnormal	When the power supply unit detects that the bus voltage is abnormal, ON signal is output.
9	Three-phase input abnormal	When the power supply unit detects that three-phase input is abnormal, ON signal is output.
10	Three-phase input normal	When the power supply unit detects that three-phase input is normal, ON signal is output.
11	Module overtemperature fault output	When the module overtemperature fault occurs in the power supply unit, it outputs ON signal.
12	Module overtemperature warning output	When the power supply unit detects that the module temperature exceeds the module warning temperature, it outputs ON signal.

7.6 Fault Record Group

The last five faults of the power supply unit are recorded. For possible causes and solutions of every fault code, see "9.4 Fault Codes and Solutions".

FA-00	Fault code upon the fifth fault	Fault code upon the last fault
FA-01	Fault subcode upon the fifth fault	Fault subcode upon the last fault
FA-02	Bus voltage upon the fifth fault	Bus voltage upon the last fault
FA-03	Module temperature upon the fifth fault	Module temperature upon the last fault
FA-04	Braking transistor temperature upon the fifth fault	Braking transistor temperature upon the last fault
FA-05	Braking circuit current upon the fifth fault	Braking circuit current upon the last fault
FA-06	Power grid voltage Usr upon the fifth fault	Power grid voltage Usr upon the last fault
FA-07	Power grid voltage Ust upon the fifth fault	Power grid voltage Ust upon the last fault
FA-08	Power grid voltage Utr upon the fifth fault	Power grid voltage Utr upon the last fault
FA-09	Level of three-phase imbalance upon the fifth fault	Level of three-phase imbalance upon the last fault
FA-10	DI status upon the fifth fault	DI status upon the last fault
FA-11	RO status upon the fifth fault	RO status upon the last fault

FA-12	Stop command sent from the power supply unit upon the fifth fault	Stop command sent from the power supply unit upon the last fault
FA-13	Total power-on time upon the fifth fault (h)	Total power-on time upon the last fault (h)
FA-14	Total power-on time upon the fifth fault (min)	Total power-on time upon the last fault (min)
FA-15	Total power-on time upon the fifth fault (s)	Total power-on time upon the last fault (s)
FA-20	Fault code upon the fourth fault	Same as FA-00 to FA-15
FA-21	Fault subcode upon the fourth fault	
FA-22	Bus voltage upon the fourth fault	
FA-23	Module temperature upon the fourth fault	
FA-24	Braking transistor temperature upon the fourth fault	
FA-25	Braking circuit current upon the fourth fault	
FA-26	Power grid voltage Usr upon the fourth fault	
FA-27	Power grid voltage Ust upon the fourth fault	
FA-28	Power grid voltage Utr upon the fourth fault	
FA-29	Level of three-phase imbalance upon the fourth fault	
FA-30	DI status upon the fourth fault	
FA-31	RO status upon the fourth fault	
FA-32	Stop command sent from the power supply unit upon the fourth fault	
FA-33	Total power-on time upon the fourth fault (h)	
FA-34	Total power-on time upon the fourth fault (min)	
FA-35	Total power-on time upon the fourth fault (s)	
FA-40	Fault code upon the third fault	
FA-41	Fault subcode upon the third fault	
FA-42	Bus voltage upon the third fault	
FA-43	Module temperature upon the third fault	
FA-44	Braking transistor temperature upon the third fault	
FA-45	Braking circuit current upon the third fault	
FA-46	Power grid voltage Usr upon the third fault	
FA-47	Power grid voltage Ust upon the third fault	
FA-48	Power grid voltage Utr upon the third fault	
FA-49	Level of three-phase imbalance upon the third fault	
FA-50	DI status upon the third fault	
FA-51	RO status upon the third fault	
FA-52	Stop command sent from the power supply unit upon the third fault	
FA-53	Total power-on time upon the third fault (h)	
FA-54	Total power-on time upon the third fault (min)	
FA-55	Total power-on time upon the third fault (s)	
FA-60	Fault code upon the second fault	
FA-61	Fault subcode upon the second fault	
FA-62	Bus voltage upon the second fault	
FA-63	Module temperature upon the second fault	
FA-64	Braking transistor temperature upon the second fault	
FA-65	Braking circuit current upon the second fault	
FA-66	Power grid voltage Usr upon the second fault	
FA-67	Power grid voltage Ust upon the second fault	
FA-68	Power grid voltage Utr upon the second fault	
FA-69	Level of three-phase imbalance upon the second fault	
FA-70	DI status upon the second fault	
FA-71	RO status upon the second fault	
FA-72	Stop command sent from the power supply unit upon the second fault	
FA-73	Total power-on time upon the second fault (h)	
FA-74	Total power-on time upon the second fault (min)	

FA-75	Total power-on time upon the second fault (s)	Same as FA-00 to FA-15
FA-80	Fault code upon the first fault	
FA-81	Fault subcode upon the first fault	
FA-82	Bus voltage upon the first fault	
FA-83	Module temperature upon the first fault	
FA-84	Braking transistor temperature upon the first fault	
FA-85	Braking circuit current upon the first fault	
FA-86	Power grid voltage Usr upon the first fault	
FA-87	Power grid voltage Ust upon the first fault	
FA-88	Power grid voltage Utr upon the first fault	
FA-89	Level of three-phase imbalance upon the first fault	
FA-90	DI status upon the first fault	
FA-91	RO status upon the first fault	
FA-92	Stop command sent from the power supply unit upon the first fault	
FA-93	Total power-on time upon the first fault (h)	
FA-94	Total power-on time upon the first fault (min)	
FA-95	Total power-on time upon the first fault (s)	

7.7 Parameter Management

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FP-00	User password	0	0 to 65535	Used to set a password.

If it is set to any non-zero number, the password protection function is enabled. When entering the menu, you must enter a correct password, otherwise you cannot view and modify function parameters. Please remember the set user password.

If FP-00 is set to 00000, the previously set user password is cleared, and the password protection function is disabled.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FP-01	Parameter initialization	0	0: No operation 1: Restore default parameters (excluding groups FA and FP) 2: Clear record information 4: Back up your current parameters 501: Restore your backup parameters	Perform operations such as parameter restoration and backup.

1: Restore default parameters (excluding parameters in groups FA and FP)

2: Clear record information. Clear fault record information and accumulated running time of the power supply unit

4: Back up your current parameters

Back up the current parameters set by you. The current parameter setting is backed up, helping you to restore the setting after performing incorrect parameter setting.

501: Restore your previously backed-up parameters, i.e. restore parameters that are backed up by setting FP-01 to 4.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FP-02	Parameter modification prevention selection	0	0: Disabled 1: Enabled	After it is set to 1, any modification to all function parameters is disabled.

Set FP-02 to 1 to prevent any modification after you set function parameters.

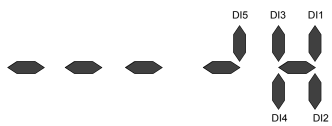
Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FP-03	Parameter display attribute	0	0: Not displayed 1: Displayed	When it is set to 0, the corresponding monitoring parameter is not displayed in level 0 menu through the switchover of the shift key.

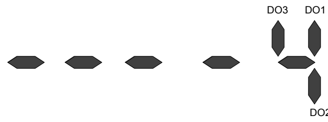
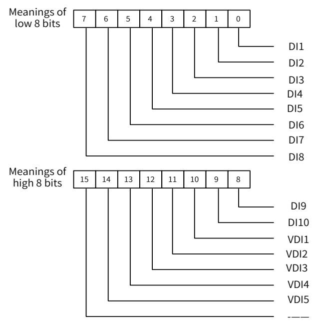
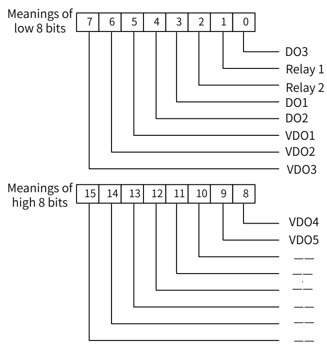
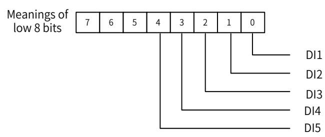
The following table shows the meaning of the display parameter for every bit setting of FP-03.

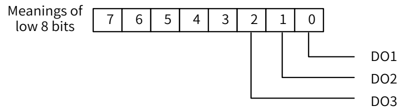
FP-03	Meaning	Description
Bit 0	Bus voltage	0: Not displayed 1: Displayed
Bit 1	Heatsink temperature	
Bit 2	Braking piping temperature	
Bit 3	Braking circuit current	
Bit 4	Input voltage Usr	
Bit 5	Input voltage Ust	
Bit 6	Input voltage Utr	
Bit 7	Degree of three-phase imbalance	
Bit 8	DI status	
Bit 9	RO status	
Bit 10	0	
Bit 11	0	
Bit 12	Fault code	
Bit 13	Fault subcode	

7.8 Monitoring Parameters

Parameters in group U0 are used to monitor running status information of the power supply unit. You can view them via the panel to facilitate site commissioning or read parameter group values via communication to perform host controller monitoring. The communication address is 0x7000 to 0x7021.

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-00	Bus voltage (V)	0.1 V	0.0 V to 2000.0 V	Displays the bus voltage value of the power supply unit.
U0-01	Heatsink temperature (° C)	1° C	-20° C to +124° C	Displays the heatsink temperature of the power supply unit.
U0-02	Braking transistor temperature (° C)	1° C	-20° C to +124° C	Displays the braking transistor temperature of the power supply unit.
U0-03	Braking circuit current (A)	0.01 A		Displays the braking circuit current of the power supply unit.
U0-04	Input voltage Usr	1 V	0 V to 1000 V	Displays the effective value of input voltage Usr.
U0-05	Input voltage Ust	1 V	0 V to 1000 V	Displays the effective value of input voltage Ust.
U0-06	Input voltage Utr	1 V	0 V to 1000 V	Displays the effective value of input voltage Utr.
U0-07	Degree of three-phase imbalance		0.00% to 100.00%	Displays the degree of three-phase voltage imbalance.
U0-08	DI status	---	---	DI status display: ON indicates high level; OFF indicates low level. 

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-09	DO status	---	---	DO status display: ON indicates high level; OFF indicates low level. 
U0-08	DI status	1	0x0000 to 0x7FFF	Displays state of DI terminals. After it is converted into binary data, every bit corresponds to one DI signal. The value 1 indicates that the input is high level. The value 0 indicates that the input is low level. The relation between every bit and input terminals is as follows: 
U0-09	DO status	1	0x0000 to 0x03FF	Displays the current DO status value. After it is converted into binary data, every bit corresponds to one DO signal. The value 1 indicates that the output is high level. The value 0 indicates that the output is low level. The relation between every bit and output terminals is as follows: 
U0-12	Current fault code	1	1 to 65535	Displays the current fault code of the power supply unit.
U0-13	Current fault subcode	1	1 to 65535	Displays the fault subcode corresponding to the current fault code of the power supply unit.
U0-14	DI status after delay processing	1	0 to 31	Displays state of DI terminals. After it is converted into binary data, every bit corresponds to one DI signal. The value 1 indicates that the input is high level. The value 0 indicates that the input is low level. The relation between every bit and input terminals is as follows: 

Parameter No.	Parameter Name	Minimum Unit	Monitoring Range	Parameter Description
U0-15	DI status after positive and negative logic processing	1	0 to 31	Displays the input status value after positive and negative logic judgment on the DI value in U0-14.
U0-17	RO status after delay processing	1	0 to 7	Displays the current DO status value. After it is converted into binary data, every bit corresponds to one DO signal. The value 1 indicates that the input is high level. The value 0 indicates that the input is low level. The relation between every bit and input terminals is as follows: 
U0-18	RO status after positive and negative logic processing	1	0 to 7	Displays the input status value after positive and negative logic judgment on the DO value in U0-17.
U0-20	Power-on time since last power-on (h)	1h	0 to 65535	Displays the running hours of the power supply unit from power-on to now since last power-on.
U0-21	Power-on time since last power-on (min)	1 min	0 to 59	Displays the running minutes of the power supply unit from power-on to now since last power-on.
U0-22	Power-on time since last power-on (s)	1	0 to 59	Displays the running seconds of the power supply unit from power-on to now fsince last power-on.
U0-23	Power-on time since last power-on (ms)	1	0 to 999	Displays the running milliseconds of the power supply unit from power-on to now since last power-on.
U0-24	Command word for fan control	1	0 to 1	0: The fan stops running. 1: The fan always runs.
U0-25	Command word for braking unit control	1	0 to 1	0: The braking transistor is turned off. 1: The braking transistor is turned on.
U0-27	Command word for interaction between the power supply and drive units	1	1 to 3	1: Run 2: Coast to stop 3: Stop by a setting method
U0-30	Total power-on time (h)	1	0 to 65535	Displays the running hours of the power supply unit from the first power-on to now.
U0-31	Total power-on time (min)	1	0 to 59	Displays the running minutes of the power supply unit from the first power-on to now.
U0-32	Total power-on time (s)	1	0 to 59	Displays the running seconds of the power supply unit from the first power-on to now.
U0-33	Total power-on time (ms)	1	0 to 999	Displays the running milliseconds of the power supply unit from the first power-on to now.

8 Process Application

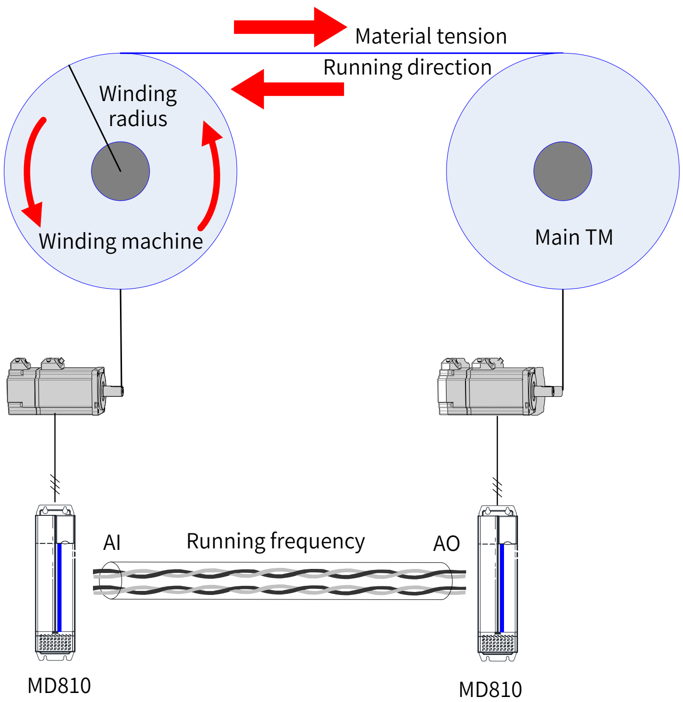
This chapter mainly describes four common process functions, namely, tension control, wobble control, fixed length control, and counting.

8.1 Tension Control

This section mainly describes four tension control modes, including open-loop torque control, closed-loop speed control, closed-loop torque control, and constant linear speed control (corresponding to the section of B0-00, Tension control mode).

1) Open-loop torque control

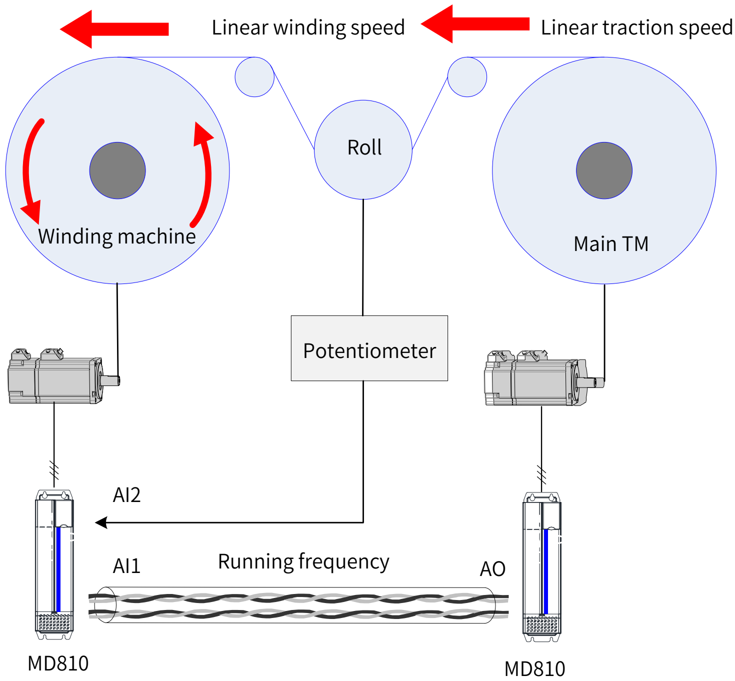
Characteristics: No pendulum (dancer roll) or tension sensor is required, no closed tension loop is formed, and the tension is less accurate. This mode is applicable to the scenarios where high tension accuracy is not required.



When the winding machine works in the open-loop torque control mode, the winding diameter is calculated based on linear speed control, and the output torque is calculated based on the requirements on material tension. Inertia and friction compensation can be selected, depending on the system status.

2) Closed-loop speed control

Characteristics: A pendulum (dancer roll) or tension sensor is used to feed back material tension. The output frequency of the drive is regulated in the closed-loop mode to ensure stable pendulum position or constant tension. This mode is applicable to the scenarios where a pendulum or tension sensor is used (the impact of speed change on tension is slow) and speed regulation allowance is considered.

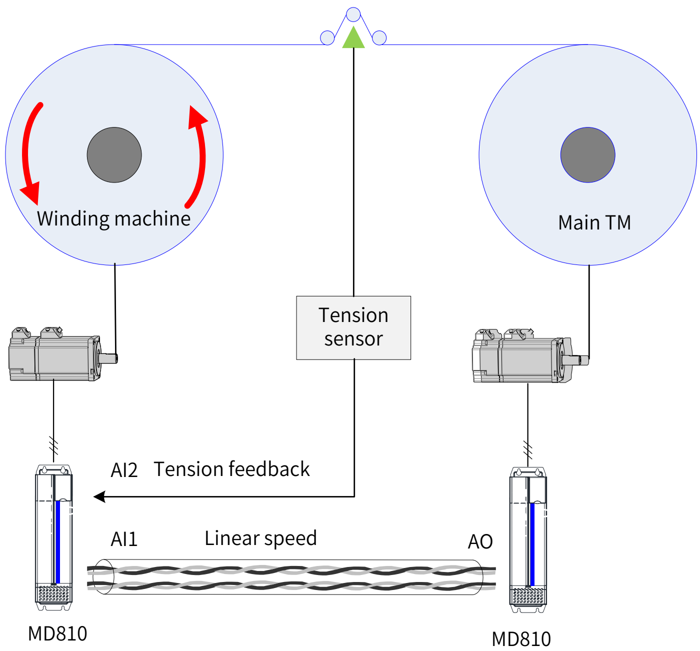


When the winding machine works in the closed-loop speed control mode, the two AI signal channels respectively receive pendulum position potentiometer signals and main traction motor (TM) frequency signals. The winding diameter is calculated based on linear speed control. The output frequency depends on the main frequency calculated based on linear speed control and the closed-loop control based on pendulum position feedback.

Compared with the main frequency + PID mode for the general drives, due to winding diameter calculation, the main frequency reference follows the change in linear speed more accurately. The pendulum position is also more stable.

3) Closed-loop torque control

Characteristics: A tension sensor is used to feed back material tension. The output torque of the drive is controlled in the closed-loop mode to ensure constant torque. This mode integrates mode 1 (open-loop torque control mode). Higher tension accuracy is realized by combining open-loop tension calculation and closed-loop tension control. This mode is applicable to the scenarios where elastic materials with high rigidity are used or speed regulation allowance is not considered.

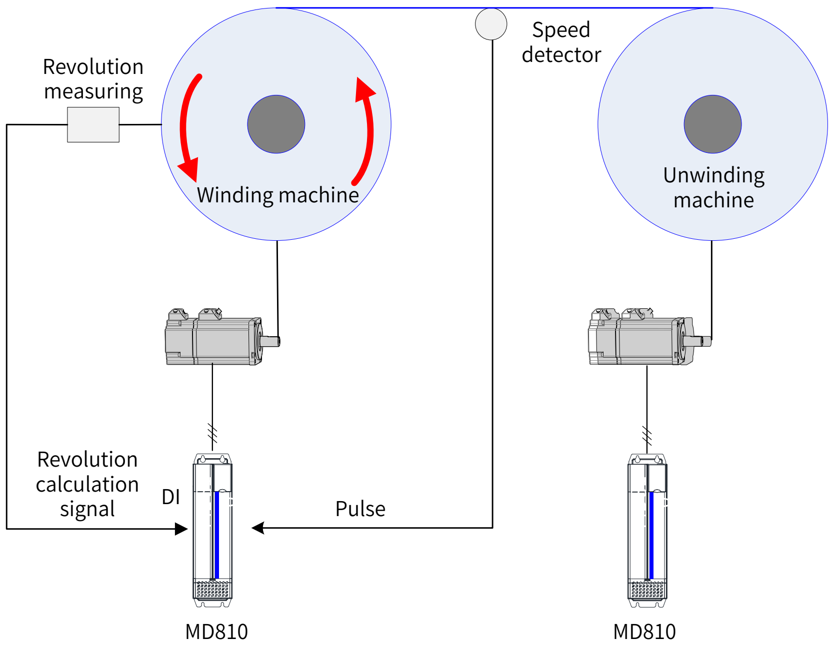


When the winding machine works in the closed-loop torque control mode, the two AI signal channels respectively receive tension sensor signals and main TM frequency signals. This mode combines open-loop tension control and closed-loop control using a tension sensor. The winding diameter calculation in the open-loop tension control mode is also performed. Inertia and friction compensation can be ignored due to combination of closed-loop control, or selected to increase the response speed.

When a tension sensor is used for elastic materials with speed regulation allowance, mode 2 (closed-loop speed control mode) can also be used to prevent elastic oscillation.

4) Constant linear speed control

Characteristics: This mode is applicable to the scenarios without main TMs. One winding/unwinding machine works in the constant linear speed control mode and is also used for traction.



The winding machine is concurrently used as a main TM. To keep the material running at a constant linear speed, the winding diameter must be calculated. Two practical methods are shown in the above figure: 1) calculate the winding diameter by accumulative thickness based on the loop revolution signals from the DI terminal; 2) calculate the winding diameter based on linear speed by providing a speed detector on the material and sending the speed to the drive by pulses or other means. You only need to select one of the two methods or an alternative method. Calculate the frequency value according to the linear speed and winding diameter. Then, control the material to run at a constant linear speed without the main TM. Depending on the actual conditions, the unwinding machine can run in any of the preceding three tension control modes.

NOTE

◆ The above typical applications are only given to describe the applicable scenarios of the four tension control modes. Other modes may be selected based on the actual conditions if the basic requirements are met.

The preceding parts describe the typical applications of the four tension control modes. Their realization mainly depends on the winding diameter, linear speed, and control feedback, as listed in the following table:

Table 7-1 Required conditions for tension control modes of MD810

Function/Limitation	Winding Diameter[1]	Linear Speed	Control Feedback
Open-loop torque control	Required	Not required[2]	Not required
Closed-loop speed control	Required	Required	Required

Function/Limitation	Winding Diameter[1]	Linear Speed	Control Feedback
Closed-loop torque control	Required	Not required	Required
Constant linear speed control	Required	Not required	Not required

[1] If the winding diameter is calculated based on linear speed control (B0-07 = 0), the linear speed is required.
[2] Inertia and friction compensation is associated with linear speed, so the linear speed is required when control accuracy is considered in the open-loop torque control mode.

8.1.1 Control Mode Selection

You need to select a proper tension control mode and determine the winding mode according to the actual conditions. Correct running direction setting ensures proper tension control functions.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-00	Tension control mode	0	0 to 4	0: Disabled 1: Open-loop tension torque control 2: Closed-loop tension speed control 3: Closed-loop tension torque control 4: Constant linear speed control

Set B0-00 (Tension control mode) to select a tension control mode.

0: Disabled

Similar to the function for general drives, this mode can be enabled to perform basic operations such as direction determination and motor auto-tuning.

1: Open-loop torque control

Tension/position detection and feedback are not required. In torque control, the drive controls the output torque and material tension. FVC is recommended to achieve the desired control effect.

2: Closed-loop speed control

Tension/position detection and feedback are required. In speed control, the drive superposes PID closed-loop calculation according to the main frequency calculated based on the linear speed and winding diameter. In this way, it controls the output frequency to realize the tension reference or position stability. SVC, V/F control, or FVC can be selected.

3: Closed-loop torque control

Tension detection and feedback are required. In torque control, the drive superposes PID closed-loop calculation according to the open-loop torque reference. In this way, it controls the output torque to realize the tension reference. FVC is recommended to achieve the desired control effect.

4: Constant linear speed control

In speed control, the drive adjusts its running frequency according to the change in winding diameter to ensure constant linear speed of the system. SVC, V/F control, or FVC can be selected.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-01	Winding mode	0	0 to 1	0: Winding 1: Unwinding

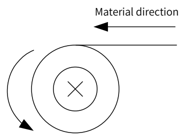
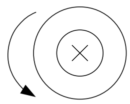
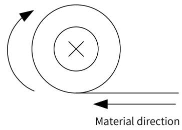
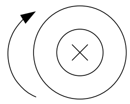
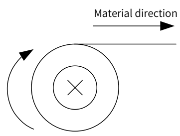
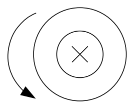
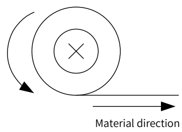
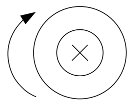
This parameter is set together with DI terminal function 58 (winding/unwinding switchover terminal) to determine the winding mode. When the winding/unwinding switchover terminal is disabled, the winding mode setting is the same as the parameter setting. When the winding/unwinding switchover terminal is enabled, the winding mode setting is opposite to the parameter setting.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
F0-09	Running direction	0	0 to 1	0: Run in the same direction 1: Run in the reverse direction

Set F0-09 (Running direction) to ensure that the motor running direction meets the winding/unwinding requirements.

■ Direction commissioning for first running:

Disable the tension control mode (B0-00 = 0). In speed control, the running direction is as shown in the following table:

	Running Direction in Load Condition	Running Direction in No-load Condition (Speed Control)
Winding		
		
Unwinding		
		

NOTE

◆ When the device is running for the first time, you need to determine the running direction and set the parameter properly. When the switchover between winding and unwinding is required, modify B0-01 (Winding mode) directly, or change the state of the winding/unwinding switchover terminal without modifying B0-01 (otherwise, it will cause malfunction).

8.1.2 Winding Diameter Calculation

Winding diameter is required in all tension control modes. Select a proper winding diameter calculation method and set the related parameters correctly to ensure accuracy of the winding diameter calculation. Otherwise, the tension control function will be abnormal.

■ Parameter for selection of winding diameter calculation methods:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-07	Winding diameter calculation method	0	0 to 6	0: Calculated based on linear speed 1: Calculated based on accumulative thickness 2: AI1 3: AI2 5: Pulse input (DIO1) 6: Communication setting (1000H)

0: Calculated based on linear speed

This calculation method is independent of material thickness. The linear speed and running frequency are calculated in real time, so the error is not accumulated.

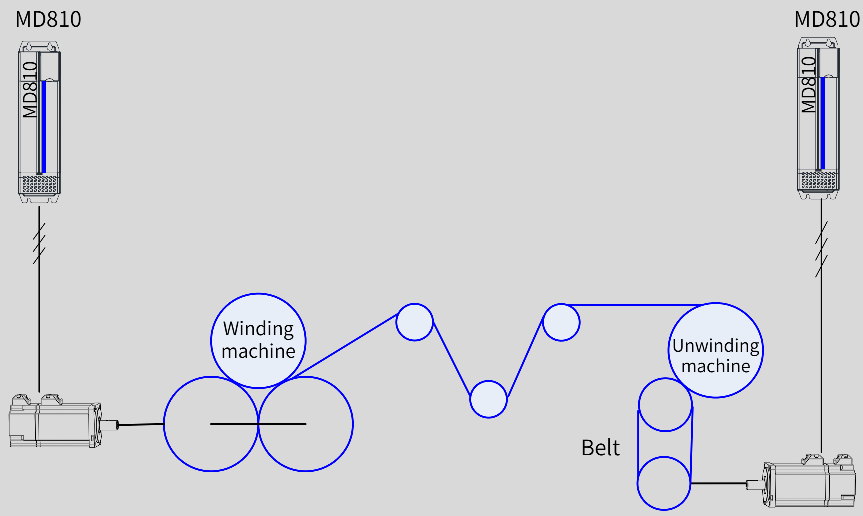
The following conditions must be met for the application:

Linear speed: See "8.1.3 Linear Speed".

Mechanical transmission ratio: B0-03

NOTE

◆ This calculation method is applicable to central winding/unwinding but not to surface winding/unwinding. The following is a typical surface winding/unwinding diagram. The drive shaft is not coaxial with the winding/winding shaft, so the winding diameter cannot be calculated based on linear speed.



1: Calculated based on accumulative thickness

This calculation method does not require linear speed. The winding diameter is calculated based on the accumulative material thickness and revolution calculation signals. The calculation result is stable, but the error is accumulated.

The following must be set for the application:

Material thickness: B0-31 (Setting channel of material thickness) to B0-36 (Maximum thickness)

Revolution calculation signal source: DI terminal function 61 (revolution calculation signal)

Operation mapping: B0-29 (Number of pulses per revolution) and B0-30 (Revolutions per layer, for wire rods)

2: AI1

3: AI2

5: Pulse input (DIO1)

6: Communication setting (1000H)

The winding diameter can be obtained by the calculation methods from 2 to 6. This includes the cases where the winding diameter is directly measured by using a sensor or calculated outside the drive.

When the preceding calculation methods are used, B0-08 (Maximum winding diameter) must be set correctly based on the per-unit mapping. When AI1 is enabled (B0-07 = 2), 100.0% AI1 input must correspond to B0-08 (Maximum winding diameter).

■ Parameters for initial winding diameter:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-08	Maximum winding diameter	500.0 mm	0.1 mm to 6000.0 mm	Corresponds to the actual full winding diameter

In the tension control mode, this parameter has the following functions:

1) Upper limit for winding diameter calculation;
2) Calibration of winding diameter related values (see B0-07 and B0-10);
3) Optional unwinding diameter reset value (see B0-10).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-09	Reel diameter	100.0 mm	0.1 mm to 6000.0 mm	Corresponds to the actual reel diameter.

In the tension control mode, this parameter has the following functions:

1) Lower limit for winding diameter calculation;
2) Optional winding diameter reset value (see B0-10).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-10	Setting channel of initial winding diameter	0	0 to 4	0: Digital setting 1: AI1 2: AI2 4: Communication setting (1000H)

When the system is shut down due to reel replacement, running faults, or other reasons, the winding diameter value often changes. To ensure accurate winding diameter during startup of the system, the winding diameter must be reset by enabling DI terminal function 54 (winding diameter reset).

Set B0-10 (Setting channel of initial winding diameter) to select an input channel of the initial winding diameter.

0: Digital setting

When B0-10 (Setting channel of initial winding diameter) is set to 0, the setting channel of initial winding diameter is affected by DI terminal functions 55 and 56 (initial winding diameter selection terminals) and the winding mode (winding/unwinding).

Example:

When B0-10 (Setting channel of initial winding diameter) is set to 0, set DI1 to DI terminal function 55 and DI2 to DI terminal function 56. Then, the mapping for the setting channel of initial winding diameter is as shown in the following table:

DI2	DI1	Setting channel of initial winding diameter
0	0	B0-09 (winding) or B0-08 (unwinding)
0	1	B0-11
1	0	B0-12
1	1	B0-13

By default, the setting channel of initial winding diameter is set to B0-08 (Maximum winding diameter) or B0-09 (Reel diameter) based on the winding mode.

1: AI1

2: AI2

4: Communication setting (1000H)

The initial winding diameter can be obtained by the calculation methods from 1 to 4. When the preceding calculation methods are used, B0-08 (Maximum winding diameter) must be set correctly based on the per-unit mapping.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-11	Initial winding diameter 1	100.0 mm	0.1 mm to 6000.0 mm	See B0-10.
B0-12	Initial winding diameter 2	100.0 mm	0.1 mm to 6000.0 mm	
B0-13	Initial winding diameter 3	100.0 mm	0.1 mm to 6000.0 mm	

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-14	Current winding diameter	---	0.1 mm to 6000.0 mm	Displays the current winding diameter in real time.

Set B0-14 to modify the current winding diameter. The winding diameter calculation result will overwrite this parameter. This method can be used to reset the winding diameter.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-18	Winding diameter reset during running	0 to 1	0	0: Disabled 1: Enabled

Set B0-18 to enable winding diameter reset during running.

- Parameters for winding diameter calculation based on linear speed (they affect winding diameter calculation only when B0-07 is set to 0)

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-03	Mechanical transmission ratio	1.00	0.01 to 300.00	It is the ratio of motor speed to reel speed. Set B0-03 based on the mechanical transmission structure.

When the winding diameter is calculated based on linear speed (B0-07 = 0), the larger the value of B0-03, the larger the winding diameter, and vice versa. According to this rule, the parameter can be corrected according to the difference between the calculated winding diameter and the actual value.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-06	Minimum linear speed for winding diameter calculation	20.0 m/min	0.1 m/min to 6500.0 m/min	Enabled only when B0-07 is set to 0

When the linear speed is smaller than the value of B0-06, the current winding diameter is maintained. When the linear speed is higher than the value of B0-06, winding diameter calculation is performed.

Set this parameter properly in the scenarios where the running frequency is low or winding calculation is inaccurate during acceleration.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-15	Winding diameter filter time	5.00s	0.00s to 10.00s	Enabled only when B0-07 is set to 0

Set B0-15 to filter the winding diameter calculation results and suppress winding diameter jitter.

The larger the value of B0-15, the smoother the calculated winding diameter and the longer delay in the winding diameter change.

Rule: When the winding diameter changes linearly, the time taken for a real-time winding diameter change is basically equal to the value of B0-15.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-16	Winding diameter change rate	0	0: Disabled 0.1 mm/s to 1000.00 mm/s	Enabled only when B0-07 is set to 0

Set B0-16 to a non-zero value to limit the change of winding diameter per unit time and prevent fast change under abnormal conditions. If the winding diameter change rate is too small, the delay in winding diameter calculation is large. Set the change rate properly according to the actual conditions.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-17	Winding diameter change direction limit	0	0 to 1	0: Disabled 1: Decrease inhibited during winding, and increase inhibited during unwinding Enabled only when B0-07 is set to 0

Set B0-17 to limit the winding diameter change direction. Use this function only when B0-16 (Winding diameter change rate) is set properly; otherwise, abnormal winding diameter fluctuation may occur and result in a large deviation of the winding diameter calculation result.

■ Parameters for winding diameter calculation based on accumulative thickness (they affect winding diameter calculation only when B0-07 is set to 1)

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-29	Number of pulses per revolution	1	1 to 60000	Indicates the number of pulses per revolution of the reel.
B0-30	Revolutions per layer	1	1 to 10000	Indicates the number of revolutions for each layer of winded materials, generally used for wire rods.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-31	Setting channel of material thickness	0	0 to 2	0: Digital setting 1: AI1 2: AI2

Set B0-31 to select a setting channel of material thickness.

0: Digital setting

When B0-31 is set to 0, the material thickness is affected by DI terminal functions 62 and 63 (material thickness selection terminals).

Example: When B0-31 is set to 0, set DI1 to DI terminal function 62 and DI2 to DI terminal function 63. Then, the mapping for material thickness is as shown in the following table:

DI2	DI1	Setting channel of initial winding diameter
0	0	Depends on B0-32 (Material thickness 0).
0	1	Depends on B0-33 (Material thickness 1).
1	0	Depends on B0-34 (Material thickness 2).
1	1	Depends on B0-35 (Material thickness 3).

1: AI1

2: AI2

The initial winding diameter can be obtained by the calculation methods from 1 to 3. When the preceding calculation methods are used, the maximum material thickness (B0-36) must be set correctly based on the per-unit mapping.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-32	Material thickness 0	0.01 mm	0.00 mm to 100.00 mm	See B0-31.
B0-33	Material thickness 1	0.01 mm	0.00 mm to 100.00 mm	
B0-34	Material thickness 2	0.01 mm	0.00 mm to 100.00 mm	
B0-35	Material thickness 3	0.01 mm	0.00 mm to 100.00 mm	
B0-36	Maximum thickness	1.00 mm	0.00 mm to 100.00 mm	

8.1.3 Linear Speed

In the closed-loop speed control mode, the winding synchronization frequency reference must be calculated based on linear speed. Linear speed is required for winding diameter calculation method based on linear speed. It can also be used for pre-drive, inertia compensation, friction compensation, and other functions. Therefore, linear speed is important for tension control.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-04	Line speed setting channel	0	0 to 6	0: No input 1: AI1 2: AI2 4: Pulse input 5: Communication setting (1000H) 6: Communication setting (731AH)

0: No input

1 to 5: When any of the preceding channels are selected, B0-05 (Maximum linear speed) must be set properly based on per-unit mapping.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-05	Maximum linear speed	1000.0 m/min	0.0 m/min to 6500.0 m/min	Sets the maximum linear speed.

B0-05 corresponds to the actual linear speed when B0-04 (Line speed setting channel) is set to 1, 2, 3, 4, or 5 (100.0% input). The maximum linear speed is not necessarily the same as the that required for production. Identify them clearly when you set the two parameters.

When the winding diameter is calculated based on linear speed (B0-07 = 0), the larger the value of B0-03 (Mechanical transmission ratio), the larger the winding diameter, and vice versa. According to this rule, the parameter can be corrected according to the difference between the calculated winding diameter and the actual value.

8.1.4 Tension Setting

In the open-loop torque control mode (B0-00 = 1) and closed-loop torque control mode (B0-00 = 3), tension control is performed by controlling the output torque. Therefore, in the two modes the target tension must be set based on the material characteristics and production requirements.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-00	Tension setting channel	0	0 to 5	0: Set by B1-01 1: AI1 2: AI2 3: Reserved 4: Pulse input 5: Communication setting (1000H)

0: B1-01 (digital setting)

1 to 5: All the above channel inputs refer to the percentage of the target tension to the maximum tension (B1-02). This parameter must be set properly based on the machine condition.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-01	Tension digital setting	50 N	0 N to 65000 N	See B1-00 (B1-00 = 0).
B1-02	Maximum tension	200 N	0 N to 65000 N	Set B1-02 to select the maximum tension. When B1-00 is set to 1, 2, 3, 4 or 5, B1-02 corresponds to the tension when the input value becomes 100%. When the actual tension does not meet requirements, modify B1-02 to correct the tension without changing AI, pulse input signals, or curves.

8.1.5 PID Closed-loop Control

In the closed-loop speed control mode (B0-00 = 2) and closed-loop torque control mode (B0-00 = 3), PID closed-loop control based on the open-loop reference is important to ensure control accuracy. Therefore, the parameters for PID closed-loop control must be set properly.

When B0-00 (Tension control mode) is set to 2 (Closed-loop tension speed control) or 3 (Closed-loop tension torque control), the Group FA parameters required for closed-loop control, such as PID setting channel, PID feedback channel, PID direction, and PID proportional and integral parameters, must be set properly according to the actual conditions.

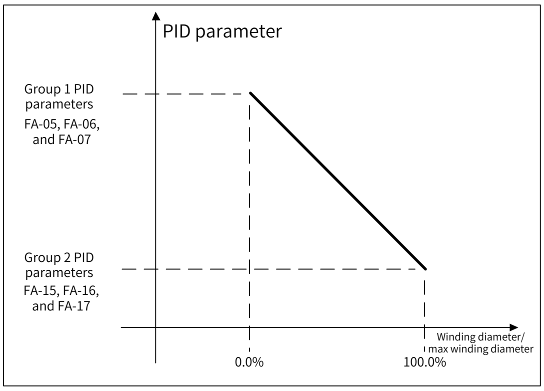
Only the different PID parameters are described here. For details of standard parameters, see descriptions of Group FA parameters.

The PID parameter switchover function based on winding diameter is added for the tension control mode.

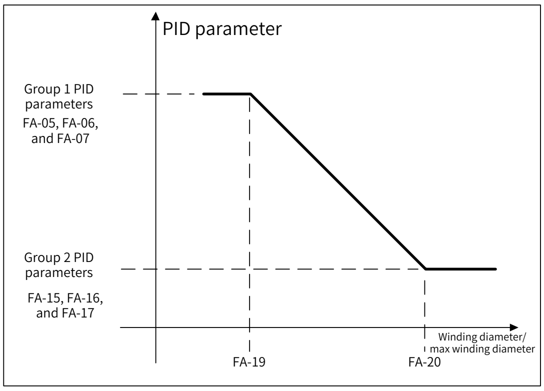
Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FA-18	PID parameter switchover condition	0	6 to 7	6: Auto adjustment based on winding diameter 7: Auto adjustment based on percentage of maximum winding diameter

6: The first group of PID parameters are used under no-load conditions. The second group of PID parameters are used under full-load conditions. The PID parameters change linearly under partial-load conditions.

7: The first group of PID parameters are used under no-load conditions. The second group of PID parameters are used under full-load conditions. The PID parameters change linearly to some extent, which is determined by FA-19 (PID deviation 1 for auto switchover) and FA-20 (PID deviation 2 for auto switchover), under partial-load conditions. See the following figure.



6: Auto adjustment based on winding diameter (1)



7: Auto adjustment based on winding diameter (2)

8.1.6 Frequency and Torque Limit

In different modes, set the related parameters properly when frequency, torque, and other control values need to be limited. This can prevent runaway speed and interruption, and realize closed-loop control limit, reverse tightening, and other functions.

■ Parameters for frequency limit in the tension control mode

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-02	Unwinding reverse tightening selection	0	0: Disabled 0.1 m/min to 6500.0 m/min	Sets the action of the unwinding machine at zero material speed in the tension control mode.

When B0-02 is set to 0, the unwinding reel becomes inactive, and the material is not tightened at zero material speed.

When B0-02 is set to a value in the range of 0.1 m/min to 6500.0 m/min: If there is no load, or the material is in loose state, the unwinding reel runs at the set linear speed in the reverse direction; if the material speed is zero, the unwinding reel remains active, and the material is tightened.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-28	Winding frequency limit selection	0	0: Disabled (only limited by F0-10, Maximum frequency) 1: Limit by B0-26 and B0-27	By default (B0-28 = 0), the winding frequency upper limit is disabled. To prevent interruption and runaway speed, set B0-28 to 1 to enable the winding tension upper limit.
B0-26	Winding frequency limit	50.0%	0.0% to 100.0%	
B0-27	Winding frequency limit offset	5.00%	0.0% to 100.0%	

When B0-28 is set to 1, the winding frequency upper limit is obtained using the following formula according to the synchronization frequency (winding machine running frequency that matches the current linear speed) and the maximum frequency (winding machine running frequency that matches the maximum linear speed).

Winding frequency upper limit = Synchronization frequency x (1 + Value of B0-26) + Maximum frequency x Value of B0-27

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-05	Frequency acceleration time in torque control mode	1.0s	0.0s to 6500.0s	Modifies the change rate of frequency upper limit over time
B1-06	Frequency deceleration time in torque control	1.0s	0.0s to 6500.0s	

In the tension control mode, the frequency upper limit affects the motor output. Generally, you do not need to set B1-05 (Frequency acceleration time in torque control mode) or B1-06 (Frequency deceleration time in torque control). In special cases, you may set B1-05 or B1-06 properly according to the required output.

Example

Taking the winding process as an example, tension must be established quickly during startup. Set B1-05 (Frequency acceleration time in torque control mode) to a value less than the TM acceleration time. To prevent loose winding of materials, tension must be held during shutdown. Set B1-06 (Frequency deceleration time in torque control) to a value larger than the TM deceleration time.

For the similar purposes, set the parameters flexibly according to the actual conditions, or control the start and stop timing logic of different motors through PLC.

■ Parameters for closed-loop speed limit:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-28	Closed-loop speed limit selection	0	0 to 1	0: Limited according to B0-26 and B0-27 1: Limited to the fixed frequency set by B0-26
B0-26	Closed-loop speed limit	50.0%	0.0% to 100.0%	
B0-27	Closed-loop speed limit offset	5.00 Hz	0.0 Hz to 100.0 Hz	

To ensure system stability, limit the closed-loop control values when closed-loop control is performed based on open-loop reference. In the closed-loop speed control mode, the control values can be limited according to the synchronization frequency (winding machine running frequency that matches the current linear speed) and the speed limit offset.

B0-28 = 0: The output frequency in the closed-loop control mode can be limited according to the open-loop control frequency and the maximum frequency.

B0-28 = 1: The frequency in the closed-loop control mode is fixed and depends on FA-23 (Maximum deviation between two PID outputs in forward direction).

■ Parameters for closed-loop torque limit:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-16	Closed-loop torque limit	50.0%	0.0% to 100.0%	Limits the percentage of the closed-loop torque control value to the open-loop control torque in the closed-loop torque control mode (B0-00 = 3).
B0-38	Closed-loop torque control mode (main + standby)	1	0: Disabled; 1: Enabled	

8.1.7 Inertia and Friction Compensation

This part is only applicable to the torque control mode. The parameters in this part are set properly to optimize the tension control effect and improve the tension stability or system response speed.

These parameters are recommended for the open-loop torque control mode (B0-00 = 1) and generally skipped for the closed-loop torque control mode (B0-00 = 3).

- Running friction compensation parameters:

When the motor runs stably, the output torque provides material tension and mitigates rotation friction at the same time. If the output torque used to mitigate the rotation friction cannot be ignored, friction compensation is required.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-07	Friction force compensation	0.0%	0.0% to 50.0%	Corresponds to the percentage of rated motor torque.

In the tension control mode, the drive automatically sets the target torque according to the tension setting and winding diameter. The target torque is increased (winding) or decreased (unwinding) according to B1-07 (Friction force compensation) to offset the effect of friction on material tension.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-17	Friction force compensation correction coefficient	0.0%	-50.0% to 50.0%	Corresponds to the percentage of rated motor torque.

In most scenarios, friction may vary depending on the running frequency, winding diameter, and other factors. If the ideal friction compensation effect cannot be achieved by setting B1-07 (Friction force compensation), set B1-17 (Friction force compensation correction coefficient) together. For details, see B1-18 (Friction force compensation curve).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-18	Friction force compensation curve	0	0 to 4	0: Running frequency 1: Linear speed 2: Multi-friction compensation curve 1 3: Multi-friction compensation curve 2 4: Winding diameter

Five friction compensation modes are available to meet the complex friction change rule.

0: Running frequency

In some scenarios, the friction changes with the system running frequency. When B1-18 (Friction force compensation curve) is set to 0, the friction compensation value is determined using the following formula:

Friction compensation torque = Value of B1-07 (Friction force compensation) x (1 + Running frequency/Maximum frequency x Value of B1-17)

1: Linear speed

This mode is similar to mode 0. The friction compensation is based on linear speed, and the friction compensation value is determined using the following formula:

Friction compensation torque = Value of B1-07 (Friction force compensation) x (1 + Linear speed/ Maximum linear speed x Value of B1-17)

2: Multi-friction compensation curve 1

In some scenarios, the friction does not change linearly with the running frequency. The friction compensation correction can be realized based on a multi-friction compensation curve. For details, see B1-19 (Multi-friction force compensation torque 1) to B1-24 (Multi-friction force compensation torque 6).

3: Multi-friction compensation curve 2

Compared with compensation curve 1, compensation curve 2 is more flexible, but more parameters need to be set. For details, see B1-19 (Multi-friction force compensation torque 1) to B1-30 (Multi-friction force compensation inflexion 6).

4: Winding diameter

This mode is similar to mode 0. The friction compensation correction is based on winding diameter, and the friction compensation value is determined using the following formula:

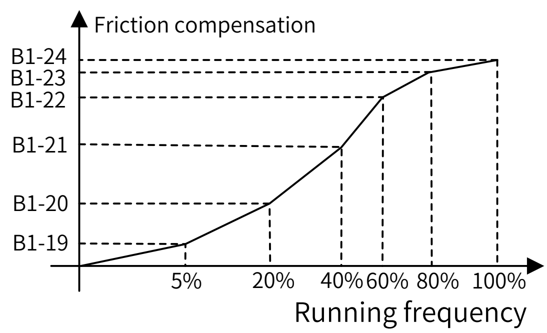
Friction compensation torque = Value of B1-07 (Friction force compensation) x (1 + Current winding diameter/Maximum winding diameter x Value of B1-17)

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-19	Multi-friction force compensation torque 1	0.0%	0.0% to 50.0%	For multi-friction compensation curves 1 and 2
B1-20	Multi-friction force compensation torque 2	0.0%	0.0% to 50.0%	
B1-21	Multi-friction force compensation torque 3	0.0%	0.0% to 50.0%	
B1-22	Multi-friction force compensation torque 4	0.0%	0.0% to 50.0%	
B1-23	Multi-friction force compensation torque 5	0.0%	0.0% to 50.0%	
B1-24	Multi-friction force compensation torque 6	0.0%	0.0% to 50.0%	
B1-25	Multi-friction force compensation inflection 1	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	
B1-26	Multi-friction force compensation inflection 2	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	
B1-27	Multi-friction force compensation inflection 3	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	
B1-28	Multi-friction force compensation inflection 4	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	
B1-29	Multi-friction force compensation inflection 5	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	
B1-30	Multi-friction force compensation inflection 6	0.00 Hz	0.00 Hz to F0-10 (Maximum frequency)	

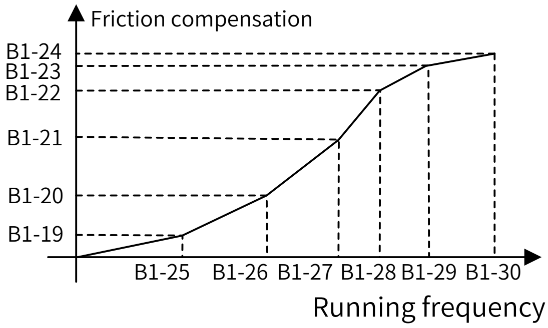
When B1-18 (Friction force compensation curve) is set to 2 (Multi-friction force compensation curve 1), parameters B1-19 to B1-24 are enabled; when B1-18 (Friction force compensation curve) is set to 3 (Multi-friction force compensation curve 2), parameters B1-19 to B1-30 are enabled.

The change curves of friction compensation values are as shown in the following two figures. Set B1-18 (Friction force compensation curve) flexibly according to the actual conditions:

B1-18 = 2, friction compensation curve1:



B1-18 = 3, friction compensation curve2:



■ Startup friction compensation parameters:

In some scenarios, the reel friction is large, which makes the system difficult to start. To solve the problem, torque compensation can be provided during startup. After the system runs normally, the torque compensation needs to be removed to ensure constant tension.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-03	Zero-speed threshold	0.0%	0.0% to 20.0%	When the running frequency is smaller than the value of this parameter, startup friction compensation is enabled based on B1-04. When the running frequency is larger than the value of this parameter, startup friction compensation is disabled.
B1-04	Zero-speed tension rise	0.0%	0.0% to 100.0%	This parameter corresponds to the percentage of tension reference and must be set properly according to the range of allowable material tension. On the premise of ensuring normal startup, the value of this parameter must be kept minimal.

■ Inertia compensation parameters:

In the open-loop torque control mode, the output torque provides material tension and mitigates rotor inertia of the system during acceleration or deceleration.

In any of the following cases, inertia compensation may be required:

1) Small material tension during acceleration of the winding machine

2) Large material tension during deceleration of the winding machine

3) Large material tension during acceleration of the unwinding machine

4) Small material tension during deceleration of the unwinding machine

The inertia of the winding/unwinding system generally consists of mechanical inertia and material inertia. The parameter can be set according to the mapping between mechanical inertia and material inertia. If the material is heavy and the reel is light, only the parameters related to material inertia need to be set, and vice versa.

Note: Accurate linear speed is required for inertia compensation.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-08	Mechanical inertia compensation coefficient	0 N·m^2	0 N · m^2 to 65535 N·m^2	Set this parameter based on the actual mechanical flywheel inertia.

For common cylindrical mechanical reels, the theoretical value of mechanical flywheel inertia can be obtained using the following formula:

$$GD_m^2 = \frac{\pi g}{8i^2}\gamma b\left(D^4 - D_0^4\right)$$

Where, g is g gravitational acceleration, γ γ is the density of mechanical materials, b is the length of the mechanical reel, D and D0 are respectively the outer diameter and inner diameter (0 for a solid reel) of the mechanical reel, and i is the i transmission ratio. The international system of units (SI) is applied.

The setting value is adjusted to mitigate the change of material tension during acceleration or deceleration.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-11	Material density	0 kg/m^3	0 kg/m^3 to 65535 kg/m^3	Set B1-11 and B1-12 based on the material properties. Ensure B0-03 (Mechanical transmission ratio) is set accurately.
B1-12	Material width	0 mm	0 mm to 65535 mm	

The drive automatically calculates the flywheel inertia according to the material density, material width, reel diameter, and material winding diameter.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-09	Correction coefficient of acceleration inertia compensation	100.0%	0.0% to 200.0%	Due to the difference between the theoretical inertia and the actual inertia, the inertia compensation effect may be unsatisfactory after the inertia parameters are set.
B1-10	Correction coefficient of deceleration inertia compensation	100.0%	0.0% to 200.0%	

Set B1-09 and B1-10 to optimize the control effect through minor adjustment. Taking winding acceleration as an example, if the material tension is low, increase the value of B1-09 to improve the compensation effect, and vice versa. Winding deceleration follows the same rule.

This group of parameters facilitate commissioning.

- Torque direction control parameters:

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B1-15	Torque direction control	0	0: Disabled 1: Torque reverse inhibited	Enabled only when B0-00 (Tension control mode) is set to 1 (Open-loop tension torque control) or 3 (Closed-loop tension torque control).

When friction compensation and inertia compensation are added, the calculated torque value is likely to be negative. Set B1-15 to select the solution for reverse torque. Torque direction is not controlled by default. Set B1-15 to 1 to prohibit reverse torque.

8.1.8 Taper

In some scenarios, the tension needs to be reduced with the increase of the winding diameter to ensure smooth winding. For this purpose, set the taper parameters properly. This group of parameters are enabled only in the winding mode (B0-01 = 0).

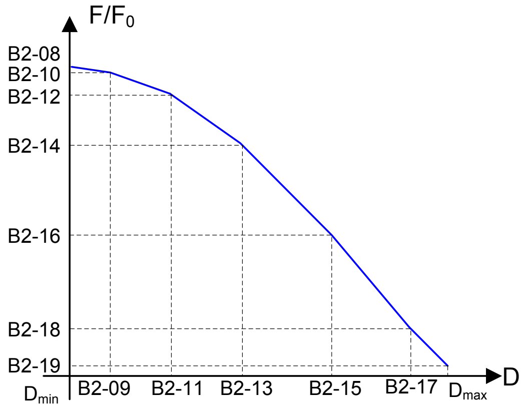
Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B2-00	Taper curve	0	0: Curve 1: Multi-segment	Selects the taper curve generation mode.

0: Curve taper

The taper curve is generated based on the taper setting and B2-03 (Correction coefficient of taper compensation). For details, see B2-03 (Correction coefficient of taper compensation).

1: Multi-segment taper

Draw a tension - winding diameter line chart based on the winding process requirements. This mode provides a maximum of five inflection points and supports a maximum of six segments. The solutions and related parameter settings are as follows:



Parameter No.	Parameter Name	Default	Parameter	Function	Default
B2-08	Taper corresponding to minimum reel diameter	100.0% (default)	B2-14	Taper of switchover point 3	80.0% (default)
B2-09	Linear taper switchover point 1	150.0 mm	B2-15	Linear taper switchover point 4	300.0 mm
B2-10	Taper of switchover point 1	100.0%	B2-16	Taper of switchover point 4	70.0%
B2-11	Linear taper switchover point 2	200.0 mm	B2-17	Linear taper switchover point 5	400.0 mm
B2-12	Taper of switchover point 2	90.0%	B2-18	Taper of switchover point 5	50.0%
B2-13	Linear taper switchover point 3	250.0 mm	B2-19	Taper corresponding to maximum winding diameter	30.0%

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B2-01	Setting channel of tension taper	0	0: Set by B2-02 (Tension taper) 1: AI1 2: AI2	0: Set by B2-02 (digital setting) 1 or 2: Set based on AI1 or AI2
B2-02	Tension taper	0.0%	0.0% to 100.0%	See mode 0 of B2-01.
B2-03	Correction coefficient of taper compensation	0 mm	0 mm to 10000 mm	Correction coefficient of taper compensation

Set the preceding parameters to realize the curve taper based on the taper setting. The taper value can be determined by using the following formula (multiple modes are available and the following is a typical example):

$$F = F_0 \times \{1 - K \times [1 - (D_0 + D_1)/(D + D_1)]\}$$

Where, F is the tension setting after taper; F0 is the tension setting before taper, which is set based on B1-00 (Tension setting channel); K is the taper value, which is set based on B2-01 (Setting channel of tension taper); D0 is B0-09 (Reel diameter); D is B0-14 (Current winding diameter); D1 is B2-03 (Correction coefficient of taper compensation).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B2-05	Setting channel of maximum external taper	0	0: Set by B2-06 (Maximum external taper setting) 1: AI1 2: AI2	0: B2-06 (digital setting) 1 or 2: Set based on AI1 or AI2

In some scenarios, material tension is determined by external actuators. The external taper output function can be used to control the external actuators to realize the tension taper.

The maximum external taper determines FMP or AO (F5-06 to F5-07). For the external taper output (Function 18), the maximum taper output is that obtained under no-load conditions. The setting channel of external taper is set by B2-05.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B2-06	Maximum external taper setting	100.0%	0.0% to 100.0%	Sets the maximum external taper (digital setting). For details, see mode 0 of B2-05 (Setting channel of maximum external taper).

8.1.9 Pre-drive

The pre-drive function is applicable to scenarios such as automatic reel replacement. When a reel is replaced for winding due to full load, the linear speed of the new reel must match that of the material to realize shock-free reel replacement. For this purpose, enable DI terminal function 57 (pre-drive terminal) and set the pre-drive parameters properly.

Accurate linear speed and winding diameter are required for the function.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-19	Pre-drive speed gain	0.0%	-100.0% to +100.0%	For pre-drive, the running frequency is automatically calculated based on the linear speed and winding diameter to ensure matching with the linear speed of the material.

If there is a small deviation of linear speed, set B0-19 to increase or decrease the running frequency during pre-drive, ensuring more accurate linear speed matching.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-20	Pre-drive torque limit source	0	0 to 1	0: Based on F2-09 [Torque limit source in speed control (motoring)] 1: Based on tension control torque

In the torque control mode, the system automatically calculates the target torque to meet the requirements on material tension. In the normal mode, set the target torque based on F2-09. This parameter provides the preceding sources of target torque in the pre-drive mode. Select one according to your needs.

0: Set the target torque based on F2-09 [Torque limit source in speed control (motoring)].

1: Set the target torque based on the open-loop torque control mode (only for mode 1 and mode 3).

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-21	Pre-drive torque correction	0.0%	-100.0% to +100.0%	Enabled when B0-20 is set to 1. Correct the tension control torque in the pre-drive mode.
B0-22	Pre-drive winding diameter calculation delay	0.0s	0.0s to 6500.0s	Enabled only when B0-07 (Winding diameter calculation method) is set to 0 (Calculated based on linear speed).

When the winding diameter is calculated based on winding diameter, set B0-22 (Pre-drive winding diameter calculation delay) to delay the effective time of winding diameter calculation. This prevents inaccurate or unstable winding diameter calculation results within a short time after pre-drive.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-23	Pre-drive acceleration time	1.0s	0.0s to 6500.0s	Modifies the pre-drive frequency acceleration time.
B0-24	Pre-drive deceleration time	1.0s	0.0s to 6500.0s	

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
B0-25	Pre-drive winding diameter calculation function	0	0: Disabled; 1: Enabled	Enabled only when B0-07 (Winding diameter calculation method) is set to 1 (Calculated based on accumulative thickness).

When the winding diameter is calculated based on accumulative thickness, the winding diameter increases or decreases with the number of revolutions. Set B0-25 to 1 to avoid accumulative error caused by invalid winding diameter calculation in the pre-drive mode.

Set this parameter according to the actual operations.

8.1.10 Related I/O Functions

■ DI terminal functions:

DI terminal functions simplify tension control and operations. By setting the related parameters, select various functions.

Select DI terminal functions by setting F4-00 (DI1 function selection) to F4-04 (DIO2 function selection) or through virtual DI terminals. The DI terminal functions for general drives are not further described here.

1) DI terminal function 54: Winding diameter reset

Winding diameter reset during reel replacement is mandatory for tension control. It ensures accurate winding diameter at the moment when the system is started after reel replacement, and also ensures normal system startup and proper material tension.

2) DI terminal functions 55 and 56: Initial winding diameter selection terminals 1 and 2

Provide initial winding diameter switchover modes to meet different requirements for different reels or materials. For details of use, see B0-10 (Setting channel of initial winding diameter).

3) DI terminal function 57: Pre-drive input terminal

After you enable the terminal, the drive is switched to the pre-drive speed control mode. After you disable the terminal upon reel replacement, the tension control function works normally.

4) DI terminal function 58: Winding/unwinding switchover

Winding/unwinding switchover is performed without modifying the parameter, greatly simplifying the operation. For details of use, see B0-01 (Winding mode).

5) DI terminal function 59: Winding diameter calculation disabled

When the terminal is enabled, winding diameter calculation is disabled.

6) DI terminal function 60: Exit tension mode

When the terminal is enabled, the system exits the tension mode, and the drive restores general drive functions (the frequency source and torque source are enabled based on the general drive functions).

7) DI terminal function 61: Revolution calculation signal

When winding diameter is calculated based on accumulative thickness, set DI terminal function 61 to input revolution calculation signals from the terminal.

8) DI terminal functions 62 and 63: Thickness selection terminals 1 and 2

Provide material thickness switchover modes to meet different requirements for materials with different thickness. For details of use, see B0-31 (Setting channel of material thickness).

■ AO/pulse output functions:

In addition to the drive, PLC and actuators also affect the tension control function. The drive outputs the variables related to tension control, providing additional means to realize the tension control function.

Select AO/pulse output functions by setting F5-06 (FMP output function selection) to F5-07 (AO function selection). The terminal functions for general drives are not further described here.

1) Output function 18: External taper output

When tension taper control is required, and the material tension is determined by the external actuator, enable this function to output taper.

2) Output function 19: Winding diameter output

When the winding diameter is calculated in the drive, and the calculation result needs to be output, enable this function to output the result.

3) Output function 20: Tension output

Enable this function to output the tension reference in the drive. The actual valid tension after taper calculation is calibrated based on B1-02 (Maximum tension).

8.1.11 Monitoring Parameters

The available monitoring parameters are listed in the following table:

Parameter No.	Parameter Name	Setting Range	Minimum Unit	Communication Address
U1-00	Linear speed	0.0 m/min to B0-05 (Maximum linear speed)	0.1 m/min	7100H

Parameter No.	Parameter Name	Setting Range	Minimum Unit	Communication Address
U1-01	Current winding diameter	B0-09 (Reel diameter) to B0-08 (Maximum winding diameter)	0.1mm	7101H
U1-02	Winding diameter conversion frequency	0.00 Hz to maximum frequency	0.01 Hz	7102H
U1-03	Tension reference	0 N to B1-02 (Maximum tension)	1 N	7103H
U1-04	Tension setting after taper	0 N to B1-02 (Maximum tension)	1 N	7104H
U1-05	Target torque	0.0% to 200.0%	0.1%	7105H
U1-06	PID output	0.00 Hz to closed-loop limit	0.01 Hz	7106H
U1-07	Acceleration rate	0.0 m/min/s to -	0.1 m/min/s	7107H

It is recommended to compare the monitoring parameters with the results measured with a speed measuring device or tape during commissioning.

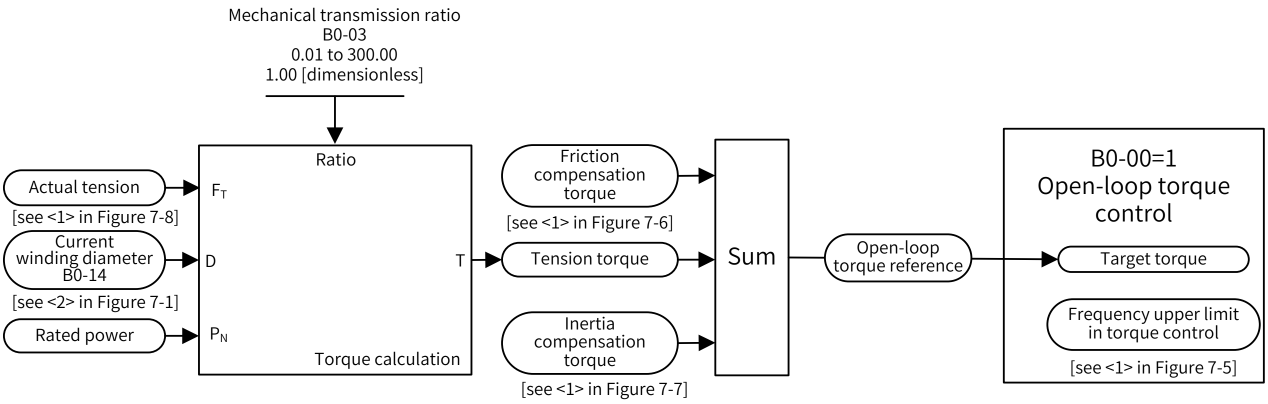
8.1.12 Functional Diagrams

■ General functional block diagrams

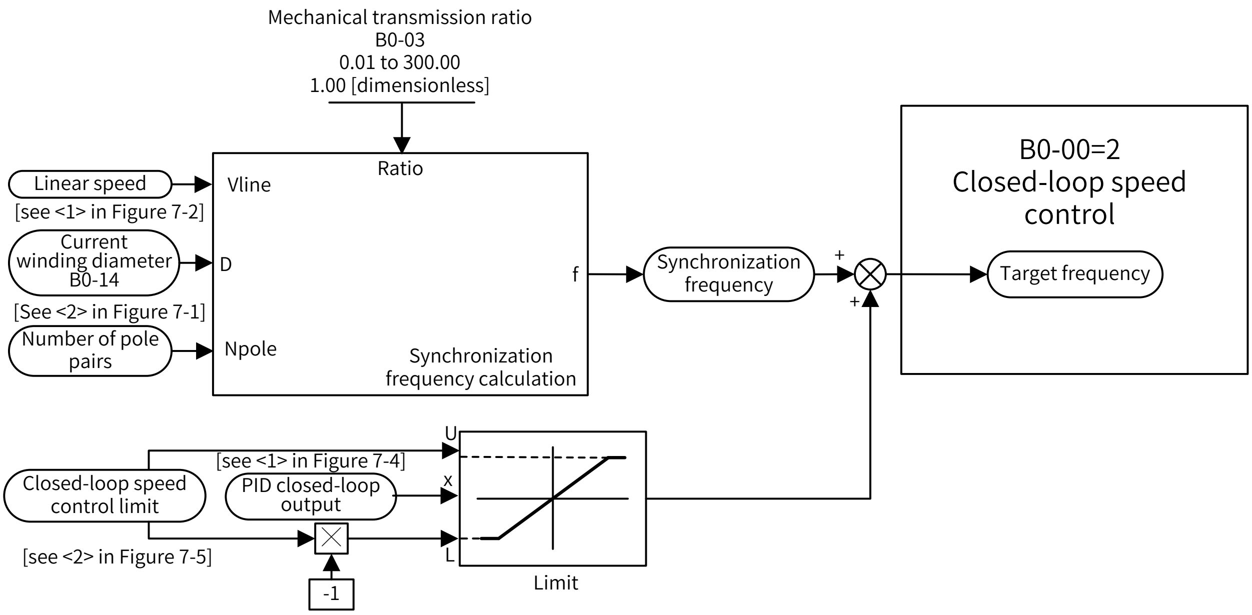
Torque and running frequency are the targets for tension control. To perform tension control, check the data flow direction of torque and running frequency on the general function block diagrams, query related data on the subdiagrams, and see related parameter descriptions.

The value of B0-00 (Tension control mode) determines the tension control mode. Totally four tension control modes are available for the product. The general function block diagrams are as follows:

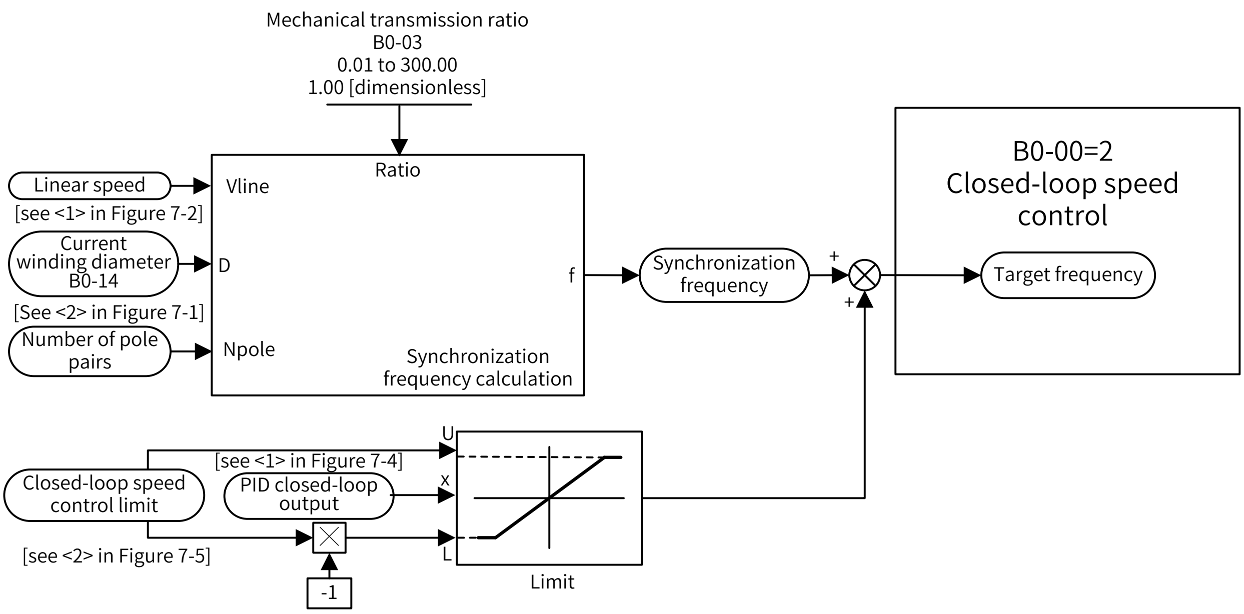
1) B0-00 = 1: Open-loop torque control



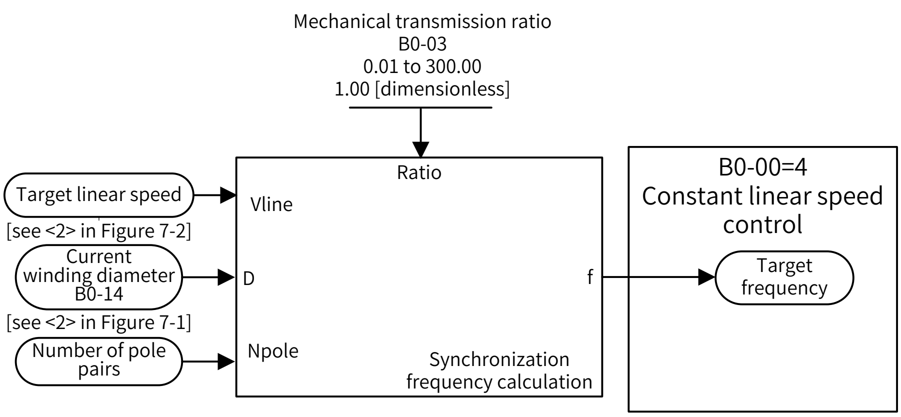
2) B0-00 = 2: Closed-loop speed control



3) B0-00 = 3: Closed-loop torque contr



4) B0-00 = 4: Constant linear speed control



5) Additional functions: For details of external taper and pre-drive output, see "Figure 8-8 Taper function" and "Figure 8-9 Pre-drive function".

- Functional block subdiagrams

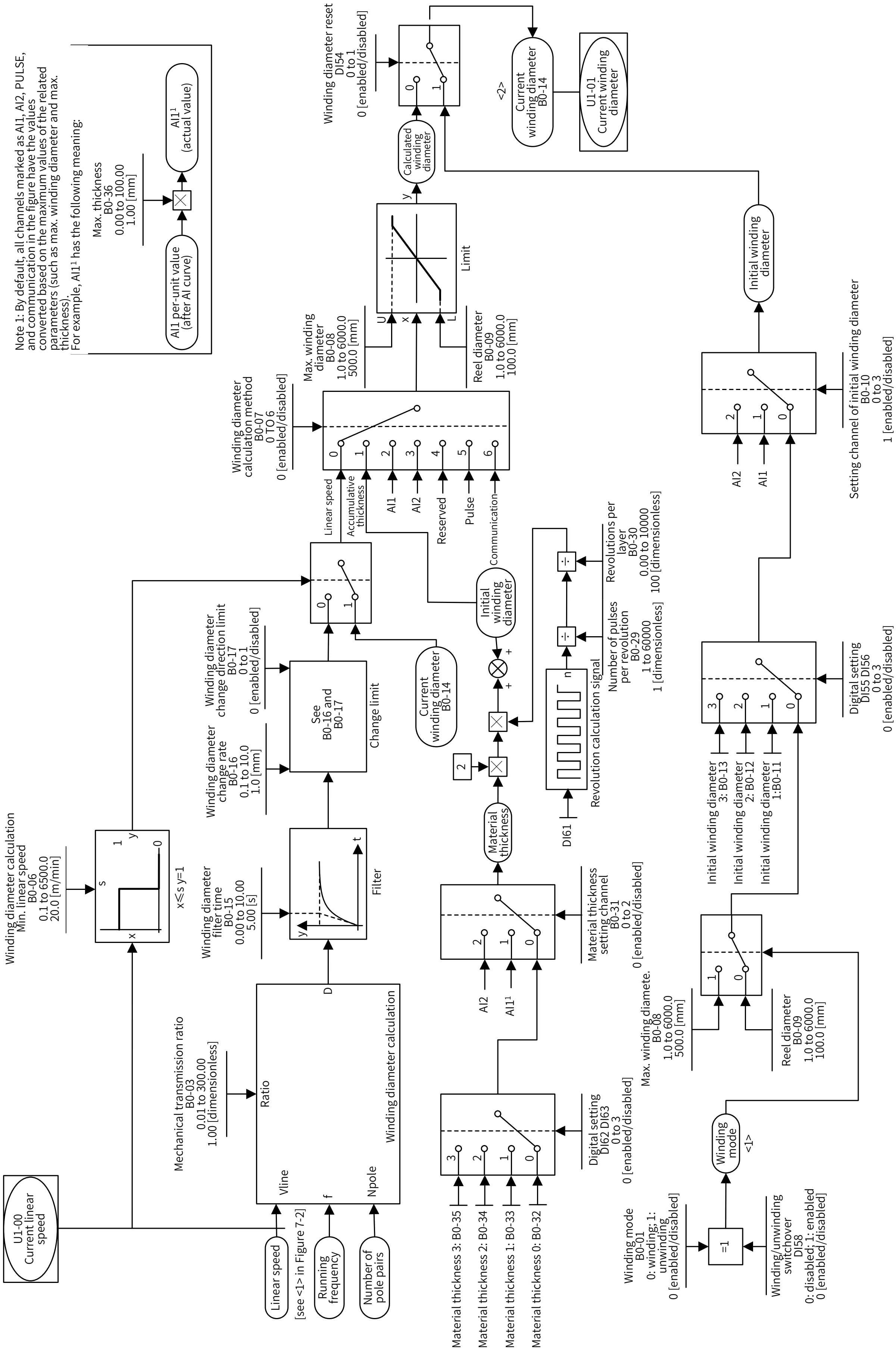
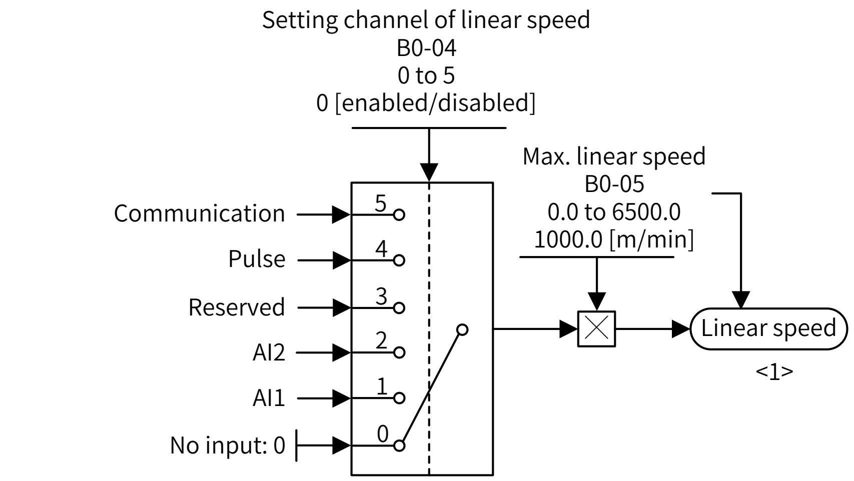


Figure 8-1 Winding diameter calculation



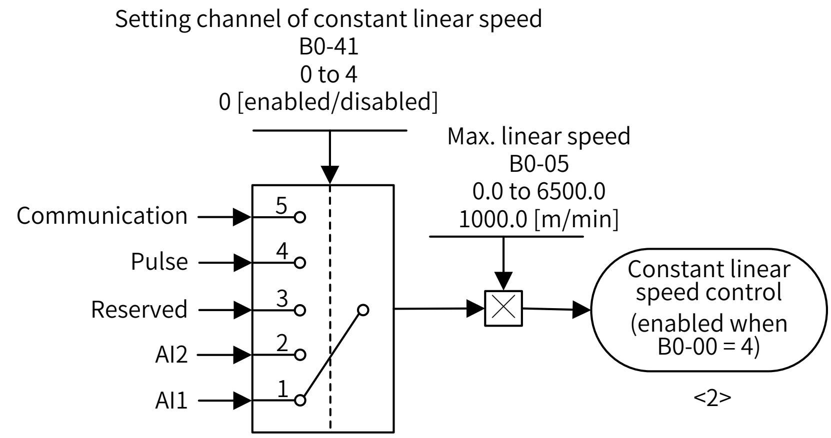


Figure 8-2 Linear speed function

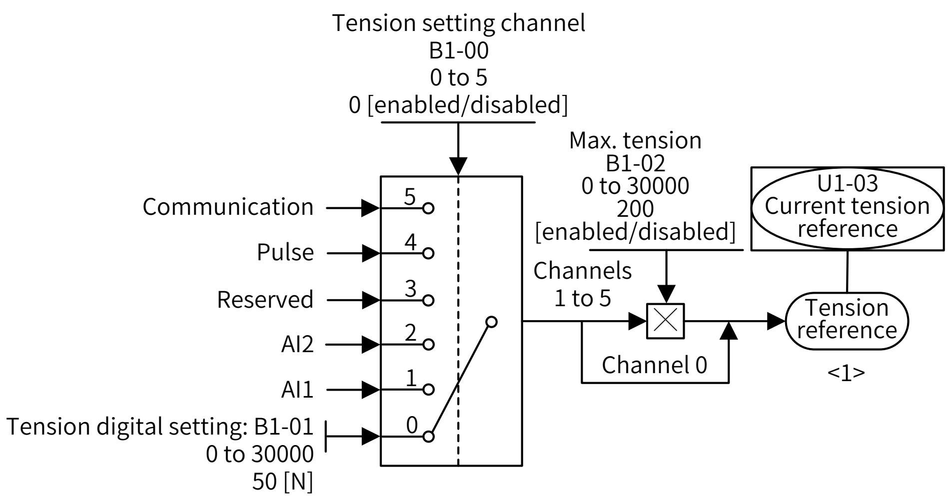


Figure 8-3 Tension reference function

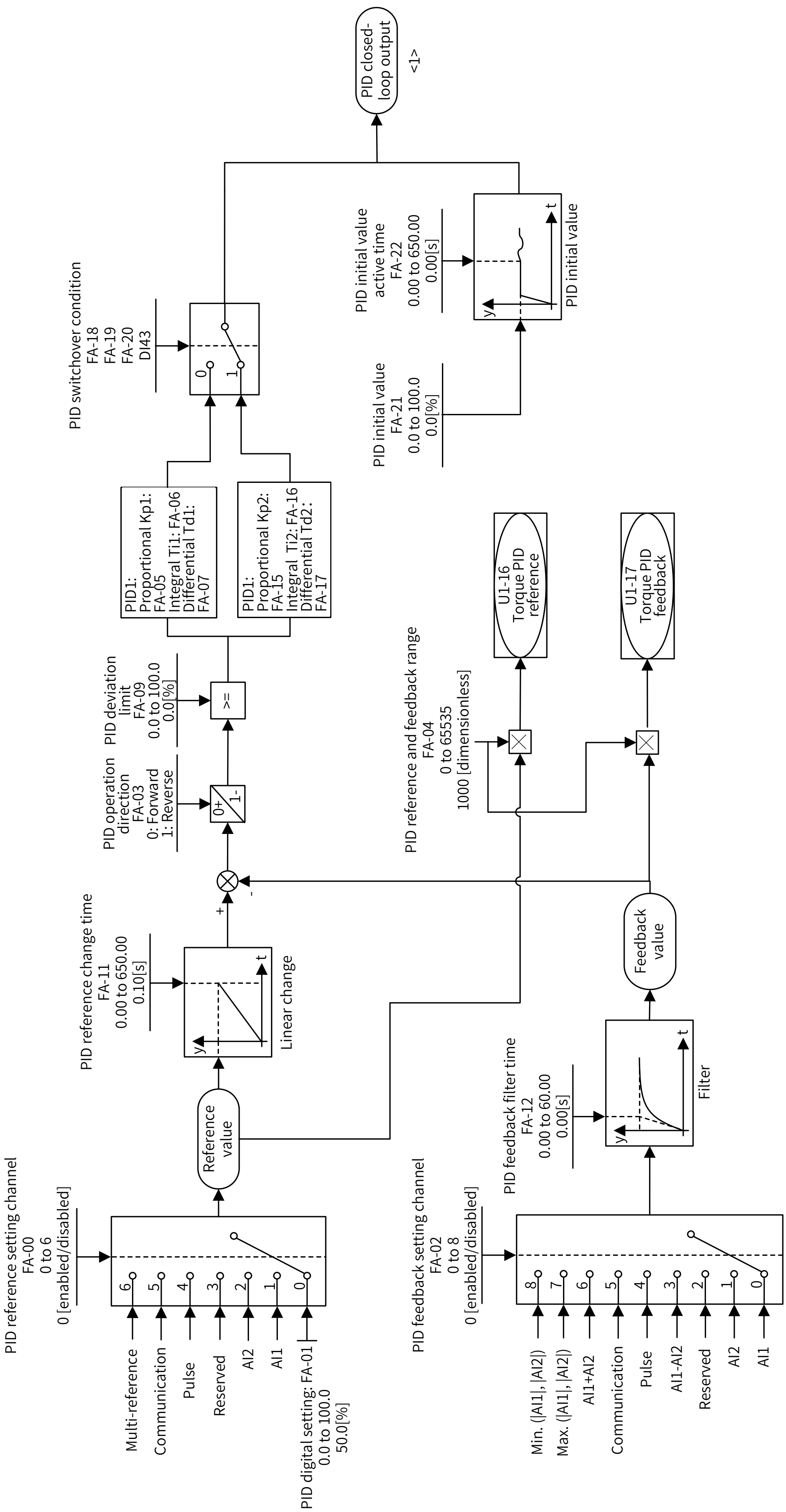


Figure 8-4 PID closed-loop control function

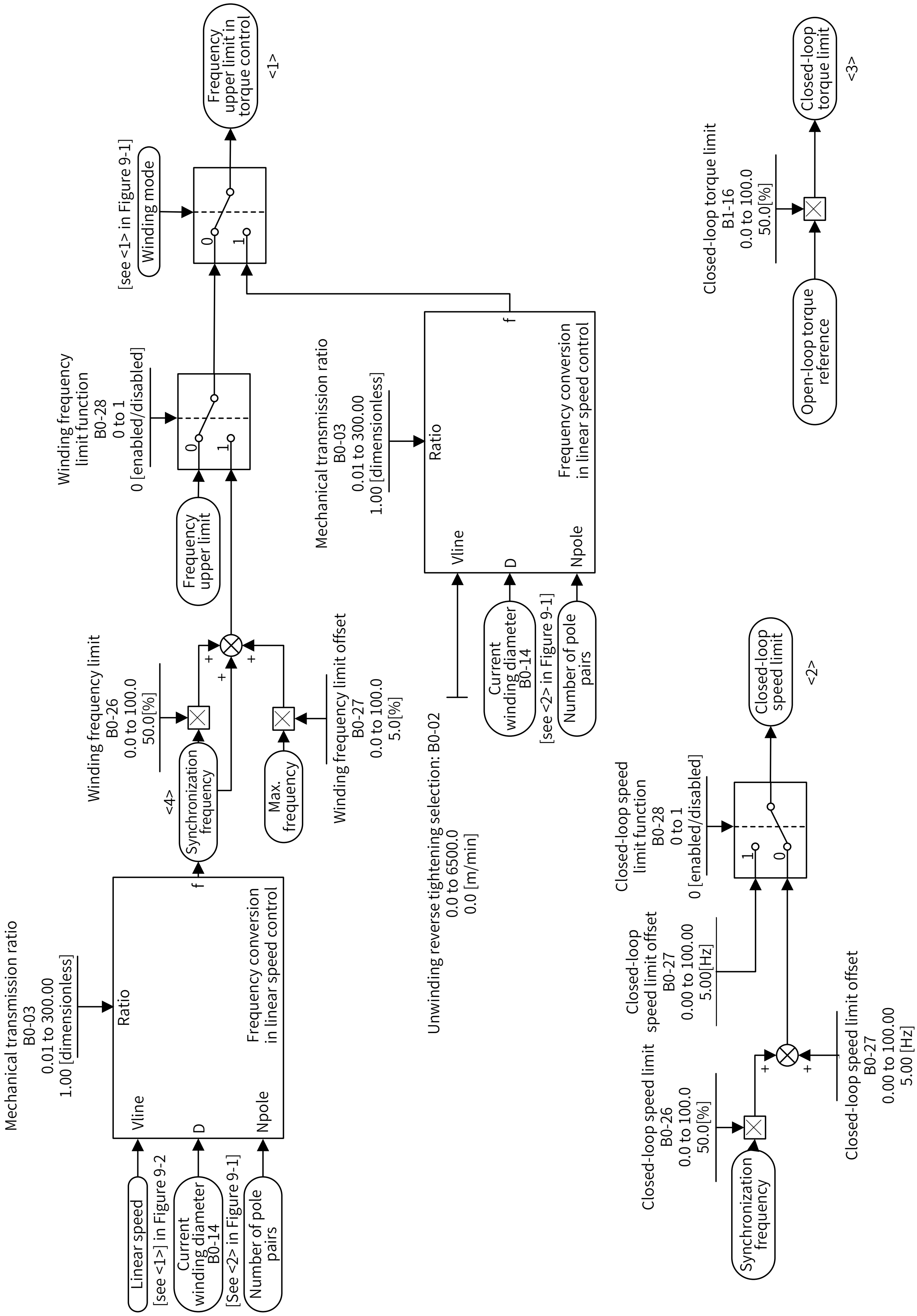


Figure 8-5 Frequency and torque limit function

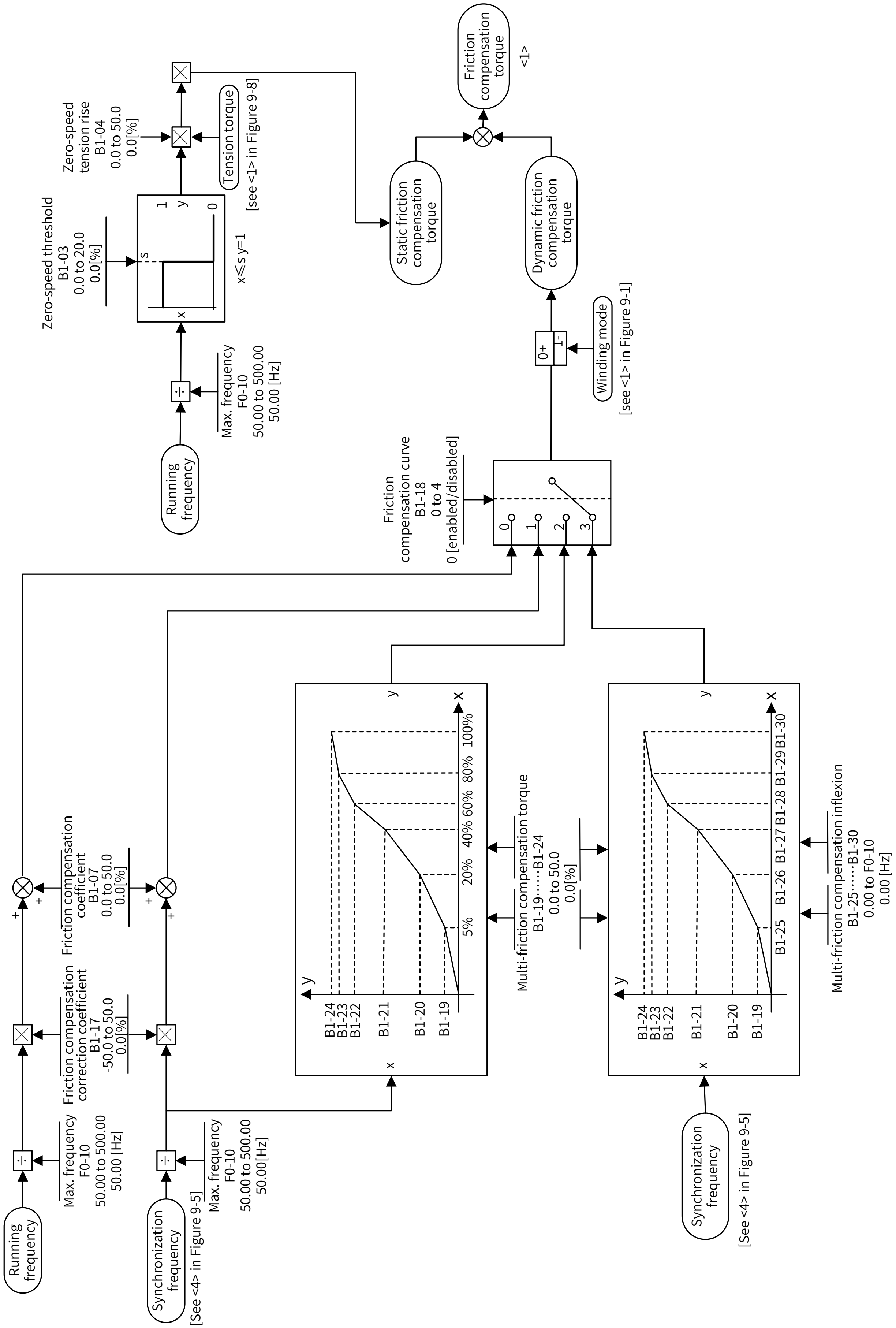


Figure 8-6 Friction compensation function

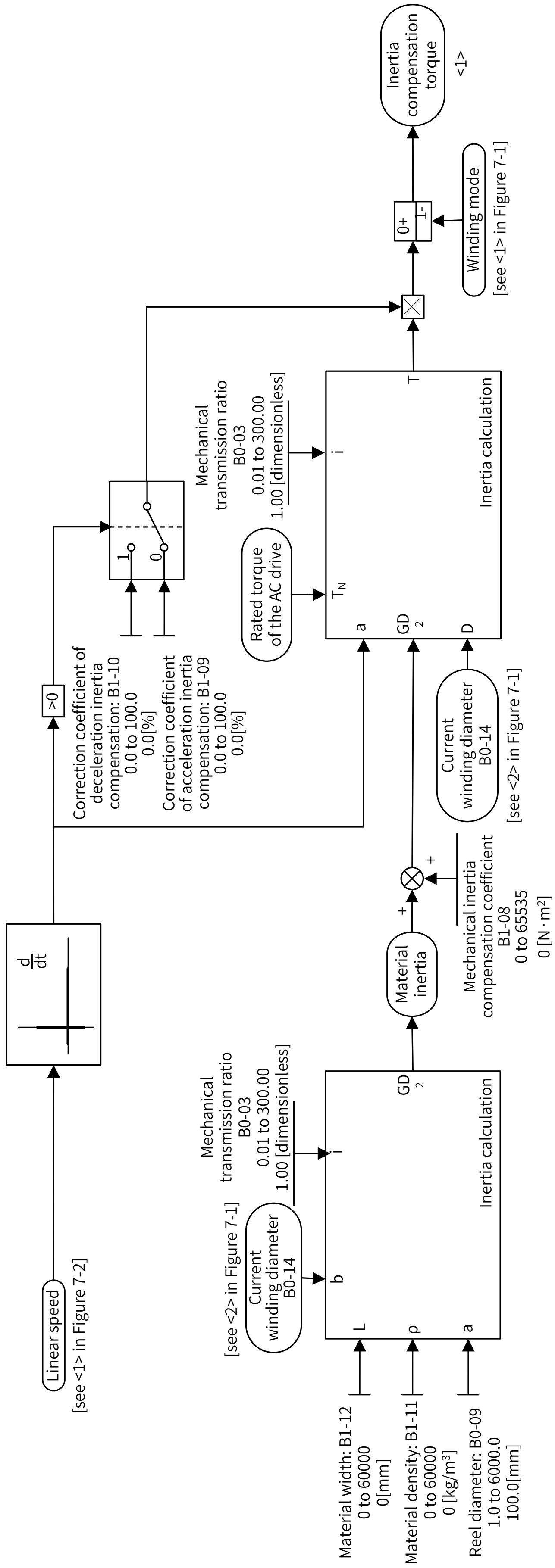


Figure 8-7 Inertia compensation function

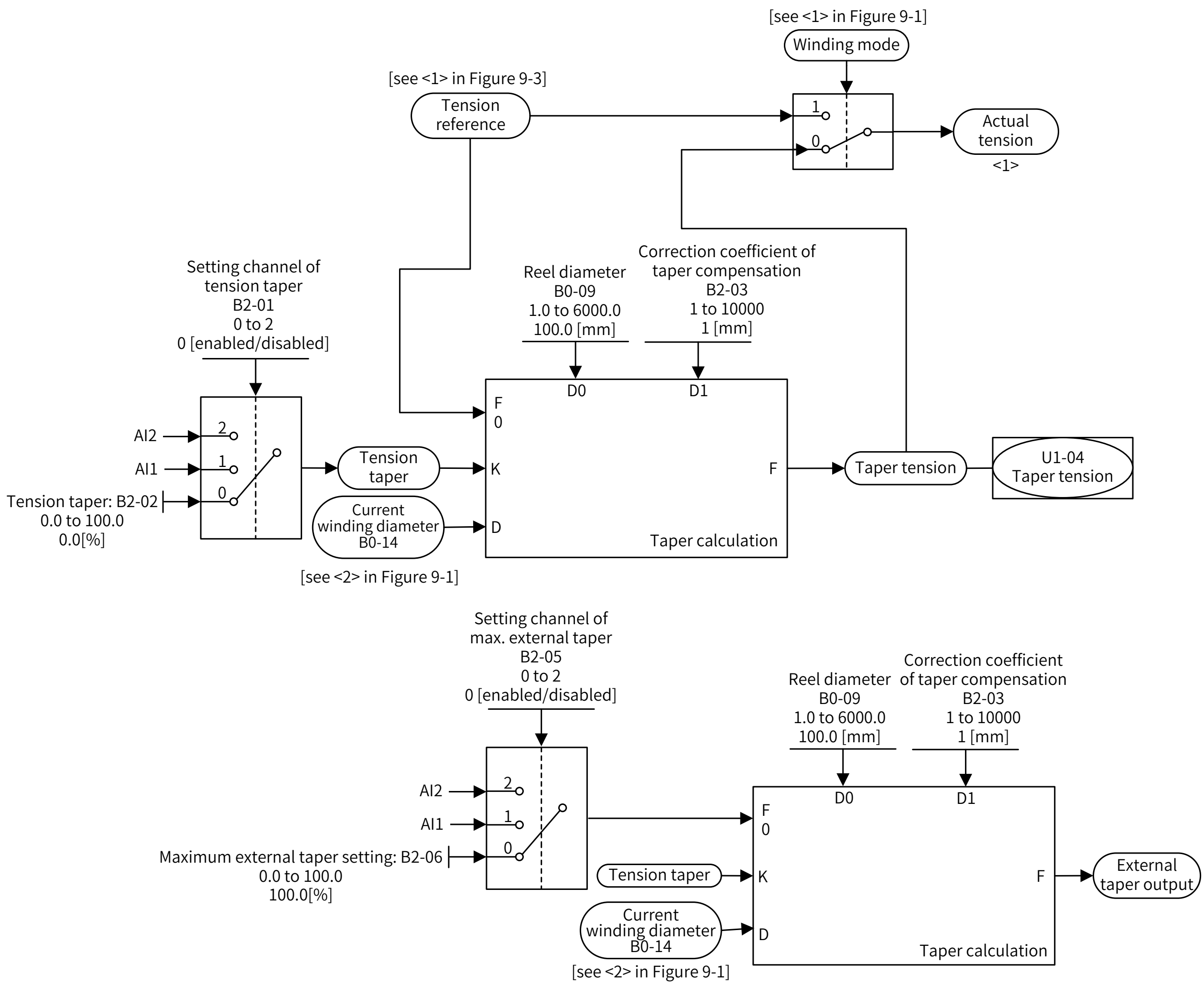


Figure 8-8 Taper function

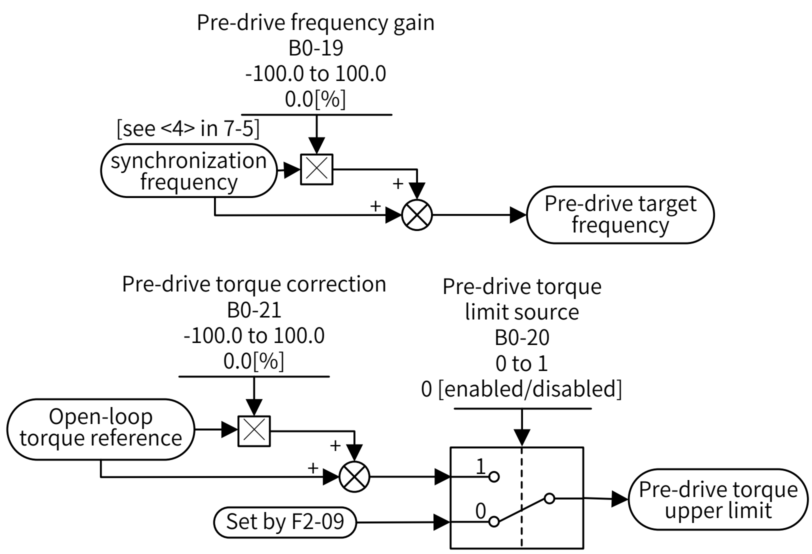


Figure 8-9 Pre-drive function

8.2 Wobble Control Function

Wobble control is the function that enables the output frequency of the drive to wobble around the frequency reference (frequency reference is set by F0-07). It is applicable to textile, chemical fiber, and other industries, as well as scenarios where horizontal movement and winding are required.

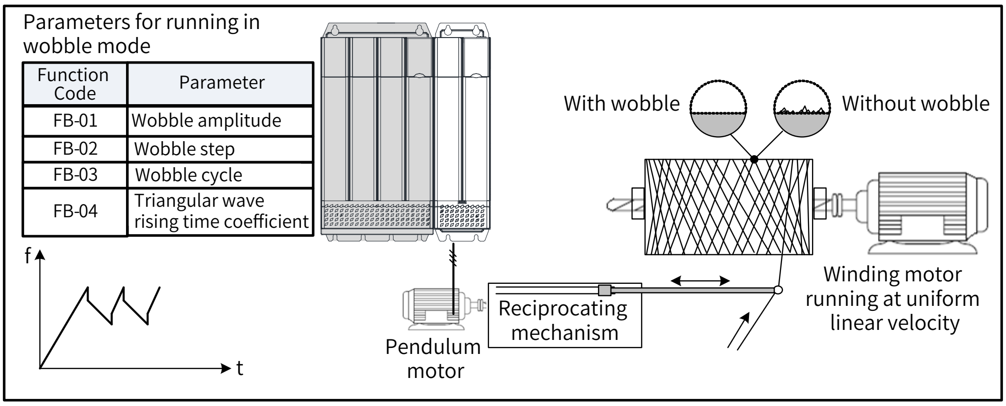


Figure 8-10 Wobble application scenario

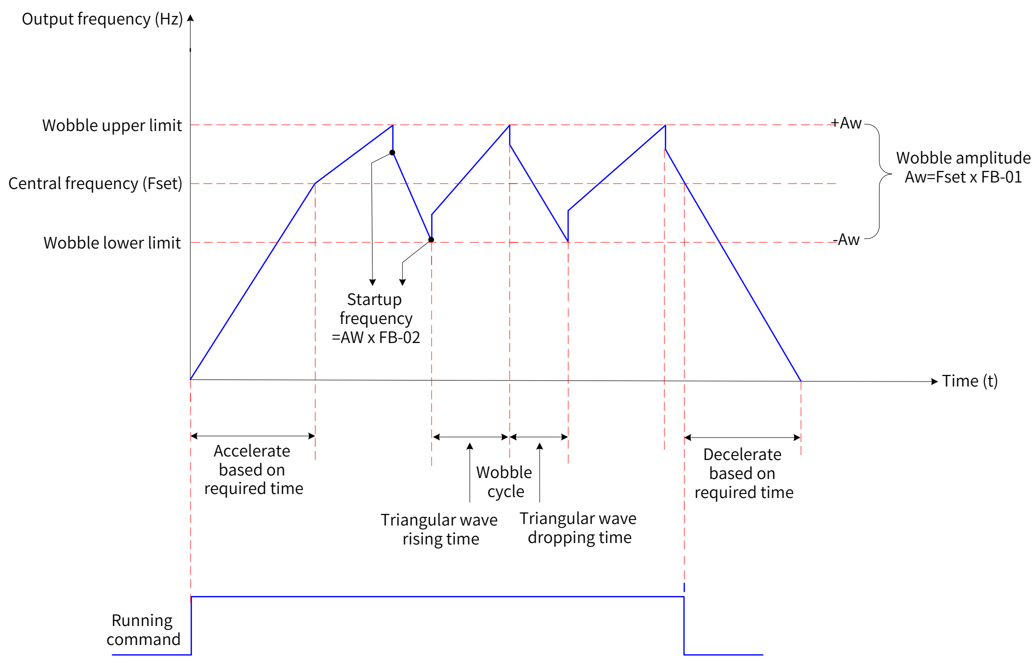


Figure 8-11 Wobble operation

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FB-00	Wobble setting mode	0	0: Relative to the central frequency	0: Relative to the central frequency (F0-07, Final frequency reference setting selection). It is a variable wobble system, and the wobble changes with the central frequency (frequency reference).
			1: Relative to the maximum frequency	1: Relative to F0-10 (Maximum frequency). It is a fixed wobble system, and the wobble is calculated based on the maximum frequency.
FB-01	Wobble amplitude	0.0%	0.0% to 100.0%	When FB-01 is set to 0, the wobble amplitude is 0, and the wobble function is disabled.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FB-02	Wobble step	0.0%	0.0% to 50.0%	It determines the wobble amplitude and startup frequency. The running frequency in the wobble mode is limited by the frequency upper limit and lower limit.
FB-03	Wobble cycle	10.0s	0.1s to 3000.0s	Duration of a complete wobble cycle
FB-04	Triangular wave rising time coefficient	50.0%	0.1% to 100.0%	Percentage of triangular wave rising time to FB-03 (Wobble cycle)

1) Wobble calculation method

When FB-00 (Wobble setting mode) is set to 0 (Relative to the central frequency), the wobble amplitude can be calculated with the following formula:

Wobble AW = F0-07 (Final frequency reference setting selection) x FB-01 (Wobble amplitude)

When FB-00 (Wobble setting mode) is set to 1 (Relative to the maximum frequency), the wobble amplitude can be calculated with the following formula:

Wobble AW = F0-10 (Maximum frequency) x FB-01 (Wobble amplitude)

2) Startup frequency calculation method

In the wobble mode, the startup frequency is relative to wobble AW (Startup frequency = Wobble AW x FB-02 (Wobble step).

When FB-00 (Wobble setting mode) is set to 0 (Relative to the central frequency), the startup frequency is variable.

When FB-00 (Wobble setting mode) is set to 1 (Relative to the maximum frequency), the startup frequency is fixed.

3) Triangular wave rising/dropping time calculation method

Triangular wave rising time = FB-03 (Wobble cycle) x FB-04 (Triangular wave rising time coefficient, in seconds)

Triangular wave dropping time = FB-03 (Wobble cycle) x (1 - FB-04, Triangular wave rising time coefficient in seconds)

(Wobble cycle = Triangular wave rising time + Triangular wave dropping time)

8.3 Fixed Length Control Function

MD810 provides the fixed length control function. The length pulse can only be collected by the DIO1 terminal, and the DIO1 terminal function 27 (length count input) must be selected.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FB-05	Set length	1000 m	0 m to 65535 m	-
FB-06	Actual length	0 m	0 m to 65535 m	The actual length is monitored. FB-06 (Actual length) = Number of pulses sampled by the terminal/FB-07 (Number of pulses per meter)
FB-07	Number of pulses per meter	100.0	0.1 to 6553.5	-

As shown in the following figure, the actual length is monitored. FB-06 (Actual length) can be calculated with the following formula: Actual length = Number of pulses sampled by the terminal/FB-07 (Number of pulses per meter). When FB-06 (Actual length) is larger than FB-05 (Set length), the relay or DO terminal outputs "length reached" ON signals (function 10). During fixed length control, set multi-function DI terminals to reset the length (DI terminal function 28 is enabled). For details of settings, see the following table and figure:

Parameter No.	Parameter Name	Setting Value	Function Description
F4-04	DIO2 function selection	27	Length count input
F4-00 to F4-04 (any)	Function selection of terminals DI1 to DIO2 (any)	28	Length reset
F5-01 to F5-04 (any)	Terminal output function selection (any)	10	Length reached

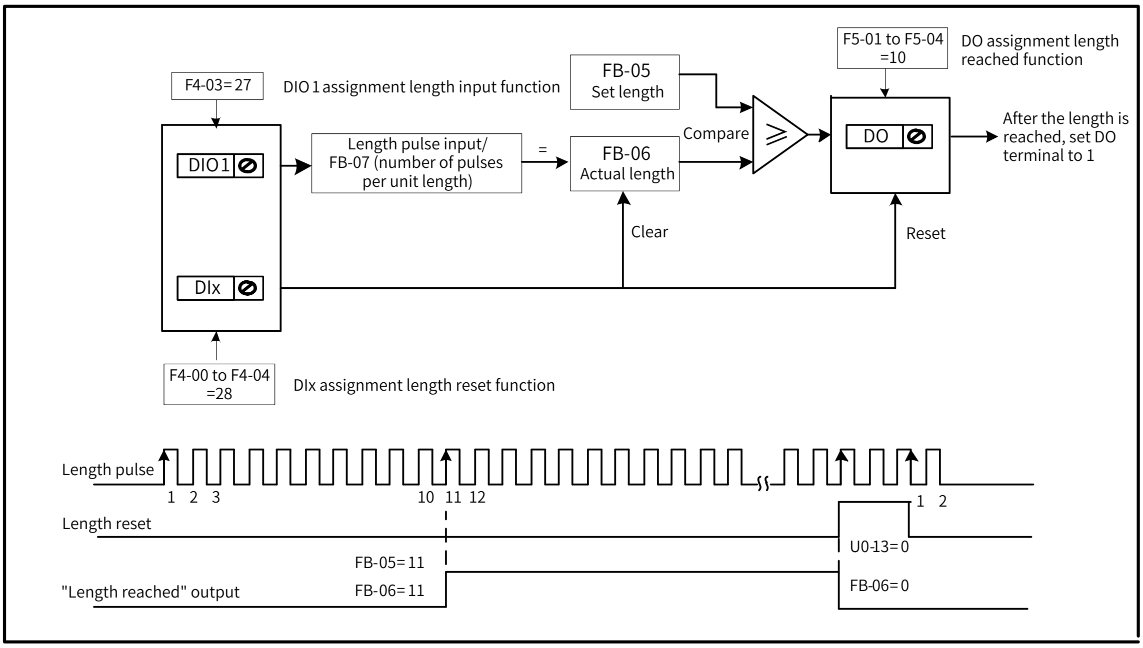


Figure 8-12 Fixed length function

In the fixed length control mode, the system cannot identify the direction and calculates the length only based on the number of pulses.

Automatic shutdown can be achieved by feeding back the "length reached" T/A-T/B signals from the relay to the shutdown input terminal of the drive.

8.4 Counting Function

The count value needs to be collected by DI terminals (in the case of high pulse frequency, the DIO1 terminal must be used), and the DI terminal function 25 (counter input) must be enabled.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
FB-08	Set count value	1000	1 to 65535	-
FB-09	Designated count value	1000	1 to 65535	FB-09 (Designated count value) cannot be larger than FB-08 (Set count value).

As shown in the following figure, the count value needs to be collected by DI terminals, and DI terminal function 25 (counter input) must be enabled. When the count value reaches FB-08 (Set count value), the multi-function DO terminal outputs "set count value reached" ON signals. When the count value reaches FB-09 (Designated count value), the multi-function DO terminal outputs "designated count value reached" ON signal.

Parameter No.	Parameter Name	Setting Value	Function Description
F4-00 to F4-04 (any)	Function selection of terminals DI1 to DIO2 (any)	25	Counter input
F4-00 to F4-04 (any)	Function selection of terminals DI1 to DIO2 (any)	26	Count reset
F5-01 to F5-04 (any)	Terminal output function selection (any)	8	Set count value reached
F5-01 to F5-04 (any)	Terminal output function selection (any)	9	Designated count value reached

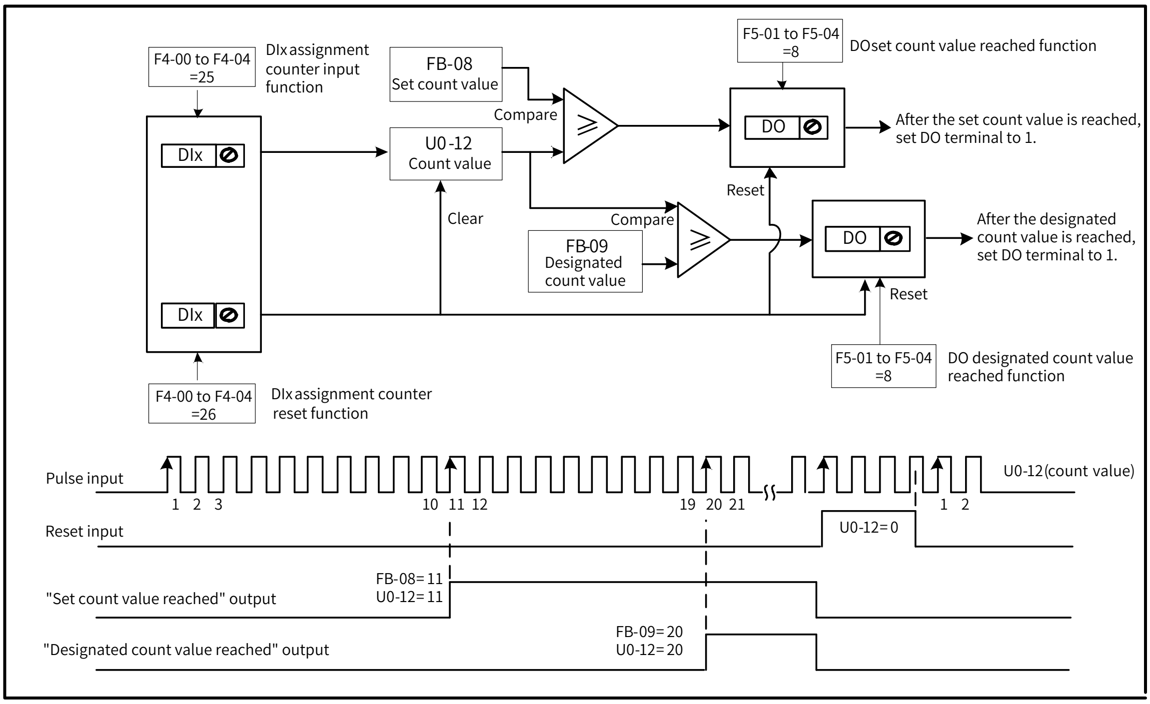


Figure 8-13 Counting function

In the case of high pulse frequency, the DIO1 terminal must be used.

The DO terminal that outputs "set count value reached" ON signal cannot be used to output "designated count value reached" ON signal.

When the drive is in RUN/STOP state, the counter keeps counting till the "set count value" is reached.

The count value is retentive at power failure.

Automatic shutdown can be achieved by feeding back the "set/designated count value reached" signal from the DO terminal to the shutdown input terminal of the drive.

8.5 PID Adjustment Methods

This section describes the general rules for PID parameter adjustment, which can be used as the reference for adjusting closed-loop process control PID parameters (FA-05 to FA-07, and FA-15 to FA-17) and speed loop PI parameters (F2-00, F2-01, F2-03, and F2-04).

1) In case of slow response, increase Kp.

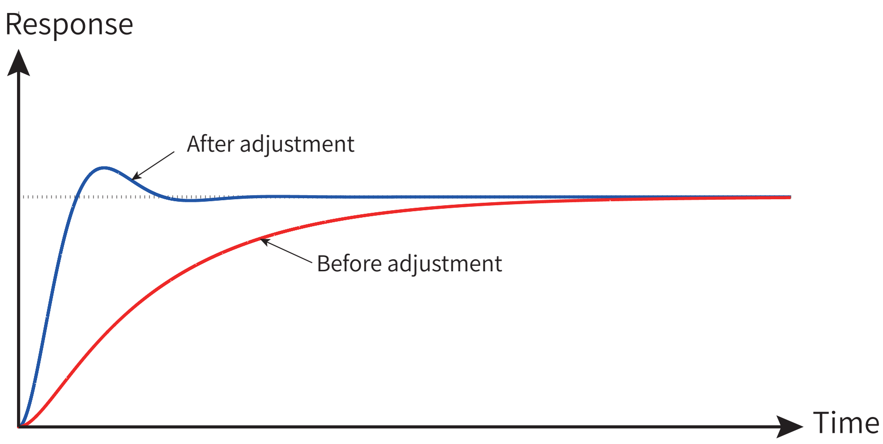


Figure 8-14 Response-time trend chart after increasing Kp

2) In case of fast oscillation, decrease Kp.

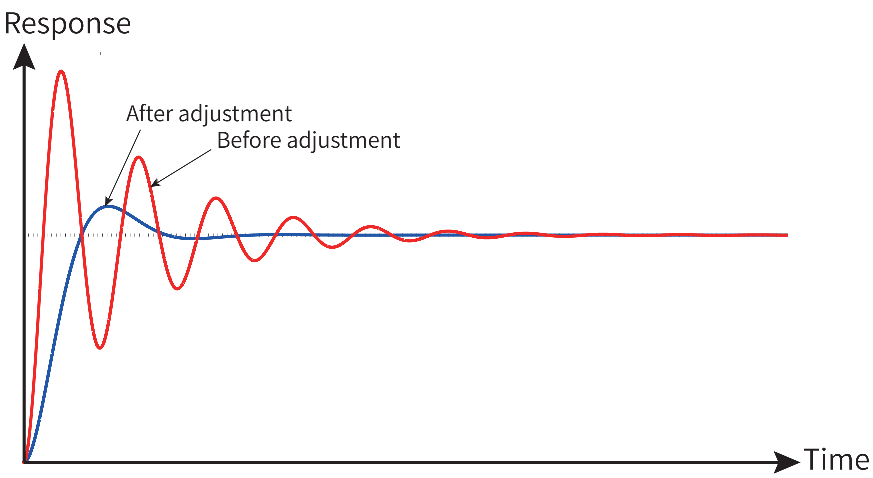


Figure 8-15 Response-time trend chart after decreasing Kp

3) In case of large overshooting and slow fluctuation, increase Ti.

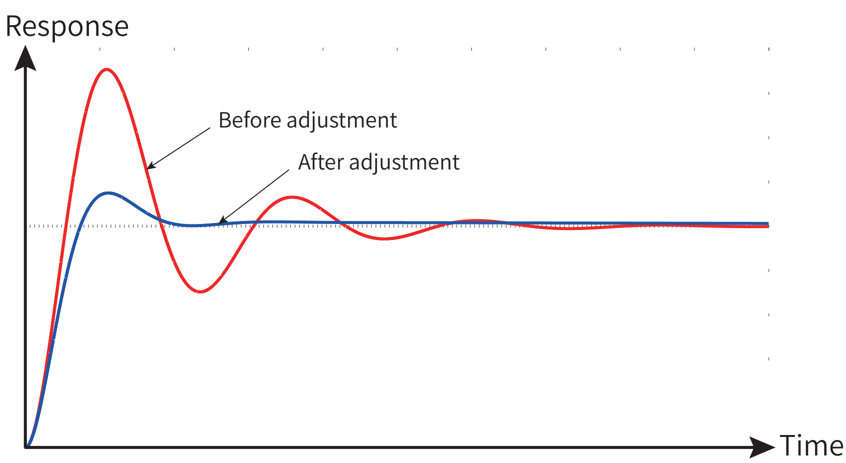


Figure 8-16 Response-time trend chart after increasing Ti

4) In case of large static difference and slow response at load fluctuation, increase Kp or decrease Ti.

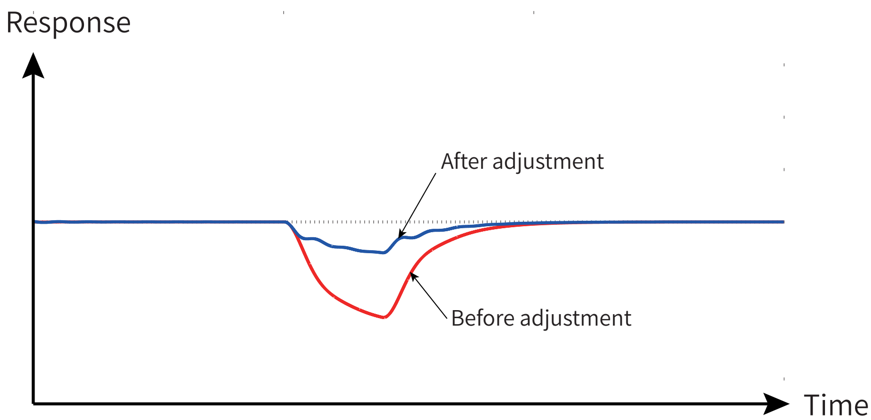


Figure 8-17 Response-time trend chart after increasing Kp at load fluctuation

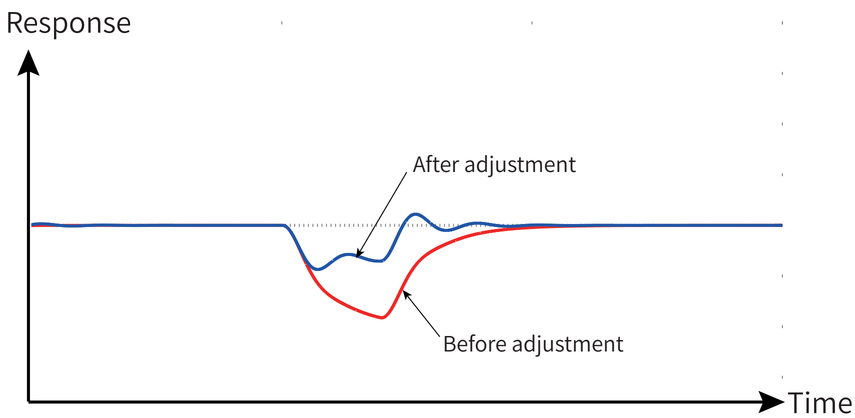


Figure 8-18 Response-time trend chart after decreasing Ti at load fluctuation

NOTE

◆ The preceding two methods meet the same static difference requirements. In general, increasing Kp has less effect on system stability.

5) System stability can be improved by incorporating differential time Td properly (excessive proportion may cause interference and oscillation)

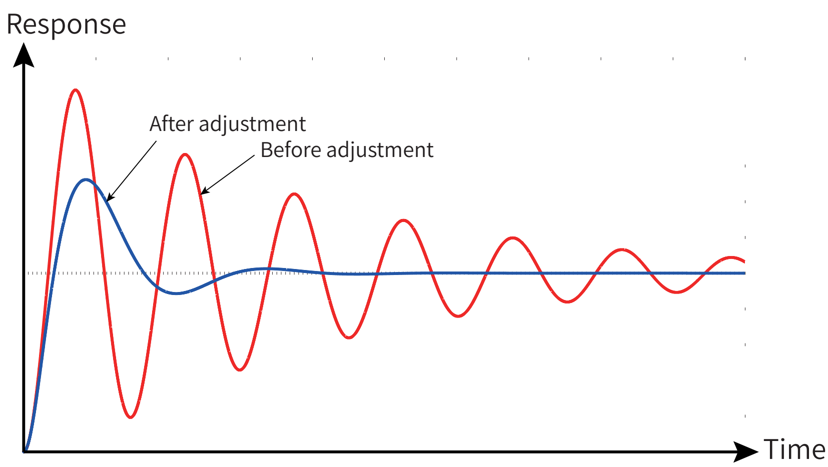


Figure 8-19 Response-time trend chart after incorporating Td

8.6 Synchronous Control

This section mainly introduces the synchronous control components integrated in the AC drive. Typical applications and scenarios for each synchronous control function and related parameters will be described below.

The dedicated CAN for synchronous control provides dedicated communication links for the synchronous control function. Before using the synchronous control function, perform networking for the drive through the CAN2 interface.

Currently, four synchronous control modes are available for meeting different process requirements.

- Speed synchronization
- Position synchronization
- Load distribution
- Droop control

When performing synchronous control networking, ensure that the node used to connect the dedicated CAN for synchronous control has different bus communication addresses.

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-00	Local address	1	1 to 124	Synchronous control network node station number

The baud rate of dedicated CAN for synchronous control is fixed to 1 M and cannot be modified.

Network timeout can be set for the slave nodes. If a slave detects network communication timeout, the AC drive reports a bus fault E16.15. For scenarios where slight interference exists on the network and frequent stop upon communication faults is not allowed, set the timeout to 0 (cancel) or increase the timeout.

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-02	Synchronous control communication timeout	1.0s	0.0 to 10.0s	Slave valid When this parameter is set to 0, the fault detection is canceled.

The slave start/stop can be controlled by separate command setting modes (DI or external communication) or following the master start/stop to simplify wiring or reduce external communication load.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
A8-14	Slave configuration parameter	1	0: Slave not following master to start/stop 1: Slave following master to start/stop	Valid for speed and position synchronization
A8-54	Slave configuration parameter	1	0: Slave not following master to start/stop 1: Slave following master to start/stop	Valid for load distribution
A8-74	Slave configuration parameter	1	0: Slave not following master to start/stop 1: Slave following master to start/stop	Valid for droop control

Set other group A8 parameters according to the selected synchronous mode. The parameters for different synchronous modes are shown as follows:

- Parameters for speed/position synchronous control: A8-10 to A8-43
- Parameters for load distribution: A8-50 to A8-63
- Parameters for droop control: A8-70 to A8-81

8.6.1 Speed/Position Synchronization

Speed synchronization is applicable for such scenarios: The devices or processes contain multiple nodes with mechanical or process connections, which requires the running speed of different nodes keeps certain ratio.

The following figure shows a typical application. The speed ratio between the transmission nodes is configured for fixing the linear speed ratio to realize tension control of flexible materials (tension determined by the node speed difference at the two ends of the material) between the transmission nodes.

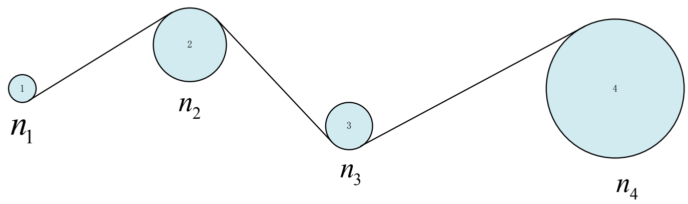


Figure 8-20 Typical application of speed synchronization

In the speed synchronization mode, position deviation will be accumulated. Therefore, for scenarios with strict position requirements on the master and slaves, use position synchronization instead. The following figure shows a typical position control application. The lifting and lowering positions of the master and slave must be synchronous to ensure stable movement of the load.

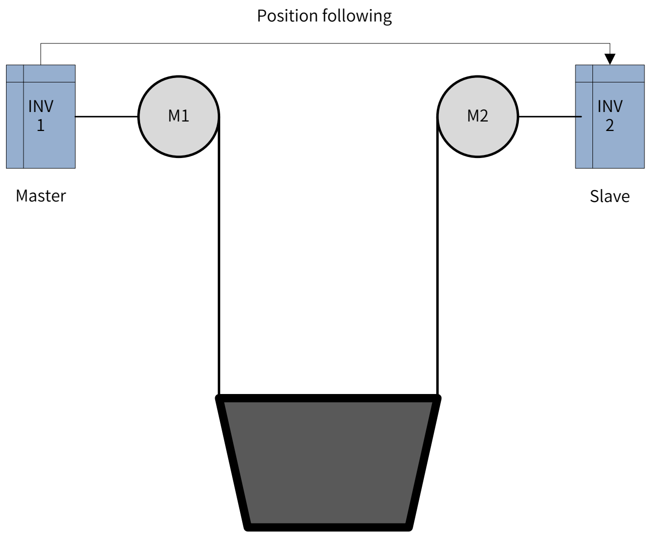


Figure 8-21 Typical application of position synchronization

Do not use speed synchronization and position synchronization for the transmission structure with only rigid connections. Otherwise, the drive direction may be reverse, causing overload or mechanical damage.

Two or more synchronous nodes may exist on a synchronous control network. You can set the following parameters to enable flexible master and slave configuration and synchronization settings.

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-10	Master/Slave selection in speed and position control	0	0 to 3	0: Disabled (no speed and position synchronization) 1: Master 2: Slave 3: Intermediate node
A8-11	Synchronization mode selection	0	0 to 1	0: Speed synchronization 1: Position synchronization
A8-12	Following master station number	1	1 to 124	Slave valid

Example:

1) Configuration 1: On the network, only one speed/position synchronization master is set and other nodes follows the master's speed or position, as shown in the following figure.

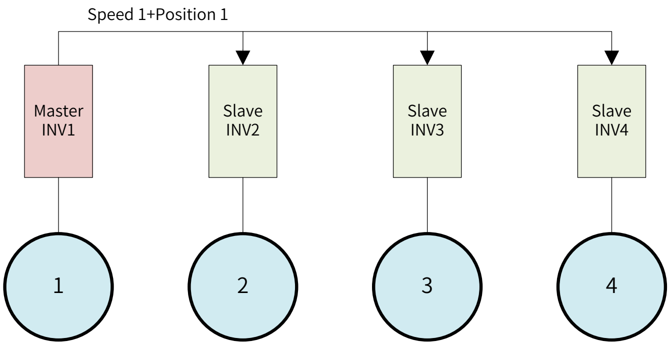


Figure 8-22 Single slave mode

2) Configuration 2: On the network, the next level nodes follow the previous level nodes. That is, one master, several intermediate nodes, and one slave are set on the network, as shown in the following figure.

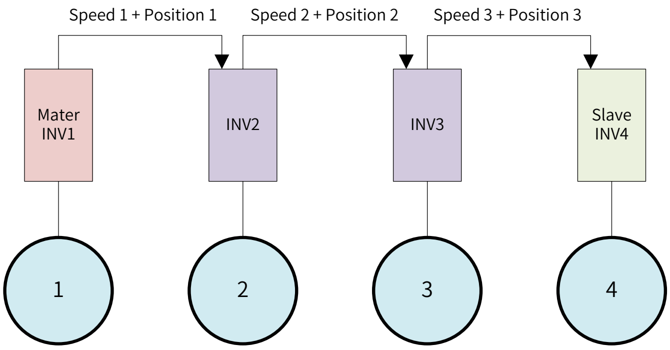


Figure 8-23 Serial connection mode

8.6.2 Load Distribution

Load distribution is applicable for scenarios where multiple motors drive the same motor or process, which requires speed synchronization and load balance between the motors. Generally, rigid connection is applied between the motors, which ensures the speed synchronization between motors through the mechanical structure. The AC drive ensures that the motor torque is synchronous, that is, load distribution.

The tension roller is a typical application of load distribution, as shown in the following figure.

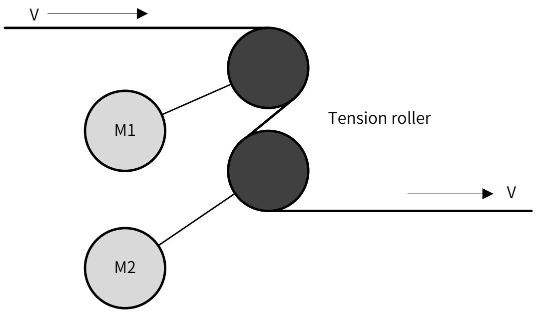


Figure 8-24 Typical application of load distribution

The tension roller is mainly used in the strip production line to control the strip speed in certain process segments. The strip tension and speed can be controlled easily by increasing the friction force between the strip and roller bed surfaces. Each of the two roller beds is controlled by one motor separately. Speed and torque must be synchronized between the two roller beds.

In the load distribution mode, the master transfers the torque and speed to the slaves simultaneously. This ensures speed and torque synchronization during normal operation and limits the slave motor speed to prevent runaway upon stall when slip occurs.

Different torque distribution can be enabled by setting the following parameters for the slaves. The slave speed limit can be set flexibly to realize slave speed control under abnormal conditions.

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-57	Frequency gain	1.00	-10.00 to +10.00	Frequency gain and offset percentage
A8-58	Frequency offset	0.00%	-100.00% to +100.00%	
A8-59	Torque gain	1.00	-10.00 to +10.00	
A8-60	Torque offset	0.00%	-100.00% to +100.00%	

8.6.3 Droop Control

In some flexible connection systems, such as belt drive or applications where slip occurs easily, the speed synchronization between motors cannot be ensured by mechanical connections, and load unbalance occurs due to machining accuracy or friction force difference. In this case, droop control can be used to ensure load balance between motors.

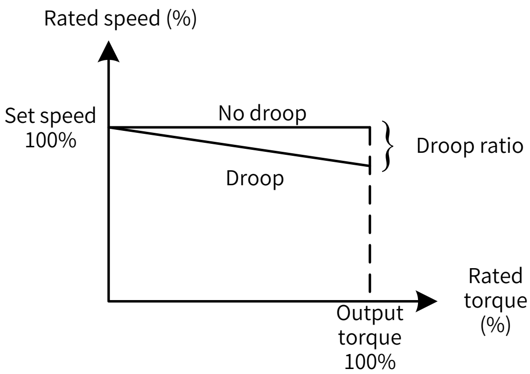


Figure 8-25 Droop control principle

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-77	Droop ratio	5.00%	0.00% to 15.00%	Under the same load torque, when the value of this parameter is increased, the reduction value of the set frequency is increased.

The typical application of the droop control is to transfer objects on the roller bed. Multiple roller beds are placed in one row, each roller or several rollers are driven by one motor and the row of roller beds are driven by multiple motors with the same speed. Objects are transferred through the friction force between the objects and roller beds, which requires load balance on each roller bed.

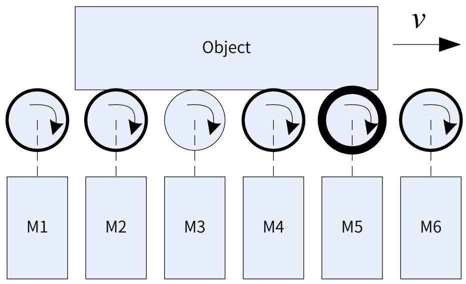


Figure 8-26 Typical application of droop control

In the droop control mode, the original set frequency is given by the master and the slaves follow the master's set frequency. The master and slaves adjust the frequency based on their own droop rate to realize load distribution. Besides, if single control or dedicated CAN for synchronous control is unavailable, droop control of a single motor can be enabled by using the self-droop function.

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-70	Master/Slave selection in droop control	0	0 to 3	0: Disabled (no droop control function) 1: Master 2: Slave 3: Self-droop

8.6.4 Combination of Synchronous Control Modes

The preceding sections describe the applicable scenarios and typical applications of each synchronous control mode. In some scenarios with complicated process control, multiple types of synchronous control may be required at the same time. In this case, several synchronous control modes can be flexibly combined through parameter settings.

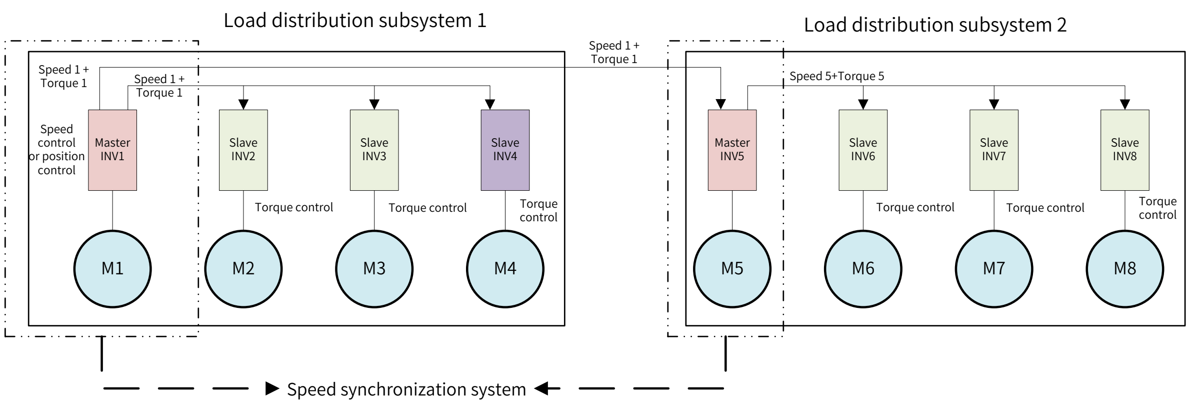


Figure 8-27 Combination example of synchronous control modes

The preceding example is for reference.

- According the process requirements, INV1 runs at the set frequency and works with INV5 as a speed following system. It is set as the speed synchronization master. INV1 is also configured as the master of load distribution subsystem 2. Load distribution is enabled between INV2 to INV4 according to the torque sent by INV1.
- INV5 works as the slave of INV1 in the speed synchronization system and the master of load distribution subsystem 2. It works with INV6 to INV8 to realize load distribution between the four nodes.

If more than one master is configured on the network, note that the slave station numbers must be set by following the master station number based on the synchronization mode of the slaves.

Parameter No.	Parameter Name	Default Value	Setting Range	Parameter Description
A8-12	Following master station number (valid for slaves)	1	1 to 124	Valid for speed and position synchronization
A8-52	Following master station number	1	1 to 124	Valid for load distribution
A8-72	Following master station number	1	1 to 124	Valid for droop control

When multiple synchronization modes are combined, one node can be set as the master of multiple synchronization modes or as the master of one mode and slave of another mode at the same time. However, one node cannot be set as the slave of two or mode synchronization modes. Otherwise, the AC drive reports the synchronous control parameter setting error (E46.01).

Memo NO. ___________

Date / /

9 Troubleshooting

9.1 Safety Information

Safety Information
⚠ Danger
◆ Do not connect the drive while power is on, and keep all breakers in OFF state. Failure to comply will result in electric shock.
⚠ Warning
◆ Make sure to ground the drive according to local laws and regulations. Failure to comply may result in electric shock or a fire.
◆ Do not remove the front cover or touch internal circuits while the power is on. Failure to comply may result in electric shock.
◆ Do not allow unqualified personnel to perform any maintenance, inspection, or part replacement work. Failure to comply may result in electric shock or a fire.
◆ When installing the drive inside an enclosed cabinet, use a cooling fan or air conditioner to keep temperature below 50°C . Failure to comply may result in overheating or even a fire.
◆ Tighten all screws based on specified tightening torque. Failure to comply may result in electric shock or a fire.
◆ Always confirm the input voltage is within nameplate rating. Failure to comply may result in electric shock or a fire.
◆ Keep flammable and combustible materials away from the drive.
⚠ Caution
◆ Cover the top of the drive with a temporary cloth or paper during installation to prevent foreign materials such as metal shavings, oil, and water from falling into the drive.
◆ After installation is complete, remove the temporary cloth or paper. Failure to comply will reduce ventilation and result in overheating.
◆ Follow proper electrostatic discharge (ESD) procedures when operating the drive. Failure to comply will damage the drive circuits because of static electricity.

9.2 FAQs and Solutions for Test Run of the Drive Unit

1) SVC mode (F0-01 = 0 by default)

In this mode, motor speed and torque are controlled without speed feedback from the encoder. Motor auto-tuning must be performed to complete automatic parameter setting.

Problem or Fault	Solution
Overload or overcurrent fault reported during motor startup	◆ Set motor parameters F1-01 (Rated motor power) to F1-05 (Rated motor rotation speed) according to the motor nameplate. ◆ Perform motor auto-tuning (F1-37 = 3, Asynchronous motor static complete auto-tuning). Complete dynamic motor auto-tuning (F1-37 = 2, Asynchronous motor complete auto-tuning) is preferred when possible. ◆ Reduce the value of F2-10 [Digital setting of torque limit in speed control (motoring)] to the range of 120% to150%.

Problem or Fault	Solution
Poor torque or speed response and large motor speed fluctuation at frequencies below 5 Hz	◆ In speed control mode (A0-00 = 00), increase speed loop proportional gain by increasing the value of F2-00 (Speed loop proportional gain Kp at low speed) in steps of 10 gradually or reduce the speed loop integral time by reducing the value of F2-01 (Speed loop integral time Ti at low speed) in steps of 0.05 gradually to improve speed response. In the case of vibration, reduce the values of F2-00 (Speed loop proportional gain Kp at low speed) and F2-01 (Speed loop integral time Ti at low speed). ◆ In torque control mode (A0-00 = 01), increase the applied torque in the case of startup failure because it may be resulted from large static friction or small torque of the mechanical equipment. ◆ In torque control mode (A0-00 = 01), enable speed fluctuation suppression to mitigate speed fluctuation in the case of large motor speed fluctuation of the winding equipment because it may be resulted from tension fluctuation during winding of the winding materials.
Poor torque or speed response and large motor speed fluctuation at frequencies above 5 Hz	◆ To improve torque and speed response, increase speed loop proportional gain by increasing the value of F2-03 (Speed loop proportional gain Kp at high speed) in steps of 10 gradually or reduce the speed loop integral time by reducing the value of F2-04 (Speed loop integral time Ti at high speed) in steps of 0.05 gradually. ◆ In torque control mode (A0-00 = 01), increase the applied torque in the case of startup failure because it may be resulted from large static friction or small torque of the mechanical equipment. ◆ In torque control mode (A0-00 = 01), enable speed fluctuation suppression to mitigate speed fluctuation in the case of large motor speed fluctuation of the winding equipment because it may be resulted from tension fluctuation during winding of the winding materials.
Low speed accuracy	◆ When the motor speed deviation is large when load is applied, increase the value of F2-06 (SVC/FVC slip compensation gain) in steps of 10% gradually.
Large speed fluctuation	◆ When the motor speed fluctuates abnormally, increase F2-07 (Speed feedback filter time) in FVC mode and A9-05 (Speed filter of asynchronous motor in SVC mode) in SVF mode properly by 0.001s。 ◆ Increase speed loop proportional gain.
Large motor noise	◆ Step up F0-15 (Carrier frequency) properly by 1.0 kHz. (Note: Step-up of carrier frequency will increase leakage current of the motor)
Insufficient motor torque or output	◆ Check whether torque upper limit is restricted. Increase F2-10 [Digital setting of torque limit in speed control (motoring)] in speed control mode or increase the torque command in torque control mode.

2) FVC mode (F0-01 = 1)

In this mode, motor speed and torque are controlled with speed feedback from the encoder. Encoder pulses per revolution, encoder type, and signal direction must be set correctly and motor auto-tuning must be performed for automatic parameter setting.

Problem or Fault	Solution
Overcurrent or overload fault reported during startup	◆ Set the encoder pulses per revolution, encoder type, and signal direction correctly.
Overload or overcurrent fault reported during motor rotation	◆ Set motor parameters F1-01 (Rated motor power) to F1-05 (Rated motor rotation speed) according to the motor nameplate. ◆ Perform motor auto-tuning (F1-37, Auto-tuning selection). Complete dynamic motor auto-tuning is preferred when possible.

Problem or Fault	Solution
Poor torque or speed response and motor vibration at frequencies below 5 Hz	◆ In speed control mode (A0-00 = 00), increase speed loop proportional gain by increasing the value of F2-00 (Speed loop proportional gain Kp at low speed) in steps of 10 gradually or reduce the speed loop integral time by reducing the value of F2-01 (Speed loop integral time Ti at low speed) in steps of 0.05 gradually to improve speed response. In the case of vibration, reduce the values of F2-00 (Speed loop proportional gain Kp at low speed) and F2-01 (Speed loop integral time Ti at low speed). ◆ In torque control mode (A0-00 = 01), increase the applied torque in the case of startup failure because it may be resulted from large static friction or small torque of the mechanical equipment. ◆ In torque control mode (A0-00 = 01), enable speed fluctuation suppression to mitigate speed fluctuation in the case of large motor speed fluctuation of the winding equipment because it may be resulted from tension fluctuation during winding of the winding materials.
Poor torque or speed response and motor vibration at frequencies above 5 Hz	◆ To improve torque and speed response, increase speed loop proportional gain by increasing the value of F2-03 (Speed loop proportional gain Kp at high speed) in steps of 10 gradually or reduce the speed loop integral time by reducing the value of F2-04 (Speed loop integral time Ti at high speed) in steps of 0.05 gradually. ◆ In torque control mode (A0-00 = 01), increase the applied torque in the case of startup failure because it may be resulted from large static friction or small torque of the mechanical equipment. ◆ In torque control mode (A0-00 = 01), enable speed fluctuation suppression to mitigate speed fluctuation in the case of large motor speed fluctuation of the winding equipment because it may be resulted from tension fluctuation during winding of the winding materials.
Large speed fluctuation	◆ When the motor speed fluctuates abnormally, increase F2-07 (Speed feedback filter time) properly by 0.001s. ◆ Increase the speed loop proportional gain and reduce the speed loop integral time.
Large motor noise	◆ Step up F0-15 (Carrier frequency) properly by 1.0 kHz; (Note: Step-up of carrier frequency will increase leakage current of the motor)
Insufficient motor torque or output	◆ Check whether torque upper limit is restricted. Increase F2-10 [Digital setting of torque limit in speed control (motoring)] in speed control mode or increase the torque command in torque control mode.

3) V/F mode (F0-01 = 2)

In this mode, motor speed and torque are controlled without speed feedback from the encoder. This mode is not sensitive to motor parameters, so you only need to set the motor parameters according to the motor nameplate. Motor auto-tuning is optional.

The set value of rated motor current has an effect on motor overload protection.

Fault	Solution
Motor vibration during running	◆ Increase the value of F3-11 (V/F oscillation suppression gain) to 100 at most in steps of 10 gradually.
Overcurrent fault reported during startup at high power	◆ Reduce the value of F3-01 (Torque boost) in steps of 0.5% gradually; increase the value of F0-17 (Acceleration time 1).
High current during running	◆ Set F1-02 (Rated motor voltage) and F1-04 (Rated motor frequency) properly; ◆ Reduce the value of F3-01 (Torque boost) in steps of 0.5% gradually, or set the value to 0.0% directly.
Large motor noise	◆ Step up F0-15 (Carrier frequency) properly by 1.0 kHz. (Note: Step-up of carrier frequency will increase leakage current of the motor)

Fault	Solution
Overvoltage fault reported when heavy load is disconnected suddenly or during deceleration	◆ Verify that F3-23 (Voltage limit selection) is enabled; increase F3-24 (Frequency gain for voltage limit)/F3-25 (Voltage gain for voltage limit) (30 by default) to 100 at most in steps of 10 gradually. ◆ Reduce F3-22 (Voltage limit, 770 V by default) to 700 V at most by 10 V gradually.
Overcurrent fault reported when heavy load is disconnected suddenly or during deceleration	◆ Increase F3-20 (Current limit gain, 20 by default) to 100 at most in steps of 10 gradually. ◆ Reduce F3-18 (Current limit level, 150% by default) to 50% at most in steps of 10% gradually.

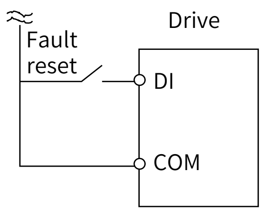
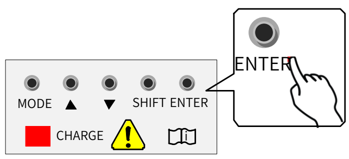
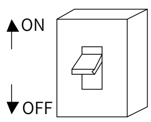
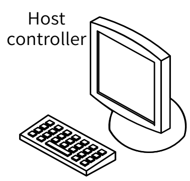
9.3 Fault Display and Solutions

The drive is designed with the fault level and alarm level for problem locating purposes. Fault takes precedence over alarm during troubleshooting.

1) Example of fault display: E02.00

2) Example of alarm display: A 16.13

When a fault occurs during running, the drive stops output immediately, the fault indicator TUNE/TC flashes in red, and the contact of the fault relay acts. The following table lists the fault types and solutions for specific fault codes. The following information is for your reference only. Do not repair or modify the drive by yourself. If the fault cannot be eliminated, contact the agent or Inovance.

Stage	Solution	Remarks
After the fault occurs	Check the operating panel for detailed information of recent three faults, such as fault type and frequency, current, bus voltage, DI/DO state, accumulative power-on time, accumulative running time, IGBT temperature, and fault subcode at occurrence of the faults.	View the information using F9-14 (1st fault type) to F9-46 (1st fault subcode). F9-14 ... F9-46
Before the fault is reset	Find and remove the fault cause. Then follow steps below to reset the fault.	Troubleshoot the fault according to "8.4 Faults and Diagnostics".
Fault resetting method	1) Allocate a DI terminal with function 9 "Fault reset (RESET)" by setting any of F4-00 (DI1 function selection) to F4-04 to 9 (Fault reset).	
	2) Press the ENTER key on the operating panel.	
	3) Automatic resetting Disconnect the main circuit power supply. Wait until the fault code disappears, and connect the power supply again.	
	4) Fault resetting using the host controller Confirm that F0-02 (Command source selection) is set to 2 (Communication control) and write "7" (fault reset) to communication address 2000H.	

9.4 Fault Codes and Solutions

9.4.1 Fault Codes and Solutions for the Power Supply Unit

Troubleshoot the fault of the power supply unit according to the following table.

Fault Name	Operating Panel Display	Cause	Possible Solution
Input voltage abnormal	E12.01	R phase loss occurs on input voltage.	Check the three-phase power. Check whether the input power cable is broken. Check that the input terminal is correctly connected. Check the hardware voltage detection circuit.
	E12.02	S phase loss occurs on input voltage.	
	E12.03	T phase loss occurs on input voltage.	
	E12.04	The input three-phase voltage is too high.	Adjust three-phase voltage to normal range.
	E12.05	Three-phase input voltage unbalance occurs.	Check the three-phase power. Check the hardware voltage detection circuit.
	E12.07	Three-phase input voltage low	Check the three-phase power. Check the hardware voltage detection circuit.
SCR overheat	E14.00	The ambient temperature is too high.	Lower the ambient temperature.
		The ventilation is clogged.	Clean the ventilation.
		The fan is damaged.	Replace the cooling fan.
		The thermally sensitive resistor of SCR is damaged.	Contact the agent or Inovance.
		The SCR is damaged.	
Communication fault	E16.01	Modbus communication times out.	Check that the RS-485 communication cable is correctly connected. Check that the setting of Fd-04 (Modbus communication timeout time) and PLC communication cycle are proper.
	E16.11	CANopen communication times out.	Check that the CAN communication cable is correctly connected. Check the setting of Fd-15 [Maximum value of node reception error count (real-time)] to Fd-17 (Bus disconnection times per unit of time) and confirm interference.
	E16.12	The PDO mapping configured for CANopen is not consistent with the actual mapping.	Check the PDO mapping of parameters in group AF.
	E16.13	Data exchange times out when the drive units receive data from the power supply unit.	Check that the power supply unit is running. Check whether the network cables of the power supply unit and drive units are connected. Check that the terminal build-out resistor is correctly connected. Check Fd-12 (CAN baud rate) and confirm that the CAN baud rate setting is consistent.
	E16.14	Data exchange is abnormal when the drive units receive data from the power supply unit.	Rectify the fault of the power supply unit.
	E16.21	The CANlink heartbeat times out.	Check that the CAN communication cable is correctly connected. Check the setting of Fd-15 [Maximum value of node reception error count (real-time)] to Fd-17 (Bus disconnection times per unit of time) and confirm interference.

Fault Name	Operating Panel Display	Cause	Possible Solution
Communication fault (continued)	E16.22	CANlink station numbers conflict.	Change the value of Fd-13 (CAN station number) to make CANlink station numbers different.
	E16.31	PROFIBUS-DP communication times out (which is specific to PROFIBUS-DP-to-CANopen gateway mode).	Check that the PROFIBUS-DP communication cable is correctly connected.
	E16.34	A CAN slave is offline during PROFIBUS-DP-to-CANopen gateway configuration.	Check whether the value of the "The number of devices" parameter of PLC is consistent with the actual number of stations. Check that the slave station number is correctly set.
	E16.35	Parameters of stations except the power supply unit are incorrectly set on the PROFIBUS-DP-to-CANopen gateway.	Check that the value of the "NO. n" parameter of PLC is consistent with the setting of AF-66 (Number of valid RPDOs) and AF-67 (Number of valid TPDOs) according to the PLC diagnosis report.
	E16.41	PROFIBUS-DP communication times out.	Check that the PROFIBUS-DP communication cable is correctly connected.
	E16.42	Parameters of the power supply unit are incorrectly set on the PROFIBUS-DP-to-CANopen gateway.	Check that the value of the "NO. 1" parameter of PLC is consistent with the setting of AF-66 (Number of valid RPDOs) and AF-67 (Number of valid TPDOs) of the gateway unit.
	E16.71	PROFINET communication times out.	Check the Ethernet wiring. Increase the PROFINET timeout interval.
	E16.72	The CANopen slave communication times out.	Check the wiring. Check whether the termination resistor is configured correctly.
	E16.74	The configured CANopen slave is missing.	Modify the AC drive site number or modify the PLC configuration to ensure consistent configuration.
	E16.75	CANopen mapping data does not match.	Check the process data mapping of parameter configuration. Ensure that the data length of the PLC configuration is consistent with the process data length of the corresponding slave.
	E16.76	The process data of the power supply unit does not match the configuration.	Check the process data mapping of parameter configuration. Ensure that the data length of the PLC configuration is consistent with the process data length of the power supply unit.
	E16.77	An internal serial communication fault occurs.	Check that Fd-10 (Communication protocol selection) is set to 5. Then, re-power on the power supply unit, and contact the agent or Inovance.
	E16.78	An internal SPI communication fault occurs.	Check that Fd-10 (Communication protocol selection) is set to 5. Then, re-power on the power supply unit, and contact the agent or Inovance.
Braking unit fault	E61.01	The braking unit is directly connected.	Check whether the braking resistor is short circuited. Check whether the brake transistor is directly connected.
	E61.02	Overcurrent occurs on the braking unit.	Check whether the resistance of the braking resistor is too low. Check for interference. Check whether an error occurs during hardware circuit detection.
	E61.03	Overload occurs on the braking unit.	Check whether the resistance and power of the braking resistor are too small.
	E61.04	An overheat warning is detected on the braking unit.	Lower the ambient temperature. Check whether the cooling fan runs properly. Clean the ventilation. Check whether the temperature sensor is damaged.
	E61.05	The braking unit overheats.	

9.4.2 Fault Codes and Solutions for the Drive Unit

Troubleshoot the fault of the drive unit according to the following table.

Fault Name	Operating Panel Display	Possible Cause	Solution
Abnormal current sampling	E01.01	The current sampling circuit is faulty.	Check whether mains power supply is on. Contact the agent or Inovance.
Contactor fault	E01.02	The driver board or power supply is faulty.	Contact the agent or Inovance.
		The contactor is faulty.	Contact the agent or Inovance.
		The surge protection device is faulty.	Contact the agent or Inovance.
Product model setup error	E01.05	Product model and hardware do not match.	Check whether the equipment model is wrong.
STO product model setup error	E01.06	Product hardware does not support STO.	Check whether there is no STO product model, and contact the manufacturer if so.
Overcurrent during acceleration	E02.00	A grounding fault or short circuit exists in the output circuit.	Check whether short-circuit occurs on the motor, motor cable, or contactor.
		The control mode is SVC or FVC but motor auto-tuning is not performed.	Set motor parameters according to motor nameplate and perform motor auto-tuning.
		The acceleration time is too short.	Increase the acceleration time.
		The overcurrent stall prevention parameters are set improperly.	Ensure that current limit is enabled (F3-19 = 1). The setting of F3-18 (Current limit level) is too large. Adjust it between 120% and 160%. The setting of F3-20 (Current limit gain) is too small. Adjust it between 20 and 40.
		Customized torque boost or V/F curve is not appropriate.	Adjust the customized torque boost or V/F curve.
		The spinning motor is started.	Enable the flying start function or start the motor after it stops.
		The drive suffers external interference.	View historical fault records. If the current value is far from the overcurrent level, find the interference source. If an external interference does not exist, the driver board or hall device may be faulty.

Fault Name	Operating Panel Display	Possible Cause	Solution
Overcurrent during deceleration	E03.00	A grounding fault or short circuit exists in the output circuit.	Check whether short-circuit occurs on the motor, motor cable, or contactor.
		The control mode is SVC or FVC but motor auto-tuning is not performed.	Set the motor parameters according to the motor nameplate and perform motor auto-tuning.
		The deceleration time is too short.	Increase the deceleration time.
		The overcurrent stall prevention parameters are set improperly.	Ensure that current limit is enabled (F3-19 = 1). The setting of F3-18 (Current limit level) is too large. Adjust it between 120% and 150%. The setting of F3-20 (Current limit gain) is too small. Adjust it between 20 and 40.
		The braking unit and braking resistor are not installed.	Install the braking unit and braking resistor.
		The drive suffers external interference.	View historical fault records. If the current value is far from the overcurrent level, find the interference source. If an external interference does not exist, the driver board or hall device may be faulty.
Overcurrent at constant speed	E04.00	A grounding fault or short circuit exists in the output circuit.	Check whether short-circuit occurs on the motor, motor cable, or contactor.
		The control mode is SVC or FVC but motor auto-tuning is not performed.	Set motor parameters according to motor nameplate and perform motor auto-tuning.
		The overcurrent stall prevention parameters are set improperly.	Ensure that current limit is enabled (F3-19 = 1). The setting of F3-18 (Current limit level) is too large. Adjust it between 120% and 150%. The setting of F3-20 (Current limit gain) is too small. Adjust it between 20 and 40.
		The drive power class is small.	If the output current exceeds the rated motor current or rated output current of the drive during stable running, replace a drive of larger power class.
		The drive suffers external interference.	View historical fault records. If the current value is far from the overcurrent level, find the interference source. If an external interference does not exist, the driver board or hall device may be faulty.

Fault Name	Operating Panel Display	Possible Cause	Solution
Overvoltage during acceleration	E05.00	Input voltage is too high.	Adjust input voltage to normal range.
		An external force drives the motor during acceleration.	Cancel the external force or install a braking resistor. The setting of F3-26 (Frequency rise threshold during voltage limit) is too small. Adjust it between 5 Hz and 15 Hz.
		The overvoltage stall prevention parameters are set improperly.	Ensure that the voltage limit function is enabled (F3-23 = 1). The setting of F3-22 (Voltage limit) is too large. Adjust it between 700 V and 770 V. The setting of F3-24 (Frequency gain for voltage limit) is too small. Adjust it between 30 and 50.
		The braking unit and braking resistor are not installed.	Install the braking unit and braking resistor.
		The acceleration time is too short.	Increase the acceleration time.
Overvoltage during deceleration	E06.00	The overvoltage stall prevention parameters are set improperly.	Ensure that the voltage limit function is enabled (F3-23 = 1). The setting of F3-22 (Voltage limit) is too large. Adjust it between 700 V and 770 V. The setting of F3-24 (Frequency gain for voltage limit) is too small. Adjust it between 30 and 50.
		An external force drives the motor during acceleration.	Cancel the external force or install a braking resistor. The setting of F3-26 (Frequency rise threshold during voltage limit) is too small. Adjust it between 5 Hz and 15 Hz.
		The deceleration time is too short.	Increase the deceleration time.
		The braking unit and braking resistor are not installed.	Install the braking unit and braking resistor.
Overvoltage at constant speed	E07.00	The overvoltage stall prevention parameters are set improperly.	Ensure that the voltage limit function is enabled (F3-23 = 1). The setting of F3-22 (Voltage limit) is too large. Adjust it between 700 V and 770 V. The setting of F3-24 (Frequency gain for voltage limit) is too small. Adjust it between 30 and 50.
		An external force drives the motor during acceleration.	Cancel the external force or install a braking resistor. The setting of F3-26 (Frequency rise threshold during voltage limit) is too small. Adjust it between 5 Hz and 15 Hz.
Undervoltage	E09.00	Instantaneous power failure occurs.	Enable the power dip ride through function (F9-59 ≠ 0).
		The drive's input voltage is not within the permissible range.	Adjust the voltage to the normal range.
		The bus voltage is abnormal.	Contact the agent or Inovance.
		The rectifier bridge, the driver board, or the control board are abnormal.	Contact the agent or Inovance.

Fault Name	Operating Panel Display	Possible Cause	Solution
Drive overload	E10.00	The load is too heavy or locked-rotor occurs on the motor.	Reduce the load or check motor and mechanical conditions.
		The drive power class is small.	Replace a drive of larger power class.
		The control mode is SVC or FVC but motor auto-tuning is not performed.	Set motor parameters according to motor nameplate and perform motor auto-tuning.
		The control mode is V/F but the setting of F3-01 (Torque boost) is too large.	Decrease the setting of F3-01 (Torque boost) in steps of 1% gradually or set F3-01 to zero (Automatic torque boost).
		Output phase loss occurs on the AC drive.	Check the output wiring of the AC drive.
Pulse-by-pulse current limit fault	E10.01	The load is too heavy or locked-rotor occurs on the motor.	Reduce the load or check motor and mechanical conditions.
		The AC drive power class is small.	Replace a drive of larger power class.
Motor overload	E11.00	F9-01 (Motor overload protection gain) is set improperly.	Set F9-01 (Motor overload protection gain) correctly. Increase its value to prolong the motor overload time.
		The load is too heavy or locked-rotor occurs on the motor.	Reduce the load or check motor and mechanical conditions.
Output phase loss	E13.00	The motor is faulty.	Check and ensure that the motor is without open circuit.
		The cable connecting the drive and the motor is abnormal.	Eliminate external faults.
		The drive's three-phase outputs are unbalanced when the motor is running.	Check whether the motor three-phase winding is normal.
		The driver board or the IGBT is abnormal.	Contact the agent or Inovance.
IGBT overheat	E14.00	The ambient temperature is too high.	Lower the ambient temperature.
		The ventilation is clogged.	Clean the ventilation.
		The fan is damaged.	Replace the cooling fan.
		The thermistor of IGBT is damaged.	Contact the agent or Inovance.
		The IGBT is damaged.	
External fault	E15.01	An external fault signal is input using DI (NO).	Eliminate external faults, and confirm that the mechanical condition allows restart (F8-18, Startup protection) and reset the operation.
	E15.02	An external fault signal is input using DI (NC).	

Fault Name	Operating Panel Display	Possible Cause	Solution
Communication fault	E16.01	Modbus communication times out.	Check whether the RS485 communication cable is correctly connected. Check whether Fd-04 (Modbus communication timeout) and PLC communication cycle are properly set.
	E16.11	CANopen communication times out.	Check whether CAN communication cable is correctly connected. Check parameters Fd-15 (Maximum value of node receiving error counter) to Fd-17 (Bus disconnection times within a period) for further action.
	E16.12	PDO mapping configured by CANopen does not match the actual communication mapping	Check the PDO mapping in group AF.
	E16.13	Timeout occurs on transmitting interactive data from the power supply unit to the drive unit.	Check whether the power supply unit is in operation. Check whether the communication cable from the power supply unit to the drive unit is correctly connected. Check whether the matching termination resistor is properly connected. Check whether Fd-12 (CAN baud rate) is correctly set.
	E16.14	The interactive data from the power supply unit to the drive unit is abnormal.	The power supply unit is faulty. Eliminate the faults.
	E16.15	Synchronous control communication times out.	Check the group A8 parameters to see whether the master station number is correct, and check whether the CAN2 cable is connected normally.
	E16.21	CANlink heartbeat times out.	Check whether CAN communication cable is correctly connected. Check parameters Fd-15 (Maximum value of node receiving error counter) to Fd-17 (Bus disconnection times within a period) for further action.
	E16.22	Conflicts are caused by the same CANlink station number.	Modify the CAN station numbers by using Fd-13 (CAN station No.).
	E16.31	PROFIBUS-DP communication times out (PROFIBUS-DP to CANopen gateway mode).	Check whether PROFIBUS-DP communication cable is correctly connected.

Fault Name	Operating Panel Display	Possible Cause	Solution
Communication fault	E16.34	Slaves are offline (PROFIBUS-DP to CANopen gateway).	Check whether the number displayed in "The number of devices" of PLC matches the actual quantity of stations. Check whether the station numbers of slaves are correctly set.
	E16.35	PROFIBUS-DP to CANopen gateway configuration parameters are set incorrectly.	Check whether the value of "NO. n" of PLC is consistent with that of AF-66/67 (Number of valid RPDOs/Number of valid TPDOs).
	E16.41	PROFIBUS-DP communication times out.	Check whether the PROFIBUS-DP communication cable is correctly connected.
	E16.42	PROFIBUS-DP to CANopen gateway configuration parameters are set incorrectly.	Check whether the value of "NO. 1" of PLC is consistent with that of AF-66/67 (Number of valid RPDOs/Number of valid TPDOs).
	E16.51	The EtherCAT synchronization frame is lost.	Check whether the EtherCAT network cable is normal and whether the connection is loose.
	E16.52	Wiring EEPROM with EtherCAT is faulty.	Contact Inovance or the agent for technical support.
	E16.53	EtherCAT initialization failed.	Contact Inovance or the agent for technical support.
	E16.54	EtherCAT state switchover failed (switching the EtherCAT state during running enabling).	Stop enabling and then switch the EtherCAT state.
	E16.81	The SPI communication of the EtherCAT module is interfered with or interrupted, or the SPI communication stops when the EtherCAT module is running.	Contact Inovance or the agent for technical support.
	E16.83	Bus synchronization is lost in the AC drive.	Contact Inovance or the agent for technical support.
External DC soft charge unit error	E17.05	The external DC soft charge unit is not connected or fails.	Check whether the external DC soft charge unit is faulty and properly connected. If the DC soft charge unit is not required, restore the tens position of F9-49 (Fault protection action selection 2) to the default value 5 (Cancelled).

Fault Name	Operating Panel Display	Possible Cause	Solution
Motor auto-tuning fault	E19.02	Synchronous motor magnetic pole angle auto-tuning is faulty.	The motor is not connected or output phase loss occurs.
	E19.04		
	E19.05	Synchronous motor initial magnetic pole angle auto-tuning is faulty.	Increase the setting of F2-29 (Synchronous motor initial angle detection current).
	E19.06	Stator resistance auto-tuning is faulty.	The motor is not connected. Set F1-03 (Rated motor current) according to the motor nameplate.
	E19.07		
	E19.08		
	E19.09	Asynchronous motor instantaneous leakage inductive reactance auto-tuning is faulty.	The motor is not connected or output phase loss occurs.
	E19.10		
	E19.11	Inertia auto-tuning is faulty.	Set F1-03 (Rated motor current) according to the motor nameplate. Increase the setting of F2-43 (Inertia auto-tuning and dynamic speed reference).
	E19.12	Timeout occurs on auto-tuning.	The motor is not connected or output phase loss occurs. Confirm the load is disconnected from the motor.
	E19.13		
	E19.14		
	E19.15		
	E19.16		
	E19.17		
	E19.19		
Motor auto-tuning fault	E19.20	Timeout occurs on synchronous motor no-load zero position angle auto-tuning.	Check feedback signal Z.
	E19.22		
	E19.23	Synchronous motor magnetic pole angle auto-tuning is faulty.	Set F1-03 (Rated motor current) according to the motor nameplate. Decrease the setting of F2-29 (Synchronous motor initial angle detection current).
	E19.24	Asynchronous motor instantaneous leakage inductive reactance auto-tuning is faulty.	The drive power class is small. Select the proper drive according to the power of motor.

Fault Name	Operating Panel Display	Possible Cause	Solution
Encoder fault	E20.00	Encoder wire-break occurs.	Repair the wire-break. Confirm the wiring of PG card is correct. Confirm the actual encoder pulses per revolution matches the setting value of F1-27 (Encoder pulses per revolution). Confirm the wiring of signal AB is correct.
	E20.01	The encoder is faulty.	
	E20.02	Encoder wire-break occurs.	
	E20.03	The synchronous motor no-load auto-tuning encoder is faulty.	
	E20.04	The synchronous motor no-load auto-tuning encoder is faulty.	
	E20.06	The synchronous motor auto-tuning encoder is faulty.	
	E20.07	The synchronous motor no-load auto-tuning encoder is faulty.	
	E20.08	The synchronous motor no-load auto-tuning encoder is faulty.	
	E20.09	The synchronous motor with-load auto-tuning encoder is faulty.	Check feedback signal Z and the wiring of PG card.
	E20.10	The synchronous motor encoder is faulty.	
	E20.11	The asynchronous motor FVC no-load auto-tuning encoder is faulty.	Confirm the encoder is correctly connected. Confirm the actual encoder pulses per revolution matches the setting value of F1-27 (Encoder pulses per revolution).
	E20.12	Error between encoder feedback speed and speed estimated by SVC is too large.	Confirm the encoder is correctly connected. Confirm the motor parameters is correctly set. Confirm motor auto-tuning is performed.
	E20.13	The resolver encoder wire-break occurs.	Confirm the encoder is correctly connected.
	E20.17	The wiring of the 23-bit encoder is faulty.	Check the wiring of the 23-bit encoder.
EEPROM read-write fault	E21.01	EEPROM read/write is abnormal.	1. If the writing is done through communication, ensure that you use the RAM address of the parameter. For the mapping rules of all RAM addresses to parameters, see section 6.2.4. 2. The EEROM chip is damaged. Contact the manufacturer to replace the control board.
	E21.02		
	E21.03		
	E21.04		

Fault Name	Operating Panel Display	Possible Cause	Solution
Motor auto-tuning warning	E22.00	The asynchronous motor stator resistance after auto-tuning is over range.	Set Group F1 (1st Motor Parameters) according to the motor nameplate. Perform auto-tuning when the motor is stopped.
	E22.01	The asynchronous motor rotor resistance after auto-tuning is over range.	
	E22.02	The asynchronous motor no-load current and mutual inductive reactance is over range. The no-load current and mutual inductive reactance is calculated according to the motor parameters and may be slightly inaccurate.	Set Group F1 (1st Motor Parameters) according to the motor nameplate. Confirm the motor is disconnected from the load.
	E22.03	The synchronous motor back EMF after auto-tuning is over range.	Set F1-02 (Rated motor voltage) according to the motor nameplate. Confirm the motor is disconnected from the load.
	E22.04	Inertia auto-tuning is faulty.	Set F1-03 (Rated motor current) according to the motor nameplate.
Short circuit to ground	E23.00	The motor is short circuited to the ground.	Replace the cable or motor.
Phase to phase short circuit	E24.00	Phase to phase short circuit occurs on the motor.	Check whether short-circuit occurs on the output UVW.
Power supply unit fault	E25.00	The power supply unit is faulty.	Eliminate the fault, such as input phase loss and overheat. 1: Operation enable 2: Incoming breaker feedback 3: Auxiliary breaker feedback 4: Leakage breaker feedback 6: Drive unit operation forbidden 7: Drive unit coast-to-stop 8: Drive unit shutdown by setting
	E25.12	The grid voltage is abnormal.	1: Check whether the three-phase power supply is normal. 2: Check whether the input cables break. 3: Check whether input terminals are connected properly. 4: Check the hardware voltage detection circuit. 5: Adjust the three-phase voltage to the allowable range. 6: Check whether the three-phase power supply is normal. 7. Check the hardware voltage detection circuit.

Fault Name	Operating Panel Display	Possible Cause	Solution
Power supply unit fault (continued)	E25.14	The IGBT is overheating.	1: Lower the ambient temperature. 2: Clean the air duct. 3: Replace the fan. 4: Contact Inovance or the agent for technical support.
	E25.16	A communication fault occurs.	1: Check whether the RS485 communication cable is connected properly. 2: Check whether the setting of Fd-04 (Modbus communication timeout) and PLC communication period are reasonable. 3: Check whether the CAN communication cable is connected properly. 4: Check Fd-15 (Maximum value of node receiving error counter) to Fd-17 (CANopen/CANlink bus disconnection times in a period) to obtain the interference information. 5: Check the PDO mapping of parameters in group AF. 6: Check whether the power supply unit is working. 7: Check whether the network cables are connected for the power supply unit and drive unit. 8: Check whether the termination resistor is connected properly. 9: Check Fd-12 (CAN baud rate) to see whether the CAN baud rate is consistent. 10: If the power supply unit is faulty, rectify the fault. 11: Check whether the CAN communication cable is connected properly. 12: Check Fd-15 (Maximum value of node receiving error counter) to Fd-17 (CANopen/CANlink bus disconnection times in a period) to obtain the interference information. 13: Modify the CAN station numbers by using Fd-13 (CAN station No.). 14: Check whether the PROFIBUS-DP cable is connected properly. 15: Check whether the number displayed in "The number of devices" of PLC matches the actual quantity of stations. 16: Check whether the station numbers of slaves are correctly set. 17: Check whether the value of "NO.n" of PLC is consistent with that of AF-66/AF-67 (Number of valid RPDOs/Number of valid TPDOs). 18: Check whether the PROFIBUS-DP cable is connected properly. 19: Check whether the value of "No.1" of PLC is consistent with that of AF-66/AF-67 (Number of valid RPDOs/Number of valid TPDOs).
	E25.21	The EEPROM is faulty.	Contact Inovance or the agent for technical support.

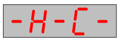
Fault Name	Operating Panel Display	Possible Cause	Solution
Power supply unit fault (continued)	E25.61	The braking unit is faulty.	1: Check whether the braking resistor is short circuited. 2: Check whether the braking transistor is short circuited. 3: Check whether the braking resistance and power class of the AC drive are too small. 4: Check whether external interference exists. 5: Check whether the hardware circuit detection is normal. 6: Check whether the braking resistance and power class of the AC drive are too small. 7. Lower the ambient temperature. 8: Check whether the cooling fan works properly. 9: Clean the air duct. 10: Check whether the temperature sensor is damaged.
Accumulative running time reached	E26.00	The accumulative running time reached the set value.	Clear the record by parameter initialization.
User-defined fault 1	E27.00	The signal of user-defined fault 1 is input through the multi-functional terminal DI.	Perform the reset operation.
		The signal of user-defined fault 1 is input through the virtual I/O.	Perform the reset operation.
User-defined fault 2	E28.00	The signal of user-defined fault 2 is input through the multi-functional terminal DI.	Perform the reset operation.
		The signal of user-defined fault 2 is input through the virtual I/O.	Perform the reset operation.
Accumulative power-on time reached	E29.00	The accumulative power-on time reached the set value.	Clear the record by parameter initialization.
Load loss	E30.00	The operation current of the drive is smaller than F9-64 (Load loss detection level).	Check whether the load is disconnected or ensure that F9-64 (Load loss detection level) and F9-65 (Load loss detection time) are set based on the actual conditions.
PID Feedback loss	E31.00	PID feedback is smaller than FA-26 (Detection level of PID feedback loss).	Check the PID feedback signal or set FA-26 (Detection level of PID feedback loss) correctly.

Fault Name	Operating Panel Display	Possible Cause	Solution
Speed error	E42.00	Encoder parameters are set improperly.	Set encoder parameters properly.
		Motor auto-tuning is not performed.	Perform motor auto-tuning.
		F9-69 (Detection level of speed deviation excessive) and F9-70 (Detection time of speed deviation excessive) are set incorrectly.	Set F9-69 (Detection level of speed deviation excessive) and F9-70 (Detection time of speed deviation excessive) correctly based on actual condition.
Motor overspeed	E43.00	Encoder parameters are set improperly.	Set encoder parameters properly.
		Motor auto-tuning is not performed.	Perform motor auto-tuning.
		F9-67 (Overspeed detection level) and F9-68 (Overspeed detection time) are set incorrectly.	Set F9-67 (Overspeed detection level) and F9-68 (Overspeed detection time) correctly based on the actual situation.
Motor overheat	E45.00	Cable connection of the temperature sensor becomes loose.	Check cable connection of the temperature sensor.
		The motor temperature is too high.	Increase the carrier frequency or take other measures to cool the motor.
		The setting of F9-57 (Motor overheat protection threshold) is too small.	Adjust the setting of motor overheat protection threshold between 90°C to 100°C .
Improper master/slave setting	E46.01	The setting of A8-10 (Master/Slave selection in speed and position control), A8-50 (Master/Slave selection in load allocation), and A8-70 (Master/Slave selection in droop control) is different.	Set A8-10 (Master/Slave selection in speed and position control), A8-50 (Master/Slave selection in load allocation), and A8-70 (Master/Slave selection in droop control) to Slave.
STO fault/ trigerring	E47.00	STO fault occured.	Check whether F8-54 (STO function) is set to 1 (Enabled). If an error is displayed on the operating panel and STO is enabled, check whether drive unit terminals STO1 and STO2 have 24 V input.

Fault Name	Operating Panel Display	Possible Cause	Solution
Home abnormal	E54.01	The AC drive does not receive valid home data after the time set by B4-18 (Home searching time limit) during home searching.	1: Check whether the home signal is connected properly. 2: Check whether B4-05 (Position control home signal source) is set properly. 3: Check whether the home searching timeout is set too short. 4: Check whether the home searching speed is too low. 5: When home data is received through the DI, check whether realted terminal function (68) is set properly. When the encoder Z signal is uased as the home, check whether the Z signal is connected and whether the periodic Z signal exists.
	E54.02	When the Z signal is used as the home, the position deviation between adjacent Z signals exceeds the value of B4-19 (Home deviation threshold).	1: The encoder signal suffers from interference. Check the field wiring and check whether the shieled cable of the encoder is connected properly. 2: The encoder Z signal is abnormal. Manually rotate the motor and check U2-75 [Adjacent home position deviation (low 16 bits)] and U-76 [Adjacent home position deviation (high 16 bits)] to see whether the adjacent home position deviation is normal. If abnormal, the encoder may be faulty.
	E54.03	In the absolute positioning or fixed length degree positioning mode, the times that the AC drive does not receive the normal home signal when passing the home position is greater than the value of B4-67 (Home loss threshold during home correction).	1: Check whether the home signal is connected properly. 2: The home signal suffers from interference. 3: The DI filter time is too large, causing DI home signal valid. Reduce the DI home filter time properly. 4: The DI home time is too short, so the home signal cannot be collected.
Position deviation large	E55.00	In position synchronization mode, the pulse deviation is too large, the main reason is that the slave can not follow the host pulse, the detection principle is that when the host and slave pulse deviation value is more than A8-32 (Detection threshold of excessive deviation), and the duration is more than A8-33 (Detection time of excessive deviation)	Set A8-32 (Detection threshold of excessive deviation) and A8-33 (Detection time of excessive deviation).

Fault Name	Operating Panel Display	Possible Cause	Solution
Limit exceeded	E58.01	1: The set frequency is reverse and feedback frequency exceeds 2 Hz in the forward direction when the DI forward limit is valid. 2: The set frequency is forward when the DI forward limit is valid.	1: Check whether the DI forward and reverse limit settings and directions are correct. 2: Check the field wiring to see whether the limit signal suffers from interference. 3: Check whether the position of the DI limit proximity switch is correct. 4: Check whether reverse slide exists.
	E58.02	1: The set frequency is forward and feedback frequency exceeds 2 Hz in the reverse direction when the DI reverse limit is valid. 2: The set frequency is reverse when the DI reverse limit is valid.	
	E58.03	In the absolute postioning mode, the current position exceeeds the forward limit position (B4-63 and B4-64) and the set frequency is forward.	Check whether the forward and reverse limit positions are correct.
	E58.04	In the absolute postioning mode, the current position exceeeds the reverse limit position (B4-65 and B4-66) and the set frequency is reverse.	
Braking fault	E61.01	Shoot-through of braking unit	Ensure that the brake pipe is normal; Check whether there is an external resistor.
	E61.02	Overcurrent of braking unit	Increase the braking resistance; Troubleshoot the over-high bus voltage.
	E61.03	Overload of braking unit	
	E61.04	Overheated brake pipe	Troubleshoot the over-high bus voltage; Decrease the ambient temperature. Ensure that the air filter is not clogged; Ensure that the fan works normally. Ensure that the thermistor works normally. Ensure that the brake pipe is normal.
Fan fault	E80.00	Fan fault	Ensure that the fan on the drive unit is connected correctly. Ensure that the fan rotates freely.

9.5 Common Symptoms and Diagnostics

No.	Fault Symptom	Possible Cause	Solution
1	There is no display upon power-on. 	There is no power supply to the drive or the power input to the drive is too low.	Check the power supply.
		The switch-mode power supply on the driver board of the drive is faulty.	Replace the drive and/or the power board, or contact the agent or Inovance for technical support.
		The control board or the operating panel is faulty.	Contact the agent or Inovance for technical support.
		The rectifier bridge is damaged.	
2	"HC" is displayed upon power-on. 	Related components on the control board are damaged.	Contact the agent or Inovance for technical support.
		The motor or the motor cable is short circuited to the ground.	
		The hall device is faulty.	
		The mains voltage is too low.	
3	"E23.00" is displayed upon power-on. 	The motor or the motor cable is short circuited to the ground.	Check the insulation status of the motor and the output cable with a megger.
		The drive is damaged.	Contact the agent or Inovance for technical support.
4	The drive display is normal upon power-on, but after running the drive displays "HC" and stops immediately. 	The cooling fan is damaged or does not rotate.	Replace the damaged fan.
		The cable of the external control terminal is short circuited.	Eliminate the external short-circuit fault.
5	Err14 (IGBT overheat) is detected frequently. 	The setting of carrier frequency is too high.	Reduce F0-15 (Carrier frequency).
		The cooling fan is damaged, or the air filter is blocked.	Replace the cooling fan and clean the air filter.
		Components (thermocouple or others) inside the drive are damaged.	Contact the agent or Inovance for technical support.
6	The motor does not rotate after the drive runs.	The cabling between the drive and motor is abnormal.	Check that cabling between the drive and the motor is normal.
		The motor parameters in group F1 are set improperly.	Restore the factory parameters and reset the following parameters properly: ◆ Encoder parameters ◆ Motor ratings, such as rated motor frequency and rated motor speed ◆ F0-01 (1st motor control mode) and F0-02 (Command source selection) ◆ F3-01 (Torque boost) in V/F control under heavy-load start
		The driver board is faulty.	Contact the agent or Inovance for technical support.

No.	Fault Symptom	Possible Cause	Solution
7	DI terminals are disabled.	The related parameters are set incorrectly.	Check and reset the parameters in group F4 again.
		The external signal is incorrect.	Re-connect the external signal cable.
		The jumper across OP and +24 V becomes loose.	Re-confirm the jumper bar across OP and +24 V.
		The control board is faulty.	Contact the agent or Inovance for technical support.
8	Motor speed does not rise in FVC control.	The encoder is faulty.	Replace the encoder and re-confirm cable connection.
		The PG card is faulty.	Contact the agent or Inovance for technical support.
		The driver board is faulty.	
9	The drive detects overcurrent and overvoltage frequently.	The motor parameters in group F1 are set improperly.	Set the motor parameters in group F1 or perform motor auto-tuning again.
		The acceleration/deceleration time is improper.	Set proper acceleration/deceleration time.
		The load fluctuates.	Contact the agent or Inovance for technical support.
10	The drive coasts to stop or has no DC injection braking during deceleration or deceleration to stop.	The encoder suffers wire-break or voltage limit function is enabled (F3-23 = 1).	If the drive is in FVC control (F0-01=1), re-confirm encode cable connection. If the braking resistor is installed, disable voltage limit function (F3-23 = 0).
11	Deceleration or motor coast to stop at deceleration or no braking ability	The encoder cable is broken or speed loss protection is valid.	Check the encoder wiring in case of FVC (F0-01 = 1). If the braking resistor has been configured, set F3-23 (Voltage limit selection) to 0 (Disabled).

Notes for dual-axis models:

- When A1 is selected to be the current axis, and failed somehow, the operating screen shows a corresponding fault code directly.
- If the A2 fails and A1 does not, the screen displays A2-Er to show A2 axis failure.
- If the current axis is A2, and A1 axis fails, the screen displays the A1-Er failure notice.
- If both axes are faulty, then the screen shows current axis failure notice directly.

Fault name	Screen Display	Fault Cause	Fault Handling
A1 axis fault indication	A1-Er	A1 axis fails due to the corresponding A1 fault code	Handle the fault based on the fault code.
A2 axis fault indication	A2-Er	A2 axis fails due to the corresponding A2 fault code	Handle the fault based on the fault code.

Memo NO. ___________

Date / /

10 Maintenance and Inspection

Safety Information

DANGER

- Do not connect or disconnect wires while the power is on.
- Disconnect all power and wait for at least 10 minutes. Do not touch any terminals before the capacitors have fully discharged.
- Do not modify or disconnect wires, remove optional extension card, or replace the cooling fan while the power is on.
- Make sure to connect the motor-side grounding terminal. Failure to comply may result in electric shock due to touching motor housing.
- Do not allow unqualified personnel to do the repair and maintenance work.
- Installation, wiring, commissioning, repair and maintenance, and component replacement must be performed only by qualified technicians.

WARNING

- Do not run the drive with the front cover removed.
- 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 instructions.
- Tighten all terminal screws based on the specified tightening torque.
- Ensure that input voltage is within the permissible range. Incorrect input voltage of the main circuit may result in abnormal running.
- Keep combustible materials far away from the drive or mount the drive on incombustible surfaces.

CAUTION

- Replace the cooling fan in correct ways as specified in this chapter. Ensure correct air outlet direction of the fan. Incorrect air direction will diminish the cooling effects.
- Do not connect or disconnect the motor while the drive is running. Failure to comply may result in electric shock and damage to the drive.
- Use shielded cables for control circuit wiring.
- Meanwhile, ground the shield to the grounding terminal reliably.
- Do not modify the drive circuitry. Failure to comply will damage the drive.
- Make sure to connect the output terminals of the drive and the terminals of the motor correctly.
- To change the motor running direction, change the connection to the output terminals of the drive.
- Do not operate the drive that has been damaged. This is to prevent further damage to external equipment.

10.1 Daily Inspection

Influence of ambient temperature, humidity, dust, and vibration will cause aging of components in the drive, which may cause potential faults or reduce the product life. Therefore, routine and periodic maintenance is necessary. More frequent inspection will be required if the drive is used in harsh environments, such as:

- High ambient temperature
- Frequent starting and stopping
- Fluctuations in the AC power supply or load
- Other harsh environments

Check the following items daily to avoid deterioration in performance or product. Copy this checklist and sign the "Checked" column after each inspection.

Inspection Item	Inspection Points	Solutions	Checked
Motor	Inspect whether the abnormal sounds and vibration occur on the motor.	◆ Check whether the mechanical connection is normal. ◆ Check whether output phase loss occurs on the motor. ◆ Check whether retaining screws of the motor are tightened.	
Fan	Inspect whether the cooling fan of the drive and motor work abnormally.	◆ Check running of the cooling fan of the drive. ◆ Check whether the cooling fan of the motor is normal. ◆ Check whether the ventilation is clogged. ◆ Check whether ambient temperature is within the permissible range.	
Installation environment	Inspect whether the cabinet and cable duct are abnormal.	◆ Check for input and output cables with insulation damaged. ◆ Check for vibration of hanging bracket. ◆ Check whether ground bars and terminals become loose or get corroded.	
Load	Inspect whether the running current of the drive exceeds the rated current of the drive and motor for a certain period.	◆ Check whether motor parameters are set properly. ◆ Check whether the motor is overloaded. ◆ Check whether the mechanical vibration is severe (allowed range: < 0.6 g).	
Input voltage	Inspect whether the power voltage of the main and control circuits is normal.	◆ Check that the input voltage is within the allowed range. ◆ Check whether start of heavy load exists.	

10.2 Periodic Inspection

10.2.1 Periodic Inspection Items

Always keep the drive clean. Clear away dust, especially metal powder, on the surface of the drive, to prevent dust from entering the drive. Clear oil dirt from the cooling fan of the drive.

DANGER

◆ Do not perform inspection while the power is on.

◆ Disconnect all power and wait for at least 10 minutes. Do not touch any terminal before the capacitors have fully discharged.

Inspection Item	Inspection Point	Solution	Checked
General	Inspect for wastes, dirt, and dust on the surface of the drive, and capacitor leakage.	◆ Check whether the cabinet of the power supply unit or drive unit is powered off. ◆ Use a vacuum cleaner to suck up wastes and dust to prevent direct touching. ◆ Wipe surface dirt gently with a soft cloth immersed in neutral detergent. ◆ Contact Inovance for electrolytic capacitor replacement in case of capacitor leakage.	
Cables	Inspect power cables and connections for discoloration. Inspect wiring insulation for aging or wear.	◆ Replace cracked cables. ◆ Replace damaged terminals.	

Inspection Item	Inspection Point	Solution	Checked
Peripheral devices such as relay and contactor	Inspect contactors and relays for excessive noise during operation. Inspect coils for signs of overheating such as melted or cracked insulation.	◆ Replace abnormal peripheral devices.	
Ventilation	Inspect whether ventilation and heatsink are clogged. Check whether the fan is damaged.	◆ Clean ventilation. ◆ Replace the fan.	
Control circuit	Inspect for control components in poor contact. Inspect for loose terminal screws. Inspect for control cables with cracked insulation.	◆ Clear away foreign matters on the surface of control cables and terminals. ◆ Replace damaged or corroded control cables.	

10.2.2 Insulation Test on the Main Circuit

NOTE

◆ Before measuring insulation resistance with megameter (500 VDC megameter recommended), disconnect the main circuit from the drive.

◆ Do not conduct the dielectric strength test. A high voltage (> 500 V) test is not required because it has been completed before delivery.

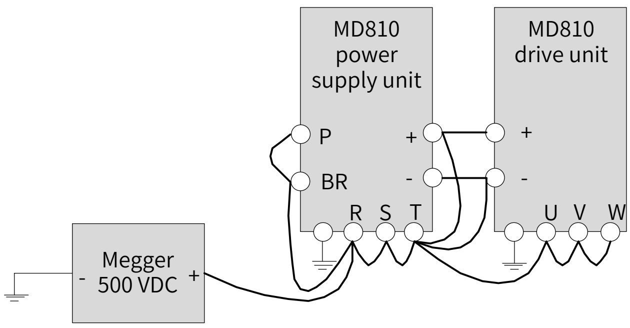


Figure 10-1 Test insulation on the main circuit

The measured insulation resistance must be greater than 5 MΩ.

Before test, remove the VDR screw from the power supply unit, whose location is shown in the following figure.

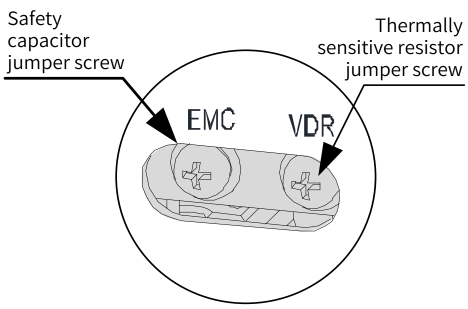


Figure 10-2 Locations of ground jumpers of the VDR screw and EMC screw

NOTE

◆ For details about the locations of ground jumpers of the VDR screw and EMC screw, see "Figure 3-2 Terminal arrangement and size of the power supply unit (booksize, unit: mm)" and "Figure 3-3 Terminal arrangement and size of the power supply unit (vertical tower, unit: mm)"

10.3 Replacing Cooling Fans

Cooling fans are wear parts and have a service life not less than 5 years[1].

[1] The standard service time indicates the service time when the drive is used in the following conditions. You can determine when to replace these parts according to the actual operating time.

1) Ambient temperature: about 40°C on average yearly
2) Load rate: below 80%
3) Operating rate: 24 hours per day

1) Possible damage causes: bearing worn and blade aging
2) Judging criteria: whether there is crack on the blade; whether there is abnormal vibration noise upon startup; whether the blade runs abnormally
3) Removal and installation:
   - Depress the fan cover hook and pull the fan outward.
   - After the replacement is completed, check that the air flow direction is from bottom to top.

NOTE

◆ Power off the power supply units and drive units before replacing the fans.

10.3.1 Number of Cooling Fans

Table 10-1 Size and number of fans on the power supply units

Model	Number of Bus Capacitor Cooling Fans			
	40 x 40 x 28 (mm)	80 x 80 x 25 (mm)	80 x 80 x 32 (mm)	80 x 80 x 38 (mm)
MD810-20M4T22GXXX	1	-	-	-
MD810-20M4T45GXXX	-	1	-	-
MD810-20M4T110GXXX	-	-	2	-
MD810-20M4T160GXXX(W)	-	-	-	3
MD810-20M4T355GXXX	-	-	-	3

Table 10-2 Size and number of fans on the drive units

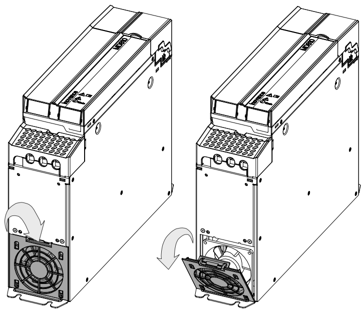
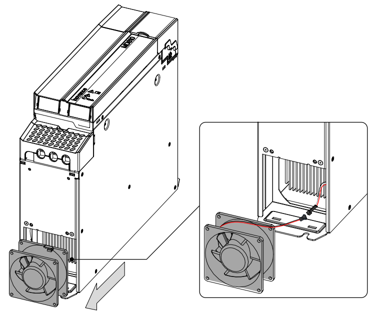
Model	Number of Fans						
	40 x 40 x 28 (mm)	50 x 50 x 15 (mm)	80 x 80 x 25 (mm)	80 x 80 x 32 (mm)	80 x 80 x 38 (mm)	120 x 120 x 38 (mm)	172 x 150 x 51 (mm)
MD810-50M4T1.5GXXX	1	-	-	-	-	-	-
MD810-50M4T2.2GXXX	1	-	-	-	-	-	-
MD810-50M4T3.7GXXX	1	-	-	-	-	-	-
MD810-50M4T5.5GXXX	1	-	-	-	-	-	-
MD810-50M4T7.5GXXX	1	-	-	-	-	-	-
MD810-50M4T11GXXX	-	-	1	-	-	-	-
MD810-50M4T15GXXX	-	-	1	-	-	-	-
MD810-50M4T18.5GXXX	-	-	-	1	-	-	-

Model	Number of Fans						
	40 x 40 x 28 (mm)	50 x 50 x 15 (mm)	80 x 80 x 25 (mm)	80 x 80 x 32 (mm)	80 x 80 x 38 (mm)	120 x 120 x 38 (mm)	172 x 150 x 51 (mm)
MD810-50M4T22GXXX	-	1	-	1	-	-	-
MD810-50M4T30GXXX	-	1	-	1	-	-	-
MD810-50M4T37GXXX	-	1	-	-	1	-	-
MD810-50M4T45GXXX	-	-	-	2	-	-	-
MD810-50M4T55GXXX	-	-	-	-	2	-	-
MD810-50M4T75GXXX	-	-	-	-	2	-	-
MD810-50M4T90GXXX	-	-	-	3	-	-	-
MD810-50M4T110GXXX	-	-	-	-	3	-	-
MD810-50M4T132GXXX	-	-	-	-	3	-	-
MD810-50M4T160GXXX	-	-	-	-	3	-	-
MD810-50M4T200GXXXH	-	-	-	-	-	3	-
MD810-50M4T250GXXXH	-	-	-	-	-	3	-
MD810-50M4T315GXXXH	-	-	-	-	-	-	3
MD810-50M4T355GXXXH	-	-	-	-	-	-	3
MD810-50M4TD1.5GXXX	1	-	-	-	-	-	-
MD810-50M4TD2.2GXXX	1	-	-	-	-	-	-
MD810-50M4TD3.7GXXX	1	-	-	-	-	-	-
MD810-50M4TD5.5GXXX	1	-	-	-	-	-	-
MD810-50M4TD7.5GXXX	-	-	1	-	-	-	-
MD810-50M4TD11GXXX	-	-	1	-	-	-	-
MD810-50M4TD15GXXX	-	-	1	-	-	-	-
MD810-50M4TD18.5GXXX	-	-	-	-	1	-	-

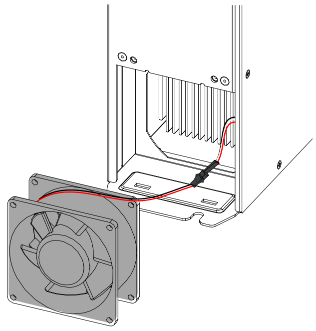
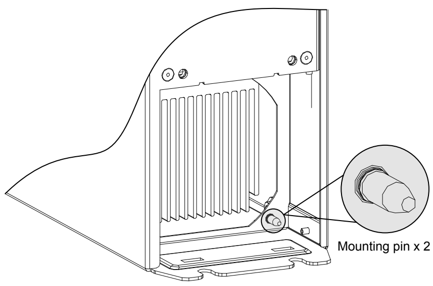
10.3.2 Removing and Installing Fans

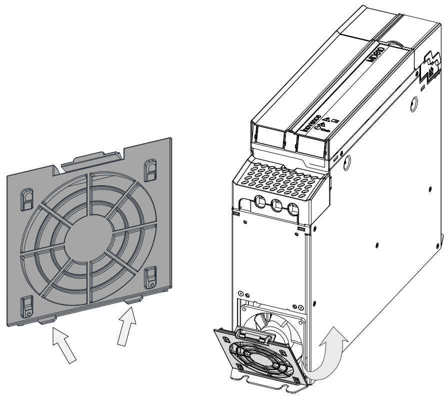
1) Removing and installing fans of the power supply unit

■ Removing the fan (80 mm x 80 mm) of a booksize unit

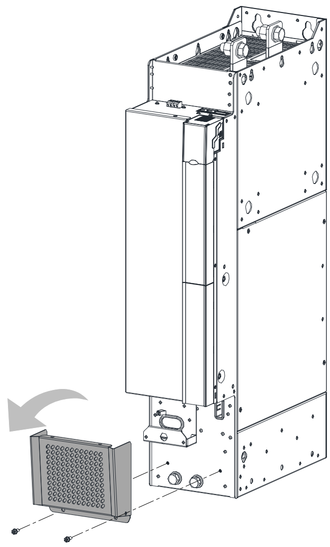
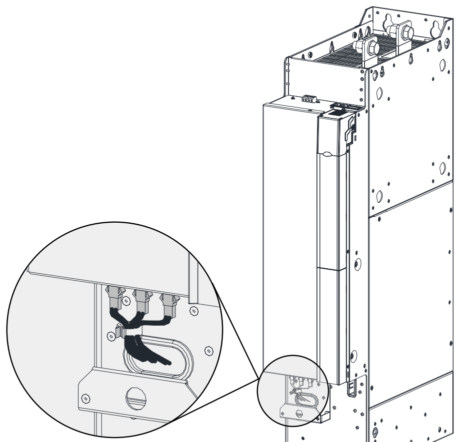
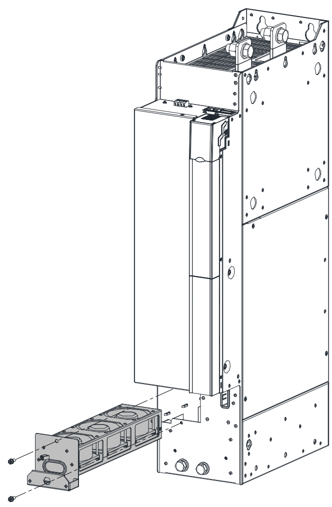
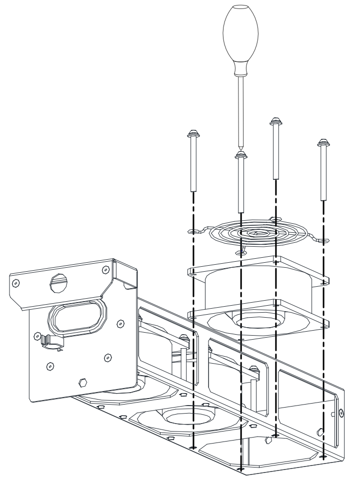
Removal	
1) Depress the fan cover hook and take the fan cover off the top of the power supply unit. 	2) Pull the fan outward and disconnect the pluggable connector of power cable. 

■ Installing the fan (80 mm x 80 mm) of a booksize unit

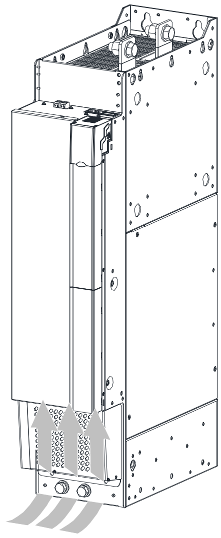
Installing
1) Install the fan in reverse order of removal. Pay attention to the fan direction.
◆ Plug in the fan power cable to the fan power socket. 
◆ Install the fan into the power supply unit and ensure that the mounting pins are aligned. 

Installing
2) Insert the two guide pins into the square holes and then press in the hook. 
3) After the replacement is complete, check that the air flow direction is from bottom to top.

■ Removing the fan of a vertical tower unit

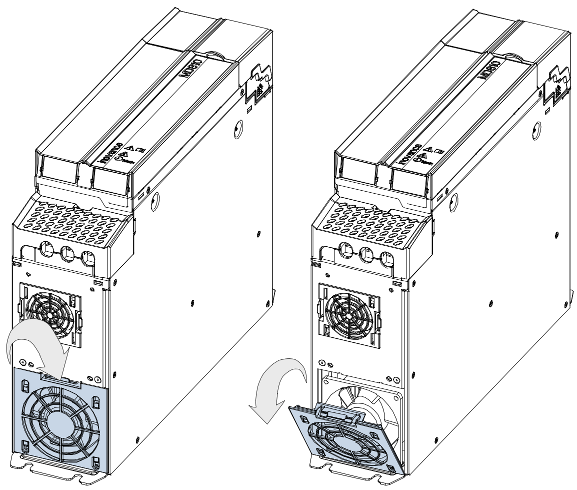
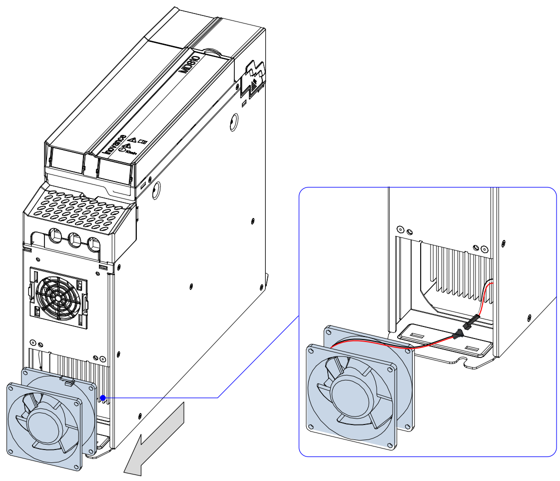
Removal	
1) Disconnect the six screws and remove the front cover. 	2) Disconnect the fan power cable connector from the power supply unit. Each fan has a power cable connector. 
3) Remove two screws from the fan box and draw the fan box out in the direction of the arrow. 	4) Loosen four screws from each fan cover and remove the fan. 

■ Installing the fan of a vertical tower unit

Installing
Install the fan in reverse order of removal. Pay attention to the fan direction. ◆ Align the fan box to the rail and push it into the power supply unit. ◆ Connect the fan power cable connectors and fix the two screws. After the replacement is complete, check that the air flow direction is from bottom to top. 

2) Removing and installing fans of the drive unit

■ Removing the fan (80 mm x 80 mm) of a booksize unit

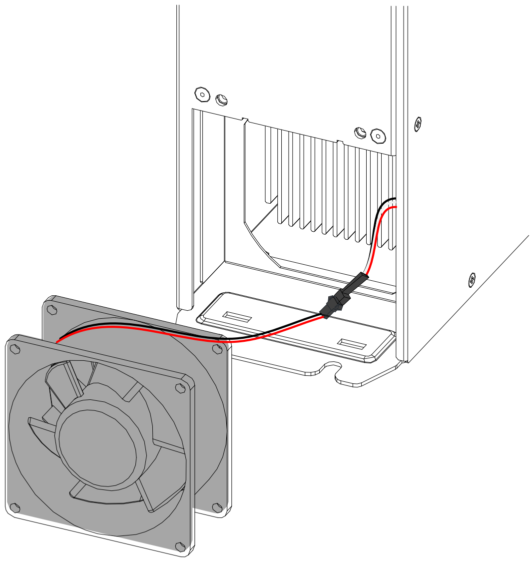
Removal	
1) Depress the fan cover hook and take the fan cover off the top of the unit. 	2) Pull the fan outward and disconnect the pluggable connector of power cable. 

■ Installing the fan (80 mm x 80 mm) of a booksize unit

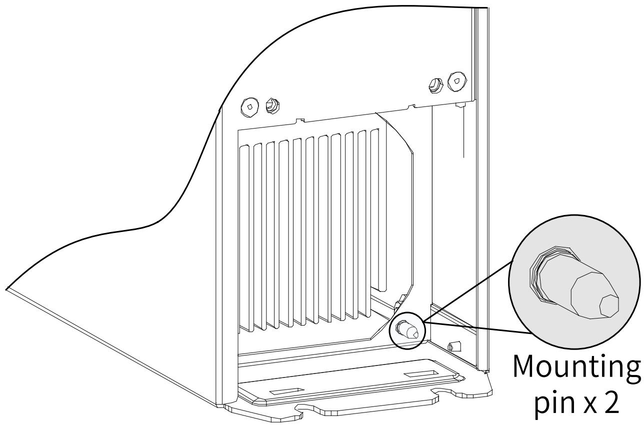
Installing

1) Install the fan in reverse order of removal. Pay attention to the fan direction.

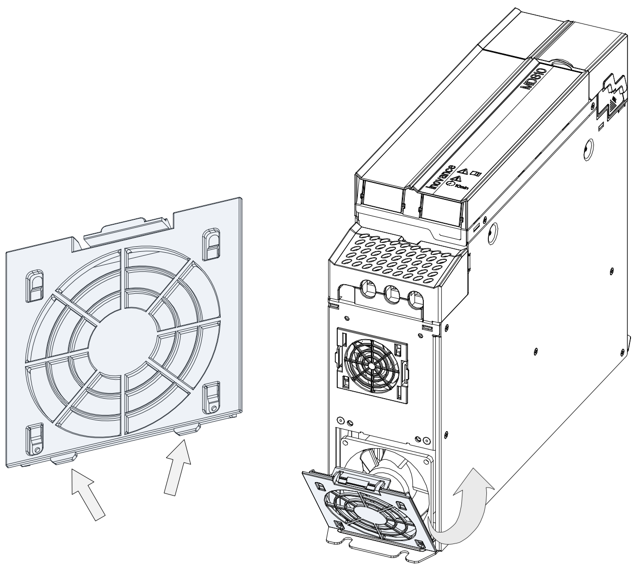
◆ Plug in the fan power cable to the fan power socket.



◆ Install the fan into the unit and ensure that the mounting pins are aligned.

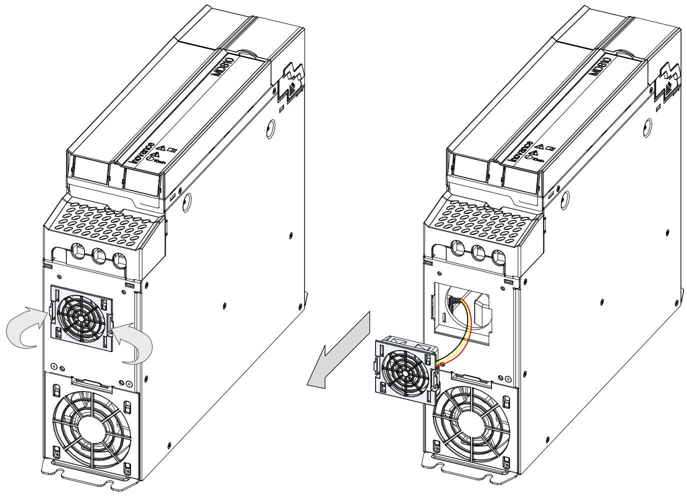
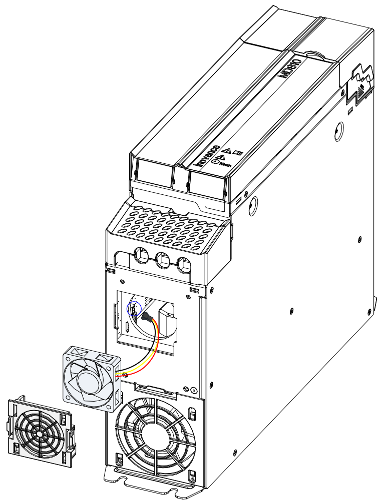


2) Insert the two guide pins into the square holes and then press in the hook.

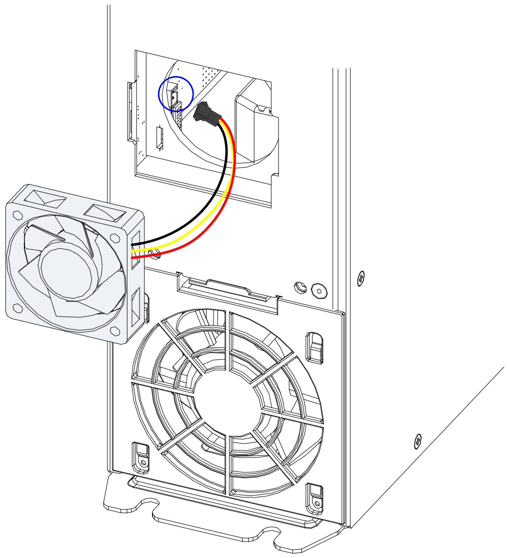


3) After the replacement is complete, check that the air flow direction is from bottom to top.

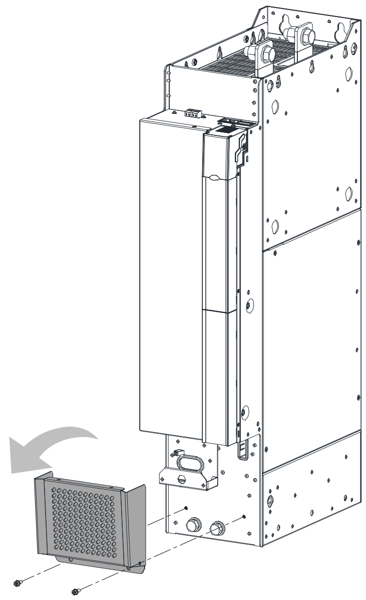
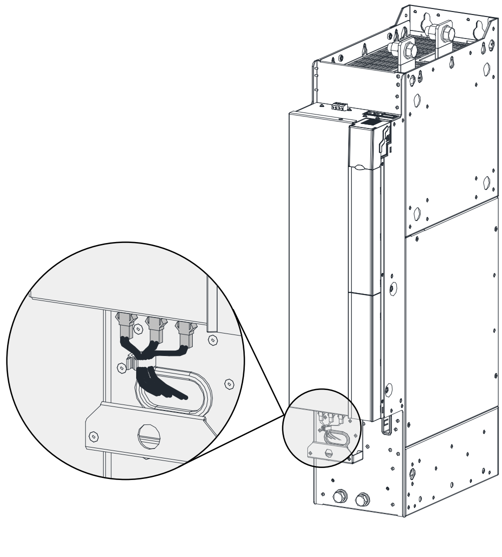
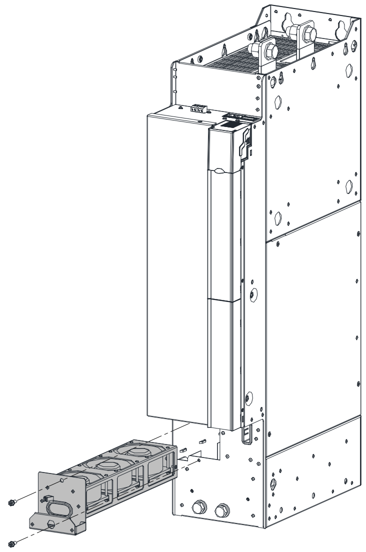
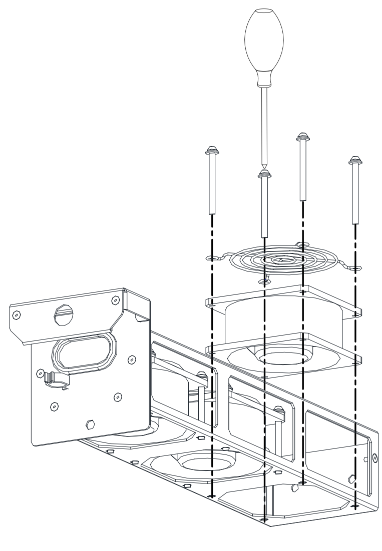
■ Removing the fan (40 mm x 40 mm, 50 mm x 50 mm) of a booksize unit

Removal	
1) Depress the fan cover hooks on the left and right at the same time, and take the fan cover and fan out of the unit. 	2) Pull the fan cover upward to remove it from the fan. Then, disconnect the pluggable connector of power cable. 

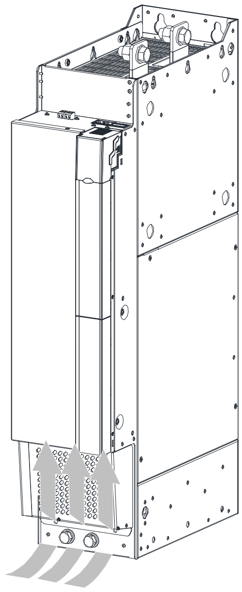
■ Installing the fan (40 mm x 40 mm, 50 mm x 50 mm) of a booksize unit

Installing
Install the fan in reverse order of removal. Pay attention to the fan direction. ◆ Plug in the fan power cable to the fan power socket.  ◆ Put the fan in the fan cover. Install the fan into the unit and ensure that the hooks on both sides are inserted in the holders on the unit. ◆ After the replacement is complete, check that the air flow direction is from bottom to top.

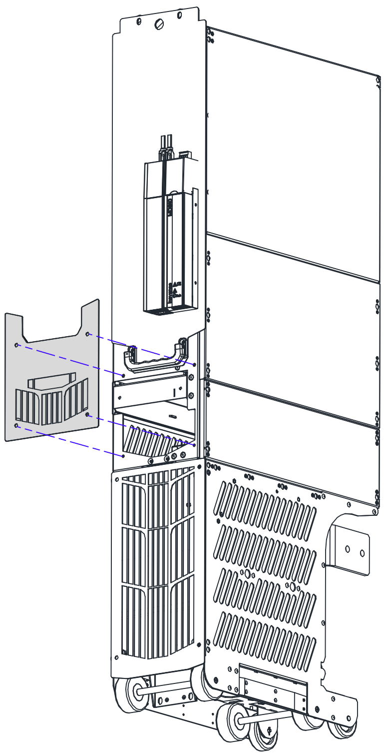
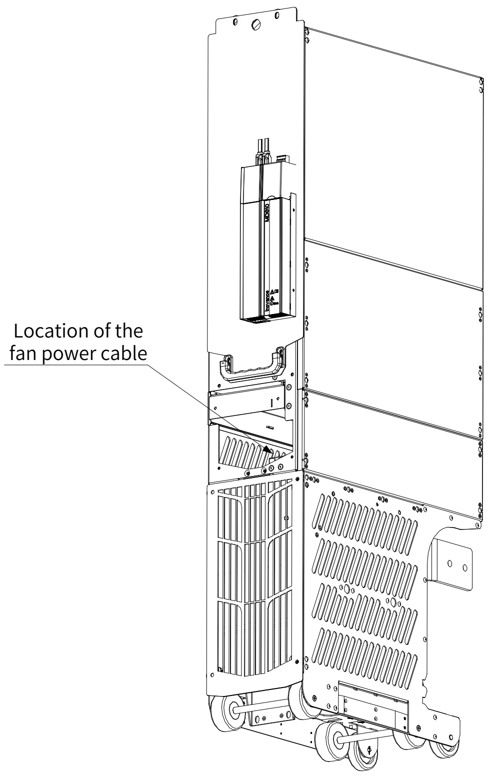
■ Removing the fan of a vertical tower unit (180 mm wide)

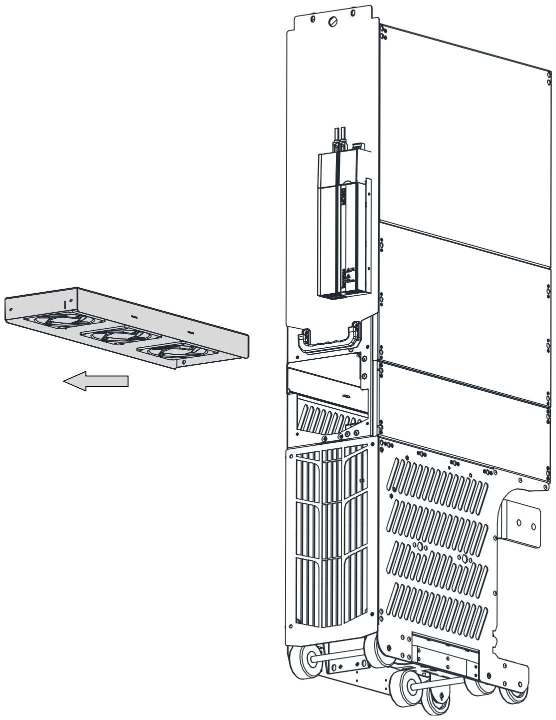
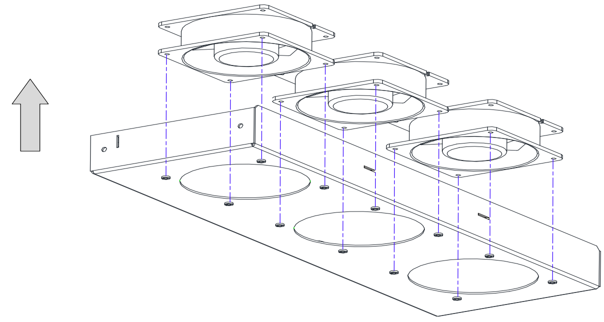
Removal	
1) Disconnect the six screws and remove the front cover. 	2) Disconnect the fan power cable connector from the unit. Each fan has a power cable connector. 
3) Remove two screws from the fan box and draw the fan box out in the direction of the arrow. 	4) Loosen four screws from each fan cover and remove the fan. 

■ Installing the fan of a vertical tower unit (180 mm wide)

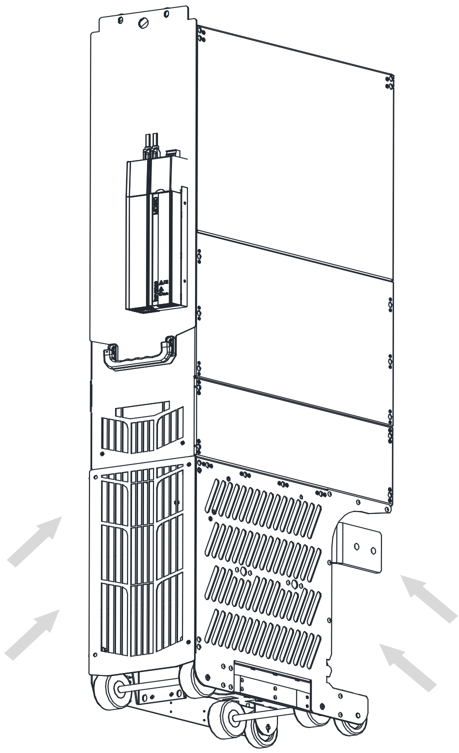
Installing
Install the fan in reverse order of removal. Pay attention to the fan direction. ◆ Align the fan box to the rail and push it into the unit. ◆ Connect the fan power cable connectors before fixing the fan box. After the replacement is complete, check that the air flow direction is from bottom to top. 

■ Removing the fan of a vertical tower unit (230 mm wide)

Removal	
1) Disconnect the four screws and remove the front cover. 	2) Disconnect the fan power cable connector from the unit. Each fan has a power cable connector. 

<table>
<tr><th colspan="2">Removal</th></tr>
<tr><td>3) Remove the fan box along the arrow shown in the figure.
</td><td>4) Remove the four screws on each fan cover.
</td></tr>
</table>

■ Installing the fan of a vertical tower unit (230 mm wide)

Installing
Install the fan in reverse order of removal. Pay attention to the fan direction. ◆ Align the fan box to the rail and push it into the unit. ◆ Connect the fan power cable connectors before fixing the fan box. After the replacement is complete, check that the air flow direction is from bottom to top. 

11 Technical Data and Model Selection

11.1 Technical Data

11.1.1 Technical Data of the Power Supply Unit

Table 11-1 Rated data of the power suppy unit

Power Supply Unit Model	Rated Power (kW)	Power Capacity (kVA)	Input Current AC (A)	Output current DC (A)	Braking Unit	Thermal Losses (W)
Three-phase 380–480 V, 50 Hz/60 Hz (47–63 Hz)						
MD810-20M4T22GXXX	22	54	49	56	(Optional) Built-in	176
MD810-20M4T45GXXX	45	81	89	107	(Optional) Built-in	290
MD810-20M4T110GXXX	110	179	196	240	(Optional) External MDBUN series	590
MD810-20M4T160GXXX(W)	160	263	292	358	(Optional) External MDBUN series	880
MD810-20M4T355GXXX	355	565	619	759	(Optional) External MDBUN series	1525
TD810-20M4T22GXXX	22	54	59	56	(Optional) Built-in	176
TD810-20M4T45GXXX	45	81	112	110	(Optional) Built-in	290
TD810-20M4T110GXXX	110	179	196	240	(Optional) External MDBUN series	590
TD810-20M4T160GXXX(W)	160	263	292	358	(Optional) External MDBUN series	880
TD810-20M4T355GXXX	355	565	619	759	(Optional) External MDBUN series	1525

Table 11-2 Technical specifications of the power suply unit

Item		Specifications
Basic parameters	Mains voltage	Three-phase 380 V AC to 480 V AC: 323 V AC to 528 V AC (–15% to +10%)
	Power range	MD810 series power suppy unitL 22 kW, 45 kW, 110 kW, 160 kW, 355 kW
	Grid type	TN, TT, and IT star topologies
	Input frequency	50 Hz/60 Hz (47–63 Hz)
	Braking	Additional braking module and resistor
Personalized function	Communication/Bus	Support for Modbus-RTU: max. baud rate 115200, 128 nodes, max. distance 1000 m Support for PROFIBUS-DP (depending on the models): 12 Mbps, 32 nodes, max. distance 100 m Support for CANopen: 1 Mbps, 64 nodes, max. distance 40 m
HMI	DI/DO	Five general multifunctional input terminals; isolation of drain source input programmable terminals; operating voltage 9 V to 30 V; inactive voltage less than 5 V; input impedance 3 kΩ; compliant with 100 Hz frequency input; three relay outputs; programmable normally open (NO) and normally closed (NC) contacts
	Operating panel display	Standard configuration: 5-bit LED display and five keys
Protections	Overtemperature protection, power phase loss protection, detection of three-phase input voltage unbalance, overvoltage protection, braking circuit overcurrent protection, braking resistor short circuit protection, and detection of braking transistor short circuit	
IP rating	IP20	
Cooling	Forced air cooling	

Item	Specifications
Ambient temperature	Operating temperature: –10°C to +50°C ; ambient temperature variation < 0.5°C /min; derating above 40°C ; derating of rated current by 1.5% with every 1°C temperature rise; max. operating temperature: 50°C Storage temperature: –25°C to +70°C Transportation temperature: –25°C to +70°C
Relative humidity	Relative humidity variation: 5% to 95%. Standard models are not suitable for use in environments with corrosive gases. Select models with corrosion-resistant coated housing. Relative humidity for storage: 5% to 95% Relative humidity for transportation: less than 95% at 40°C
Altitude	1000 m; derating of 1% with every increase of 100 m above 1000 m until 3000 m

11.1.2 Technical Data of the Drive Unit

Table 11-3 Rated data of the drive unit (single-axis 90–355 kW)

Drive Unit Model	Rated Power (kW)	Input Current DC (A)	Output Current AC (A)	Applicable Motor		Thermal Losses (W)
				kW	HP	
537–679 VDC (operating range: 350–800 VDC) Output voltage: 0–480 VAC						
MD810-50M4T1.5GXXX	1.5	4.9	3.8	1.5	2	47
MD810-50M4T2.2GXXX	2.2	7	5.1	2.2	3	59
MD810-50M4T3.7GXXX	3.7	12	9	3.7	5	76
MD810-50M4T5.5GXXX	5.5	17	13	5.5	7.5	127
MD810-50M4T7.5GXXX	7.5	22	17	7.5	10	155
MD810-50M4T11GXXX	11	31	25	11	15	249
MD810-50M4T15GXXX	15	40	32	15	20	294
MD810-50M4T18.5GXXX	18.5	46	37	18.5	25	343
MD810-50M4T22GXXX	22	55	45	22	30	425
MD810-50M4T30GXXX	30	73	60	30	40	526
MD810-50M4T37GXXX	37	90	75	37	50	669
MD810-50M4T45GXXX	45	105	91	45	60	817
MD810-50M4T55GXXX	55	129	112	55	70	1033
MD810-50M4T75GXXX	75	172	150	75	100	1379
MD810-50M4T90GXXX	90	294	184	90	125	1457
MD810-50M4T110GXXX	110	358	224	110	150	1728
MD810-50M4T132GXXX	132	420	262	132	180	2135.12
MD810-50M4T160GXXX	160	474	304	160	220	2389.1
MD810-50M4T200GXXXH	200	420	377	200	270	3342
MD810-50M4T250GXXXH	250	515	465	250	330	5109
MD810-50M4T315GXXXH	315	650	585	315	420	6143
MD810-50M4T355GXXXH	355	725	650	355	475	7912

Table 11-4 Technical specifications of the drive unit (dual-axis)

Drive Unit Model	Rated Power (kW)	Input Current DC (A)	Output Current AC (A)	Applicable Motor		Thermal Losses (W)
				kW	HP	
Input voltage: 537 VDC to 679 VDC (operating range: 350 VDC to 800 VDC); output voltage: 0 VAC to 480 VAC						
MD810-50M4TD1.5G	1.5	10	3.8	1.5	2	11
MD810-50M4TD2.2G	2.2	14	5.1	2.2	3	11
MD810-50M4TD3.7G	3.7	24	9	3.7	5	11
MD810-50M4TD5.5G	5.5	34	13	5.5	7.5	16
MD810-50M4TD7.5G	7.5	44	17	7.5	10	21
MD810-50M4TD11G	11	62	25	11	15	39
MD810-50M4TD15G	15	80	32	15	20	37
MD810-50M4TD18.5G	18.5	92	37	18.5	25	104

Table 11-5 Technical specifications of the drive unit

Item		Specifications
Basic parameters	Mains voltage	Three-phase 380 VAC to 480 VAC: 323 VAC to 528 VAC (-15% to +10%)
	Power	Drive unit (single-axis): 1.5 kW to 160 kW Drive unit (dual-axis): 1.5 kW to 18.5 kW
	Mains type	TN, TT, and IT star topologies
	Cooling	Forced air cooling
	Input voltage	537 VDC to 679 VDC (operating range: 350 VDC to 800 VDC)
	Inputfrequency	0 Hz to 500 Hz
	Input frequency resolution	Digital setting: 0.01 Hz Analog setting: Maximum frequency x 0.025%
	Carrier frequency	V/F control: 0.8 kHz to 12 kHz Vector control: 2 kHz to 6 kHz Support for automatic adjustment of carrier frequency according to the heatsink temperature
	Output frequency	V/F control: 0 Hz to 500 Hz Vector control: 0 Hz to 500 Hz
	Braking	Additional braking module and resistor
	Motor type and control mode	Three-phase asynchronous motor: V/F, SVC, and FVC Permanent magnet synchronous motor: SVC and FVC
	Speed range	1:50 (asynchronous motor, V/F) 1:100 (asynchronous motor, SVC) 1:1000 (asynchronous motor, FVC)
	Speed control accuracy	±1.0% (V/F control) ±0.5% (SVC) ±0.02% (FVC)
	Speed fluctuation	±0.5% (SVC) ±0.2% (FVC)
	Torque response	< 20 ms (SVC) < 5 ms (FVC)
	Torque control accuracy	±5% (SVC) (at frequencies above 10 Hz) ±3% (FVC)
	Torque control mode	SVC and FVC

Item		Specifications
Basic parameters (continued)	Overload capacity	115%, 1 hour 150%, 1 minute 178%, 2 seconds
	Torque boost	Automatic torque boost; manual torque boost: 0.1% to 30.0%
	V/F curve	Five modes: Linear, multi-point, square, completely separated, and partially separated V/F curves
Protection	Short circuit to ground at power-on, inter-phase short circuit, motor overheat (PT100 and PT1000), drive overcurrent, drive overload (output power limit), motor overload, drive overvoltage, drive undervoltage, drive stall in SVC mode, drive overheat, output phase loss, communication fault, current detection fault, motor auto-tuning fault, encoder fault detection, EEPROM read-write fault, buffering relay fault, locked-rotor protection, protection against large speed deviation, and stall alarm	
Personalized function	Acceleration and deceleration curves	Linear, S curve (mode 1), and S curve (mode 2)
	Built-in PID	Two sets of PID parameters, support for process control closed-loop systems
	Communication/ Fieldbus	Support for Modbus-RTU: max. baud rate 115,200, 128 nodes, max. distance 1000 m Support for PROFIBUS-DP (depending on the models): 12 Mbps, 32 nodes, max. distance 100 m Support for CANopen: 1 Mbps, 64 nodes, max. distance 40 m
	Command source for running control	Three control modes are available: Command source: LED operating panel or external LCD operating panel, control terminal, and serial communication port. Support for switchover between command sources by multiple methods
	Frequency source	Eight frequency sources are available: Digital setting, voltage AI, current AI, pulse, communication, PID, multi-speed setting, and built-in PLC Support for switchover and superposition by multiple methods
	Wobble function	Various triangular-wave frequency control modes
	Fixed length and fixed time control	Support for fixed length and fixed running time control
HMI	AI	AI1: Support for 0 V to 10 V/-10 V to 10 V, 12-bit resolution, calibration accuracy 0.3%, and input impedance 22.1 kΩ
		AI2: Support for 0 V to 10 V/0 mA to 20 mA, 12-bit resolution, calibration accuracy 0.3%, input impedance 22.1 kΩ for voltage input, and 500 Ω or 250 Ω for current input
	AO	AO: Support for 0 V to 10 V/0 mA to 20 mA, 12-bit resolution, calibration accuracy 0.5%, load impedance > 5 kΩ for voltage output or < 500 Ω for current output when the max. output load current is 2 mA
	DI/DO	Single-axis: ◆ Two DI terminals for PNP or NPN input ◆ Two DIO terminals. When the DIO is used as the DI, PNP or NPN input is supported. When the DIO is used as the DO, only the NPN output is allowed. 1) When DIO1 is used as the DI, the maximum input frequency is 100 Hz. 2) When DIO2 is used as the DO, the maximum output frequency is 100 Hz. ◆ One relay output: programmable NO/NC contact
		Dual-axis: ◆ One DI terminal for each axis for PNP or NPN input ◆ One DIO terminal for each axis. When the DIO is used as the DI, PNP or NPN input is supported. When the DIO is used as the DO, only the NPN output is allowed. 1) When DIO1 is used as the DI, the maximum input frequency is 100 Hz. ◆ One relay output: programmable NO/NC contact
	Operating panel display	Standard configuration: 5-bit LED display and five keys

Item		Specifications
Environment	Ambient temperature	Operating temperature: -10°C to +50°C ; ambient temperature variation < 0.5°C /min; derating above 40°C ; derating of rated current by 1.5% with every 1°C temperature rise; max. operating temperature: 50°C Storage temperature: -25°C to +70°C Transportation temperature: -25°C to +70°C
	Relative humidity	Relative humidity variation: 5% to 95%. Standard models are not suitable for use in environments with corrosive gases. Select models with corrosion-resistant coated housing. Relative humidity for storage: 5% to 95% Relative humidity for transportation: less than 95% at 40°C
	Altitude	1000 m; derating of 1% with every increase of 100 m above 1000 m until 3000 m.
	IP rating	Single-axis drive unit: IP20 for 1.5 kW to 75 kW IP00 for 90 kW to 160 kW Dual-axis drive unit: IP20 for 1.5 kW to 18.5 kW

11.2 Outline Drawings and Dimensions

The 810 series power supply units come in five outline structures and two unit types: booksize and vertical tower units. The booksize unit with equal height and depth is provided in four different widths: 50 mm, 100 mm, 200 mm, and 300 mm. The 355 kW power supply unit is a vertical tower unit measuring 180 mm wide.

The MD810 series drive units are designed in six outline structures and two unit types, namely, booksize and vertical tower units. The booksize unit with an equal height and depth is provided in four different widths: 50 mm, 100 mm, 200 mm, and 300 mm. The single-axis drive units of the vertical tower format is provided in two different widths: 180 mm and 230 mm.

11.2.1 Outline Drawings and Dimensions of the Power Supply Units

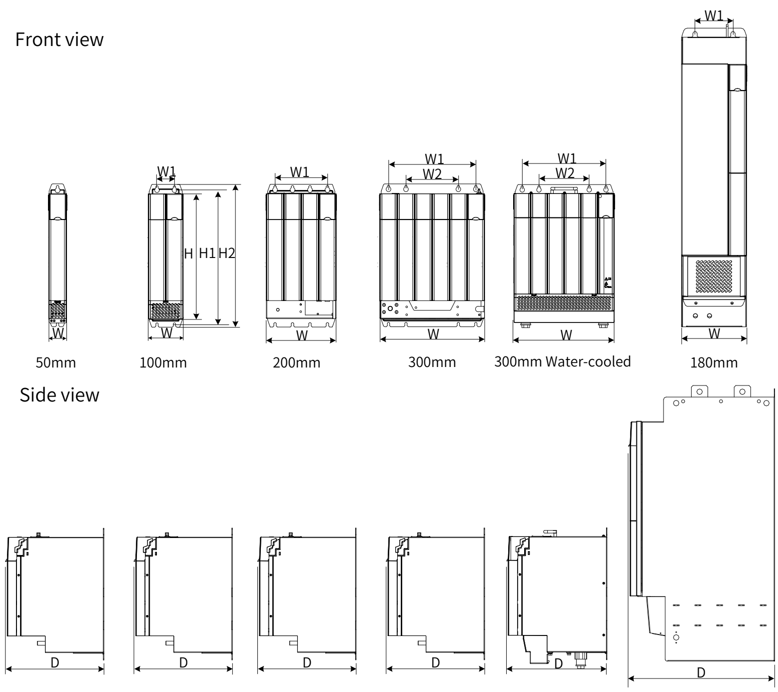


Figure 11-1 Dimensions of the power supply units

Table 11-6 Dimension data of the power supply unit

Power Supply Unit Model	Dimensions (mm)				Mounting Hole Location (mm)			Mounting Hole Size (mm)	Weight (kg)
	H2	H	W	D	W1	W2	H1		
MD810-20M4T22GXXX	400	350	50	305	-	-	384	Φ7	3.8
MD810-20M4T45GXXX	400	350	100	305	50	-	384	Φ7	8
MD810-20M4T110GXXX	400	350	200	305	150	-	384	Φ7	23
MD810-20M4T160GXXX	400	350	300	305	250	150	384	Φ7	38
MD810-20M4T160GXXXW	426.5	350	300	305	250	150	384	Φ7	38
MD810-20M4T355GXXX	832	800	180	445	105	-	795	Φ12	65

11.2.2 Outline Drawings and Dimensions of the Drive Units (Single-axis)

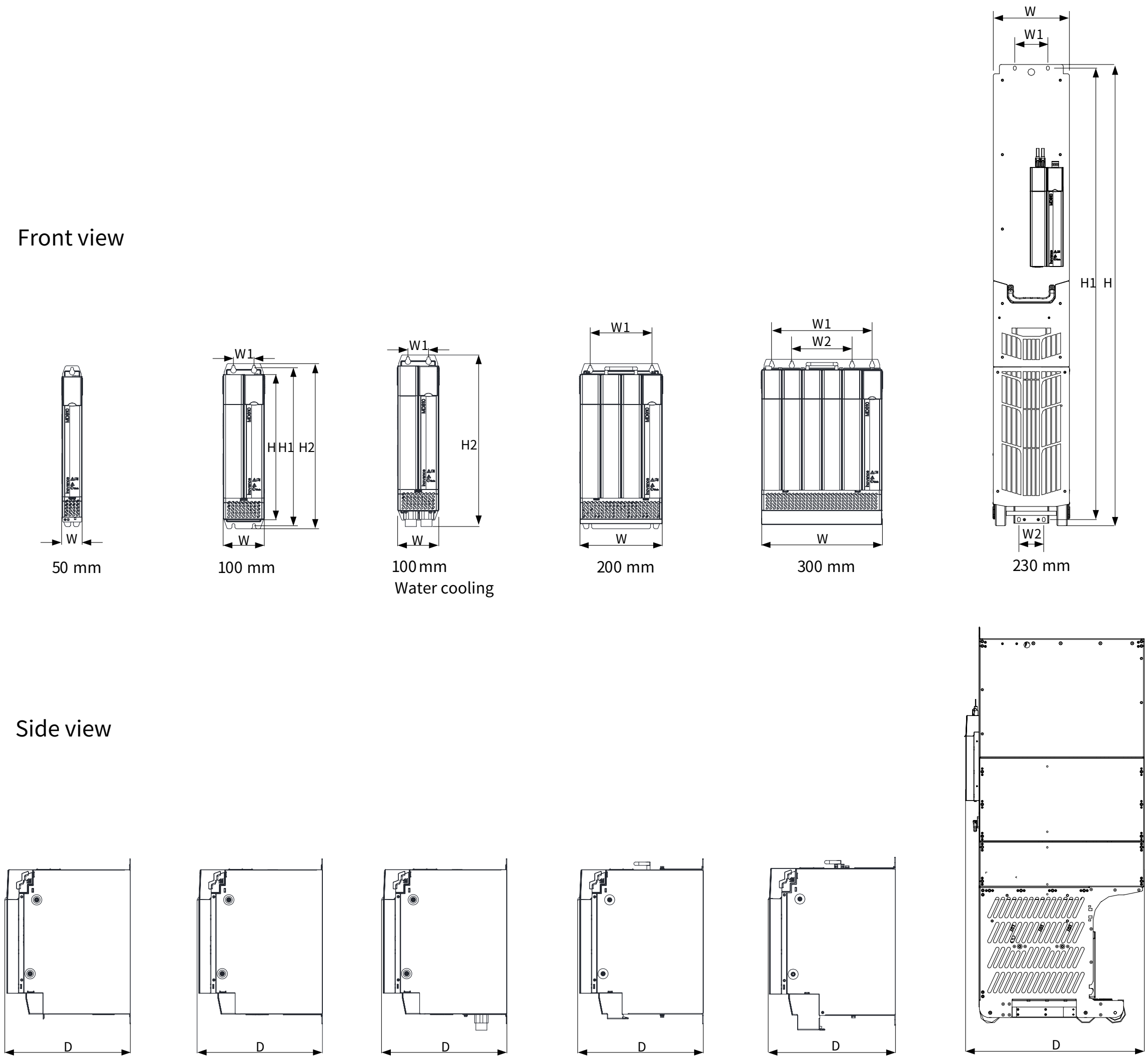


Figure 11-2 Dimensions of the drive units (single-axis 1.5–355 kW)

Table 11-7 Dimension data of the drive units (single-axis 1.5–355 kW)

Drive Unit Model	Dimensions (mm)				Mounting Hole Location (mm)			Mounting Hole Size (mm)	Weight (kg)
	H2	H	W	D	W1	W2	H1		
MD810-50M4T1.5GXXX	400	350	50	305	/	/	384	Φ7	3.8
MD810-50M4T2.2GXXX	400	350	50	305	/	/	384	Φ7	3.8
MD810-50M4T3.7GXXX	400	350	50	305	/	/	384	Φ7	3.8
MD810-50M4T5.5GXXX	400	350	50	305	/	/	384	Φ7	3.8
MD810-50M4T7.5GXXX	400	350	50	305	/	/	384	Φ7	4
MD810-50M4T11GXXX	400	350	100	305	50	/	384	Φ7	7.5
MD810-50M4T15GXXX	400	350	100	305	50	/	384	Φ7	7.5
MD810-50M4T18.5GXXX	400	350	100	305	50	/	384	Φ7	8
MD810-50M4T22GXXX	400	350	100	305	50	/	384	Φ7	8.5
MD810-50M4T30GXXX	400	350	100	305	50	/	384	Φ7	9.4
MD810-50M4T37GXXX	400	350	100	305	50	/	384	Φ7	9.4
MD810-50M4T45GXXX	400	350	200	305	150	/	384	Φ7	18.4
MD810-50M4T55GXXX	400	350	200	305	150	/	384	Φ7	18.4
MD810-50M4T75GXXX	400	350	200	305	150	/	384	Φ7	19.5
MD810-50M4T90GXXX	400	350	300	305	250	150	384	Φ7	24.2
MD810-50M4T110GXXX	400	350	300	305	250	150	384	Φ7	24.2
MD810-50M4T132GXXX	400	350	300	305	250	150	384	Φ7	25.2
MD810-50M4T160GXXX	400	350	300	305	250	150	384	Φ7	25.2
MD810-50M4T200GXXXH	/	1395	230	633	100	75	1365	Φ9	⩽ 130
MD810-50M4T250GXXXH	/	1395	230	633	100	75	1365	Φ9	⩽ 130
MD810-50M4T315GXXXH	/	1395	230	633	100	75	1365	Φ9	⩽ 130
MD810-50M4T355GXXXH	/	1395	230	633	100	75	1365	Φ9	⩽ 130

11.2.3 Outline Drawings and Dimensions of the Drive Unit (Dual-axis)

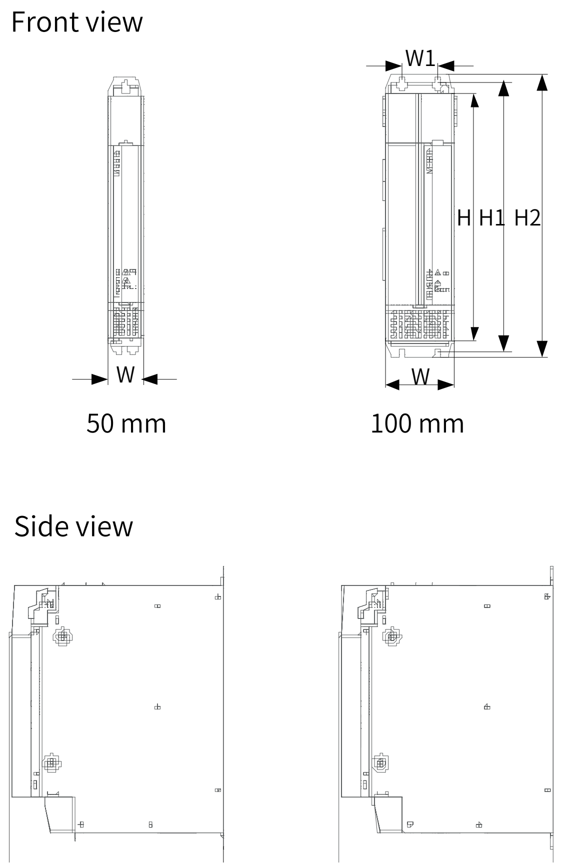


Figure 11-3 Dimensions of the drive units (dual-axis)

Table 11-8 Dimension data of the drive units (dual-axis)

Drive Unit Model	Dimensions (mm)				Mounting Hole Location (mm)			Mounting Hole Size (mm)	Weight (kg)
	H2	H	W	D	W1	W2	H1		
MD810-50M4TD1.5GXXX	400	350	50	305	-	-	384	Φ7	4.5
MD810-50M4TD2.2GXXX	400	350	50	305	-	-	384	Φ7	4.5
MD810-50M4TD3.7GXXX	400	350	50	305	-	-	384	Φ7	4.5
MD810-50M4TD5.5GXXX	400	350	50	305	-	-	384	Φ7	4.5
MD810-50M4TD7.5GXXX	400	350	100	305	50	-	384	Φ7	6.5
MD810-50M4TD11GXXX	400	350	100	305	50	-	384	Φ7	9.5
MD810-50M4TD15GXXX	400	350	100	305	50	-	384	Φ7	9.5
MD810-50M4TD18.5GXXX	400	350	100	305	50	-	384	Φ7	9.5

11.3 Peripherals and Options

Name		Applicable Drive Unit Model	Model	Code
Additional DC bus terminals	Additional DC bus terminals of 100 A	Power supply unit: 22 kW Drive unit: ◆ Single-axis: 1.5–7.5 kW ◆ Dual-axis: 1.5–5.5 kW	MD810-CON1	01040014
	Co-bus external power terminal of 200 A	Power supply unit: 45 kW, 110 kW, 160 kW Drive unit: ◆ Single-axis: 11–75 kW ◆ Dual-axis: 7.5–18.5 kW	MD810-CON2	01040015
Through-hole mounting bracket	50 mm wide through-hole mounting bracket	Power supply unit: 22 kW Drive unit: ◆ Single-axis: 1.5–7.5 kW ◆ Dual-axis: 1.5–5.5 kW	MD810-AZJ50M-W1	01040039
	100 mm wide embedded mounting bracket	Power supply unit: 45 kW Drive unit: ◆ Single-axis: 11–37 kW ◆ Dual-axis: 7.5–18.5 kW	MD810-AZJ50M-W2	01040040
	200 mm wide embedded mounting bracket	Power supply unit: 110 kW Drive unit: ◆ Single-axis: 45–75 kW	MD810-AZJ50M-W3	01040041
	300 mm wide embedded mounting bracket	Power supply unit: 160 kW Drive unit: ◆ Single-axis: 90–160 kW	MD810-AZJ50M-W4	01040042
Air guide plate	50 mm wide air guide plate	Power supply unit: 22 kW Drive unit: ◆ Single-axis: 1.5–7.5 kW ◆ Dual-axis: 1.5–5.5 kW	MD810-DLB-W1	01040044
	100 mm wide air guide plate	Power supply unit: 45 kW Drive unit: ◆ Single-axis: 11–37 kW ◆ Dual-axis: 7.5–18.5 kW	MD810-DLB-W2	01040045
	200 mm wide air guide plate	Power supply unit: 110 kW Drive unit: ◆ Single-axis: 45–75 kW	MD810-DLB-W3	01040046
	300 mm wide air guide plate	Power supply unit: 160 kW Drive unit: ◆ Single-axis: 90–160 kW	MD810-DLB-W4	01040047
Cable support bracket	50 mm wide cable support bracket	Power supply unit: 22 kW Drive unit: ◆ Single-axis: 1.5–7.5 kW ◆ Dual-axis: 1.5–5.5 kW	MD810-PBJ50M-W1	01040048
	100 mm wide shielding bracket	Power supply unit: 45 kW Drive unit: ◆ Single-axis: 11–37 kW ◆ Dual-axis: 7.5–18.5 kW	MD810-PBJ50M-W2	01040049
	200 mm wide shielding bracket	Power supply unit: 110 kW Drive unit: ◆ Single-axis: 45–75 kW	MD810-PBJ50M-W3	01040050
	300 mm wide shielding bracket	Drive unit: ◆ Single-axis: 90–160 kW	MD810-PBJ50M-W4	01040051

Name		Applicable Drive Unit Model	Model	Code
External LCD operating panel	SOP-20-external LCD operating panel	Whole series	SOP-20 -MD	01040028
External operating panel network cable	Remote LCD keypad cable (3 m)	Whole series	C45590-GNCN-C25003	01040020
Communication cable between modules	240 mm communication cable	50 mm wide model	C45590-GNCN-C2500024	01040038
	250 mm communication cable	100 mm wide model	C45590-GNCN-C2500025	01040018
	350 mm communication cable	200 mm wide model	C45590-GNCN-C2500035	01040019
	430 mm communication cable	300 mm wide model	C45590-GNCN-C2500043	01040021
	800 mm communication cable	180 mm wide model	C45590-GNCN-C2500080	01040016
Output magnetic ring	-	-	DY644020H	11013031
	-	-	DY805020H	11013032
	-	-	DY1207030H	11013033

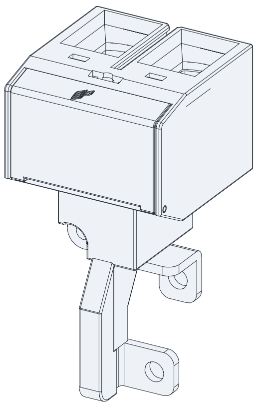
11.3.1 Additional DC Bus Terminals

- The additional DC bus terminals of 100 A are applicable to the following 55 mm wide units:

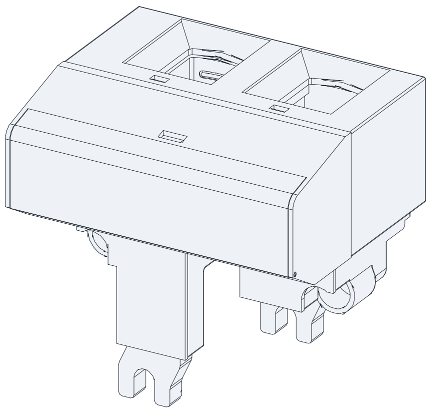
1) Power supply unit: 22 kW
2) Drive unit: single-axis 1.5–7.5 kW and dual-axis 1.5–5.5 kW

- The additional DC bus terminals of 200 A are applicable to the following 100 mm, 200 mm, and 300 mm wide units:

1) Power supply unit: 45 kW, 110 kW, 160 kW
2) Drive unit: single-axis 11–160 kW and dual-axis 7.5–18.5 kW drive units



Additional DC bus terminals of 100 A



Additional DC bus terminals of 200 A

Figure 11-4 Physical appearance of the aAdditional DC bus terminals

Table 11-9 Recommended cable diameter for the Additional DC bus terminals

Terminal Model	Cable Diameter
Co-bus external power terminal of 100 A	10 AWG to 1 AWG
Co-bus external power terminal of 200 A	6 AWG to 250 kcmil

11.3.2 Through-hole Mounting Bracket and Backplate Tapping Dimensions

The through-hole mounting bracket is only applicable to single rack installation. When installing a booksize unit, select a through-hole mounting bracket based on the unit's width. The through-hole mounting bracket is not required for installing vertical tower units.

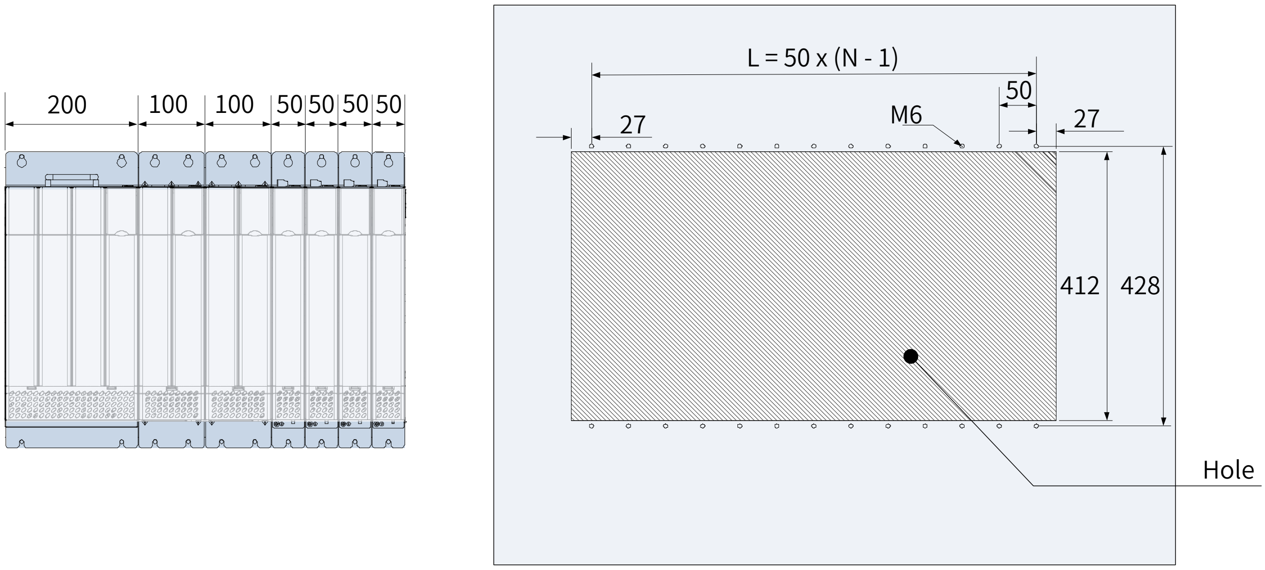


Figure 11-5 Physical appearance of the through-hole mounting bracket and backplate tapping dimensions (unit: mm)

11.3.3 Air Guide Plate

The air guide plate is applicable to dual rack installation. When installing a booksize unit, select an air guide plate based on the unit's width. The air guide plate is not required for installing vertical tower units.

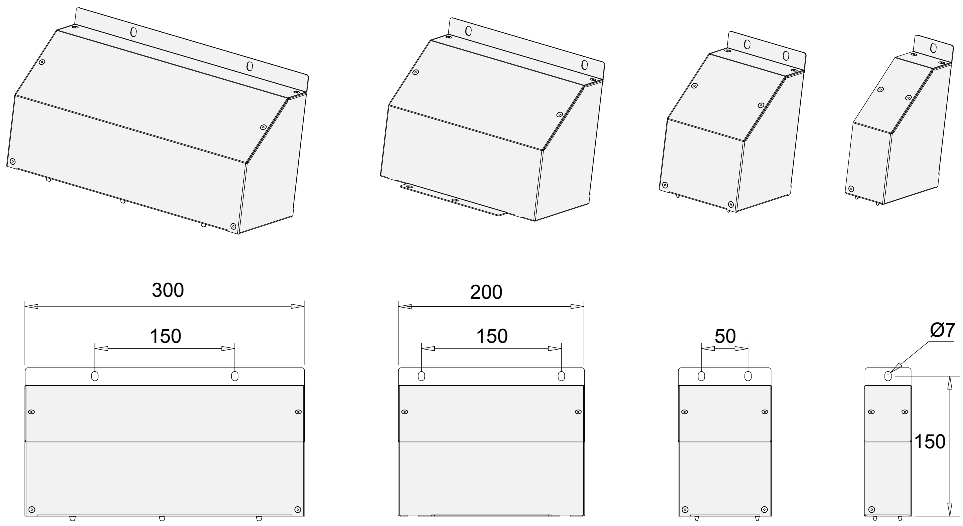


Figure 11-6 Overall dimensions of the air guide plate (unit: mm)

11.3.4 Cable Support Bracket

It is recommended that the shielding layer of the output cables is fixed to the cable support bracket. Select a cable support bracket based on the drive unit model.

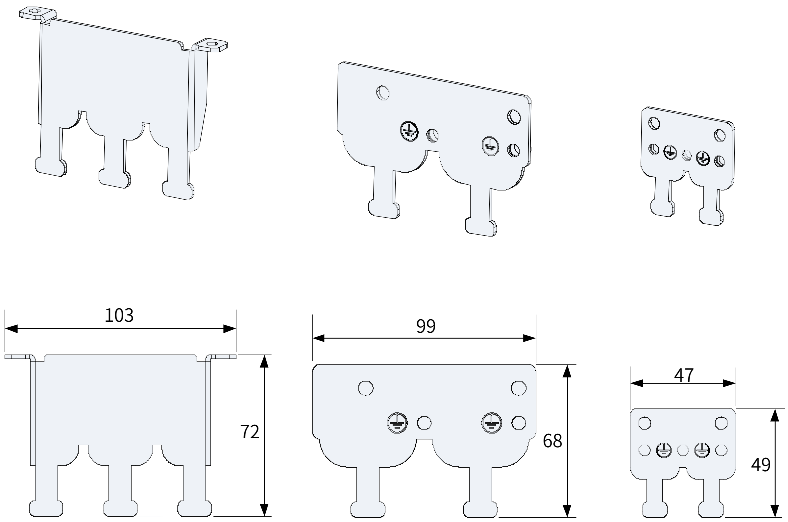


Figure 11-7 Overall dimensions of the cable support bracket (unit: mm)

11.3.5 External LCD Operating Panel

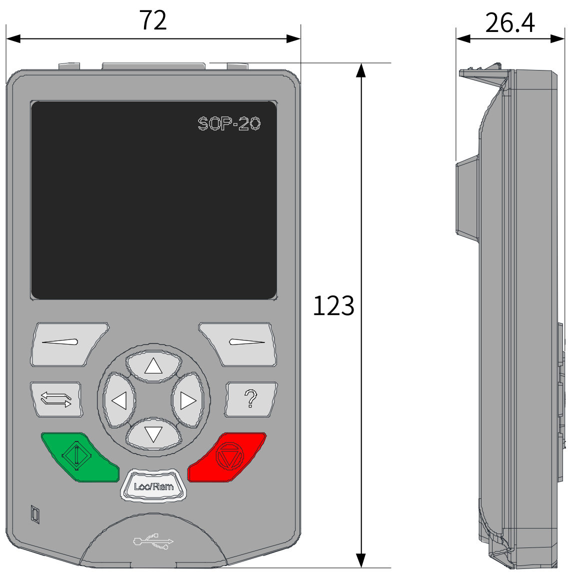


Figure 11-8 Overall dimensions of the external LCD operating panel

11.4 Selection of Braking Components

11.4.1 Selection of Resistance of the Braking Resistor

During braking, almost all regenerative energy of the motor is consumed by the braking resistor. The resistance of the braking resistor is calculated by the following formula:

$$U \times U/R = Pb$$

U indicates the braking voltage at system stable braking. U varies depending on different systems. For the 810 series power supply units, usually select the 760 V braking voltage, which can be adjusted by setting F1-02 (Braking unit applied voltage).

Pb indicates the braking power.

11.4.2 Selection of Power of the Braking Resistor

In theory, power of the braking resistor is the same as the braking power. However, in consideration of derating K, power of braking resistor is calculated using the following formula:

$$K \times Pr = Pb \times D$$

K is set to 50% or an approximate value.

Pr indicates the power of the braking resistor.

D indicates the braking frequency (percentage of regenerative process to whole deceleration).

The following two formulas can be obtained:

$$K \times Pr = Pb \times D = U \times U/R \times D$$

$$Pr = (U \times U \times D)/(R \times K)$$

The braking resistor power is calculated accordingly.

K is the derating coefficient of braking resistor. Low K value ensures that the braking resistor does not get overheated. The K value can be increased appropriately on the condition of good dissipation and must not exceed 50%. Failure to comply may result in a fire due to overheating of braking resistor.

Braking frequency (D) is determined by application. Typical values of braking frequency in different applications are listed in Table 9-6.

Table 11-10 Typical values of braking frequency in different applications

Application	Elevator	Winding and unwinding	Centrifuge	Occasional braking load	General application
Braking Frequency	20% to 30%	20% to 30%	50% to 60%	5%	10%

11.4.3 Selection Guidance

Power Supply Unit Model	Applicable Motor (kW)	Braking Unit		125% Braking Torque (10% ED; Max. 10s)		Remarks	Min. Braking Resistance (Ω)
		Model	Qty.	Braking Resistor Specifications	Number of Braking Resistors		
MD810-20M4T22GXXX	22	Built-in	-	4kW 32Ω	1		24
MD810-20M4T45GXXX	45	Built-in	-	9kW 13Ω	1		12.8
MD810-20M4T110GXXX	110	MDBUN-60-T	2	11kW 9.4Ω	2	Input voltage ⩽ 440 VAC	9.3×2
	110	MDBUN-60-5T	2	11kW 10.5Ω	2	Input voltage > 440 VAC	10.5×2
MD810-20M4T160GXXX(W)	160	MDBUN-90-T	2	16kW 6.3Ω	2	Input voltage ⩽ 440 VAC	6.2×2
	160	MDBUN-90-5T	2	16kW 7.2Ω	2	Input voltage > 440 VAC	7.0×2
MD810-20M4T355GXXX	355	MDBU-200-T	3	23kW 3.8Ω	3	Input voltage ⩽ 440 VAC	2.5×3
	355	MDBU-200-5T	3	23kW 4.9Ω	3	Input voltage > 440 VAC	3.0×3
TD810-20M4T22GXXX	22	Built-in	-	4kW 32Ω	1		24
TD810-20M4T45GXXX	45	Built-in	-	9kW 13Ω	1		12.8
TD810-20M4T110GXXX	110	MDBUN-60-T	2	11kW 9.4Ω	2	Input voltage ⩽ 440 VAC	9.3×2
	110	MDBUN-60-5T	2	11kW 10.5Ω	2	Input voltage > 440 VAC	10.5×2

Power Supply Unit Model	Applicable Motor (kW)	Braking Unit		125% Braking Torque (10% ED; Max. 10s)		Remarks	Min. Braking Resistance (Ω)
		Model	Qty.	Braking Resistor Specifications	Number of Braking Resistors		
TD810-20M4T160GXXX(W)	160	MDBUN-90-T	2	16kW 6.3Ω	2	Input voltage ⩽ 440 VAC	6.2×2
	160	MDBUN-90-5T	2	16kW 7.2Ω	2	Input voltage > 440 VAC	7.0×2
TD810-20M4T355GXXX	355	MDBU-200-T	3	23kW 3.8Ω	3	Input voltage ⩽ 440 VAC	2.5×3
	355	MDBU-200-5T	3	23kW 4.9Ω	3	Input voltage > 440 VAC	3.0×3

11.4.4 Overall Dimensions and Installation Dimensions of Braking Units

The following figures show the overall dimensions and installation dimensions of the MDBUN series braking units (unit: mm).

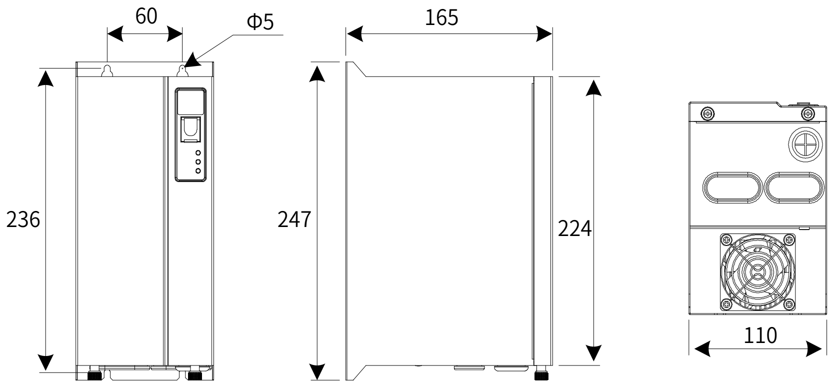


Figure 11-9 Overall dimensions of the MDBUN series braking units

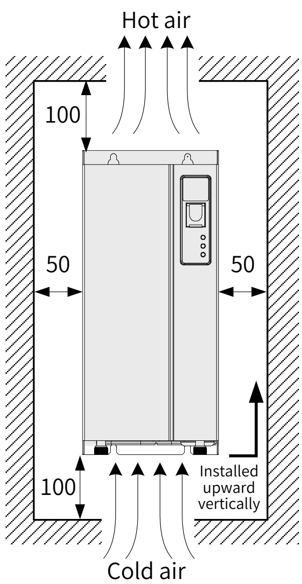


Figure 11-10 Installation dimensions of the MDBUN series braking units

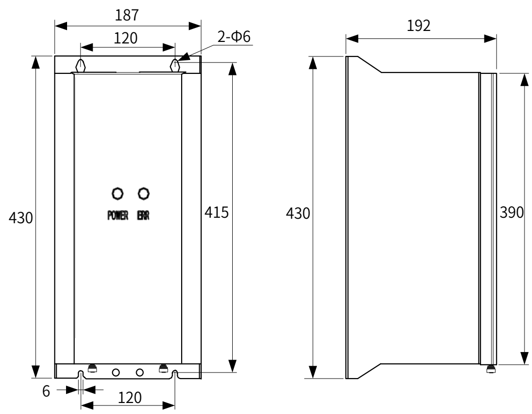


Figure 11-11 Overall dimensions of the MDBU series braking units (unit: mm)

NOTE

- For details about how to install and use MDBUN, see the 19010533 MDBUN Series Braking Unit User Guide.
- For details about how to install and use MDBU, see the 19010788 MDBU Series Braking Unit User Guide.

11.5 Selection of Electrical Peripherals

11.5.1 MCCB and Contactor

Model	Recommended Input IEC Cable Specifications (mm^2)[1]	Recommended IEC Grounding Cable Specifications (mm^2)	Power Supply Unit Terminal Width (mm)	Screw	Fuse Bussmann (Pass UL Certification)		Contactor	MCCB
					Rated Current (A)	Model	Rated Current (A)	Rated Current (A)
Three-phase 380 to 480 V, 50/60 Hz (47–63 Hz)								
MD810-20M4T22GXXX	3 x 10	10	14	M6	100	FWH-100Ba	65	80
MD810-20M4T45GXXX	3 x 25	16	18	M6	150	FWH-150B	95	160
MD810-20M4T110GXXX	3 x 95	70	28	M10	325	FWH-325A	205	400
MD810-20M4T160GXXX(W)	3 x 185	95	38	M12	500	FWH-500A	300	400
MD810-20M4T355GXXX	2 x (3 x 185)	185	/	M16	1000	170M5016	620	800

NOTE

[1] Applicable for Chinese standards. 3 x10 indicates one three-core cable, and 2 x (3 x 95) indicates two three-core cables.

11.5.2 Lugs

GTNR series TNR series TNS series

Figure 11-12 Lugs manufactured by Suzhou Yuanli Metal Enterprise Co., Ltd.

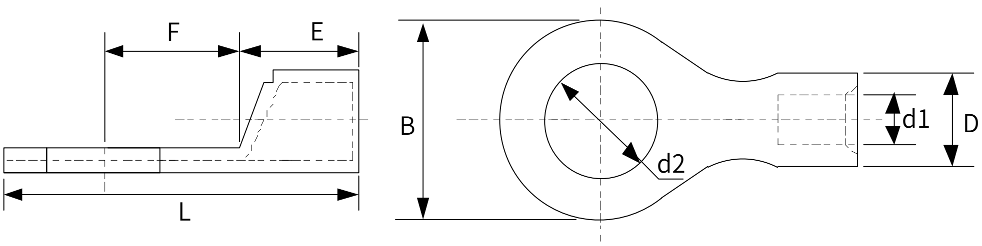


Figure 11-13 Dimensions of TNR series lug

Table 11-11 Models and dimensions of TNR series lug

Model	Cable Range		D	d1	E	F	B	d2	L	Current (A)	Crimping Tool
	AWG/MCM	mm^2									
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
TNR1.25-4	22-16	0.25-1.65	3.4	1.7	4.5	7.3	8	5.3	15.8	19	

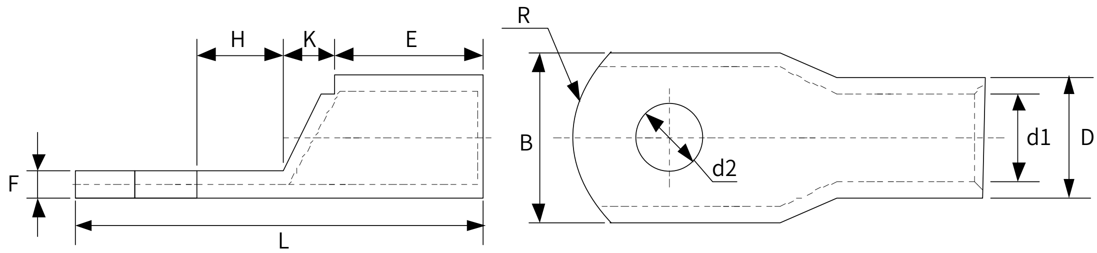


Figure 11-14 Dimensions of GTNR series lug

Table 11-12 Models and dimensions of GTNR series lug (unit: mm)

Model	D	d1	E	H	K	B	d2	F	L	R	Crimping Tool
GTNR1.5-5	4.0	2.2	5.0	5.0	2.0	8.0	5.3	1.0	16.0	5	RYO-8 YYT-8 RYO-14
GTNR2.5-4	4.5	2.9	7.0	5.0	2.0	8.0	4.3	1.0	18.0		
GTNR2.5-5				6.0			5.3		20.0	7	
GTNR2.5-6						10.2	6.4	0.8			
GTNR4-5	5.2	3.6	7.0	6.0	2.0	10.0	5.3	1.0	20.0		
GTNR4-6							6.4				
GTNR6-5	6.0	4.2	9.0	6.0	3.0	10.0	5.3	1.2	23.0		
GTNR6-6				7.5			6.4		26.0		
GTNR6-8						12.0	8.4	1.0			
GTNR10-6	7.0	5.0	9.0	8.0	3.5	12.4	6.4	1.3	26.5		
GTNR10-8							8.4		27.5		
GTNR16-6	7.8	5.8	12.0	8.0	4.0	12.4	6.4	1.3	31.0		CT-38 CT-100
GTNR16-8							8.4				
GTNR25-6	9.5	7.5	12.0	8.0	4.5	14.0	6.4	2.0	32.0	10	
GTNR25-8				9.0		15.5	8.4	1.6	34.0		
GTNR25-10				10.5		17.5	10.5	1.4	37.0		
GTNR35-6	11.4	8.6	15.0	9.0	5.0	15.5	6.4	2.8	38.0		
GTNR35-8							8.4				
GTNR35-10				10.5		17.5	10.5	2.5	40.5		
GTNR50-8	12.6	9.6	16.0	11.0	6.0	18.0	8.4	2.8	43.5		CT-100
GTNR50-10							10.5				
GTNR70-8	15.0	12.0	18.0	13.0	7.0	21.0	8.4	2.8	50.0	14	
GTNR70-10							10.5				
GTNR70-12							13.0				
GTNR95-10	17.4	13.5	20.0	13.0	9.0	25.0	10.5	3.9	55.0		
GTNR95-12							13.0				
GTNR120-12	19.8	15.0	22.0	14.0	10.0	28.0	13.0	4.7	60.0	16	RYC-150
GTNR120-16				16.0			17.0		64.0		
GTNR150-12	21.2	16.5	26.0	16.0	11.0	30.0	13.0	4.7	69.0	24	
GTNR150-16							17.0				
GTNR185-16	23.5	18.5	32.0	17.0	12.0	34.0	17.0	5.0	78.0		
GTNR240-16	26.5	21.5	38.0	20.0	14.0	38.0	17.0	5.5	92.0		
GTNR240-20							21.0				

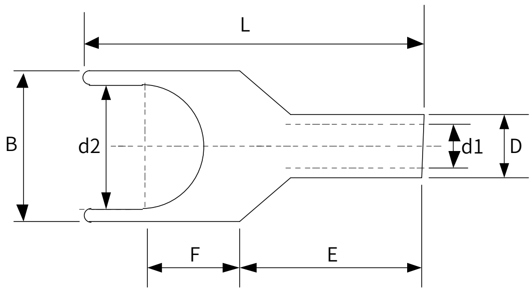


Figure 11-15 Dimensions of TNS series lug

Table 11-13 Models and dimensions of TNS series lug (unit: mm)

Model	D	d1	E	F	B	d2	L	Crimping Tool
TNS1.25-3	3.4	1.9	4.7	6.5	5.7	3.2	16.0	RYO-8 YYT-8 RYO-14
TNS1.25-3S				6.5	5.7	3.7	16.0	
TNS1.25-3W				6.5	6.2	3.7	16.0	
TNS1.25-4S				6.5	6.4	4.3	16.0	
TNS1.25-4W				6.5	7.2	4.3	16.0	
TNS1.25-5				6.5	8.0	5.3	16.0	
TNS2-3	4.0	2.4	4.7	6.5	5.7	3.2	16.0	
TNS2-3S				6.5	5.7	3.7	16.0	
TNS2-3W				6.5	6.2	3.7	16.0	
TNS2-4S				6.5	6.4	4.3	16.0	
TNS2-4W				6.5	7.2	4.3	16.0	
TNS2-5				6.5	8.0	5.3	16.0	CT-38 CT-100
TNS2-6				9.0	10.7	6.4	20.1	
TNS3.5-4	5.0	3.4	6.4	6.9	8.0	4.3	18.0	
TNS3.5-5				8.0	8.0	5.3	18.0	
TNS5.5-3	5.6	3.6	6.5	7.1	7.3	3.2	19.5	
TNS5.5-3S				7.5	8.2	3.7	19.5	
TNS5.5-4				7.5	8.2	4.3	19.5	
TNS5.5-5				8.0	9.0	5.3	19.5	
TNS5.5-6				12.0	12.0	6.4	26.2	CT-100
TNS8-6	7.0	4.6	8.6	8.5	12.2	6.7	24.0	
TNS14-5	9.3	5.6	10.0	11.0	12.0	5.3	27.5	
TNS14-6				11.0	12.0	6.7	27.5	
TNS22-8	11.3	7.5	12.0	13.0	14.0	8.4	34.0	

11.5.3 Bus Fuses

To protect the semiconductor component on the upstream power supply unit if short circuit occurs and prevent further system damage, a bus fuse can be installed between the power supply unit and the drive unit. Our drive units of 1.5 kW to 75 kW are designed with built-in bus fuses. Recommended fuses for drive units of 90 kW to 160 kW are as follows:

Table 11-14 Bus fuse models

Model	Recommended Fuse (Bussmann) UL Certified		
Three-phase 380 V to 480 V, 50/60 Hz (47–63 Hz)	Rated Current (A)	Model	Quantity
MD810-50M4T1.5GXXX	16	FWC-16A10F	1
MD810-50M4T2.2GXXX	20	FWC-20A10F	1
MD810-50M4T3.7GXXX	16	FWC-16A10F	2
MD810-50M4T5.5GXXX	20	FWC-20A10F	2
MD810-50M4T7.5GXXX	25	FWC-25A10F	2
MD810-50M4T11GXXX	32	FWP-32A14Fa	2
MD810-50M4T15GXXX	40	FWP-40A14Fa	2
MD810-50M4T18.5GXXX	50	FWP-50A14Fa	2
MD810-50M4T22GXXX	125	170M1368	1
MD810-50M4T30GXXX	160	170M1369	1
MD810-50M4T37GXXX	200	170M1370	1
MD810-50M4T45GXXX	250	170M1371	1
MD810-50M4T55GXXX	315	170M1372	1
MD810-50M4T75GXXX	200	170M1370	2
MD810-50M4T90GXXX	500	FWH-500A	1
MD810-50M4T110GXXX	600	FWH-600A	1
MD810-50M4T132GXXX	700	FWH-700A	1
MD810-50M4T160GXXX	800	FWH-800A	1
MD810-50M4T200GXXXH	900	170M6413	2
MD810-50M4T250GXXXH	1100	170M6415	2
MD810-50M4T315GXXXH	1250	170M6416	2
MD810-50M4T355GXXXH	1500	170M6418	2
MD810-50M4TD1.5GXXX	16	FWC-16A10F	2
MD810-50M4TD2.2GXXX	20	FWC-20A10F	2
MD810-50M4TD3.7GXXX	25	FWC-25A10F	2
MD810-50M4TD5.5GXXX	25	FWC-25A10F	2
MD810-50M4TD7.5GXXX	32	FWC-32A10F	2
MD810-50M4TD11GXXX	125	170M1368	1
MD810-50M4TD15GXXX	160	170M1369	1
MD810-50M4TD18.5GXXX	200	170M1370	1

11.5.4 DC Soft Charge Units

50 mm wide 100 mm wide 200 mm wide

Figure 11-16 Appearance of INOV-SU series DC soft charge units

Table 11-15 DC soft charge unit models

Drive Unit Model	DC Soft Charge Unit Model
MD810-50M4T1.5GXXX	INOV-SU-30 (50 mm wide)
MD810-50M4TD1.5GXXX	
MD810-50M4T2.2GXXX	
MD810-50M4TD2.2GXXX	
MD810-50M4T3.7GXXX	
MD810-50M4TD3.7GXXX	
MD810-50M4T5.5GXXX	
MD810-50M4TD5.5GXXX	
MD810-50M4T7.5GXXX	
MD810-50M4TD7.5GXXX	INOV-SU-60 (100 mm wide)
MD810-50M4T11GXXX(W)	
MD810-50M4TD11GXXX	
MD810-50M4T15GXXX(W)	
MD810-50M4T18.5GXXX(W)	
MD810-50M4T22GXXX(W)	
MD810-50M4TD15GXXX	INOV-SU-100 (100 mm wide)
MD810-50M4TD18.5GXXX	
MD810-50M4T30GXXX(W)	
MD810-50M4T37GXXX(W)	
MD810-50M4T45GXXX	INOV-SU-170 (200 mm wide)
MD810-50M4T55GXXX	
MD810-50M4T75GXXX	

Drive Unit Model	DC Soft Charge Unit Model
MD810-50M4T90GXXX	-
MD810-50M4T110GXXX	
MD810-50M4T132GXXX	-
MD810-50M4T160GXXX	
MD810-50M4T200GXXXH	-
MD810-50M4T250GXXXH	
MD810-50M4T315GXXXH	
MD810-50M4T355GXXXH	

1) Overall dimensions of the DC soft charge units

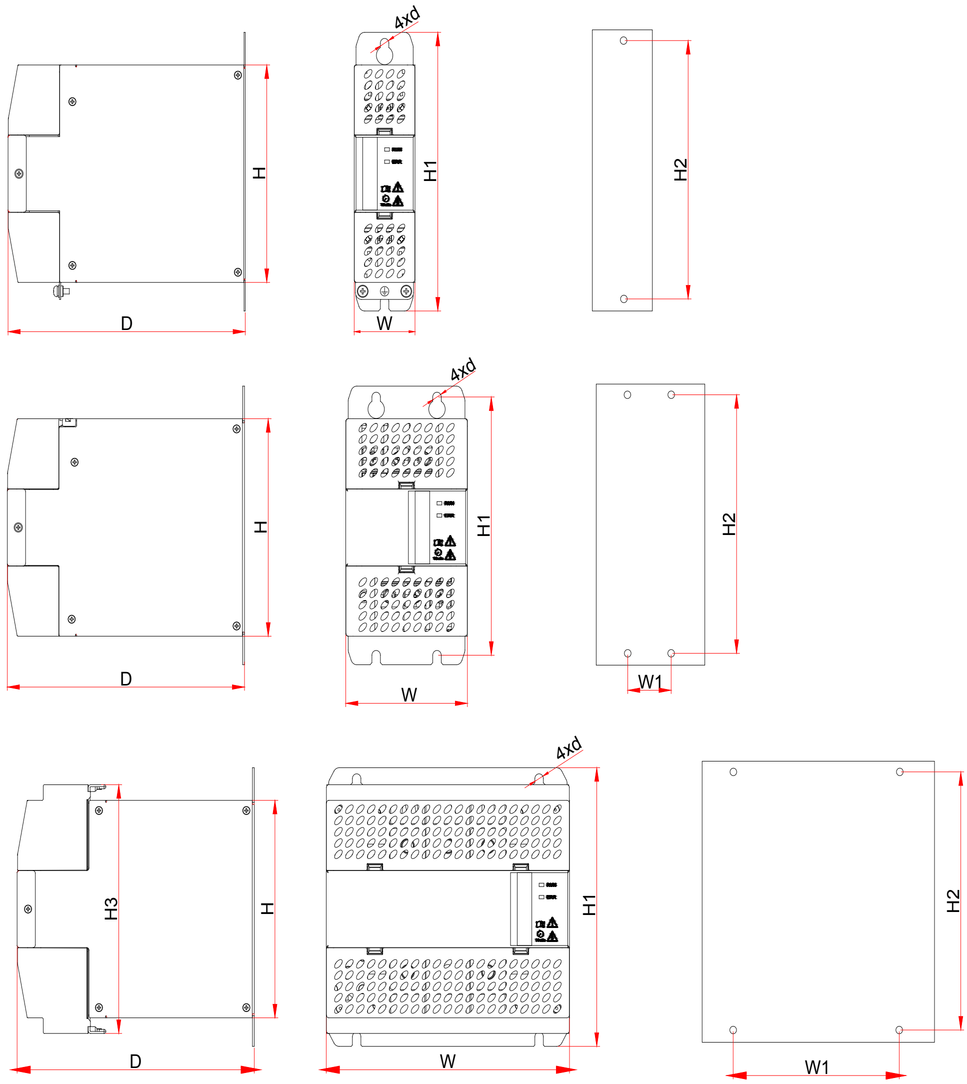


Figure 11-17 Overall dimensions of DC soft charge units INOV-SU-30 to INOV-SU-170

Table 11-16 Overall dimensions of DC soft charge units INOV-SU-30 to INOV-SU-170

DC Soft Charge Unit Model	Mounting Hole (mm)		Overall Dimensions (mm)					Mounting Hole Diameter (mm)
	W1	H2	H	H1	H3	W	D	d
INOV-SU-30	-	-	160	205	-	50	195	ϕ7
INOV-SU-60	50	190	160	205	-	100	195	ϕ7
INOV-SU-100	50	190	160	205	-	100	195	ϕ7
INOV-SU-170	150	190	160	205	183	200	195	ϕ7

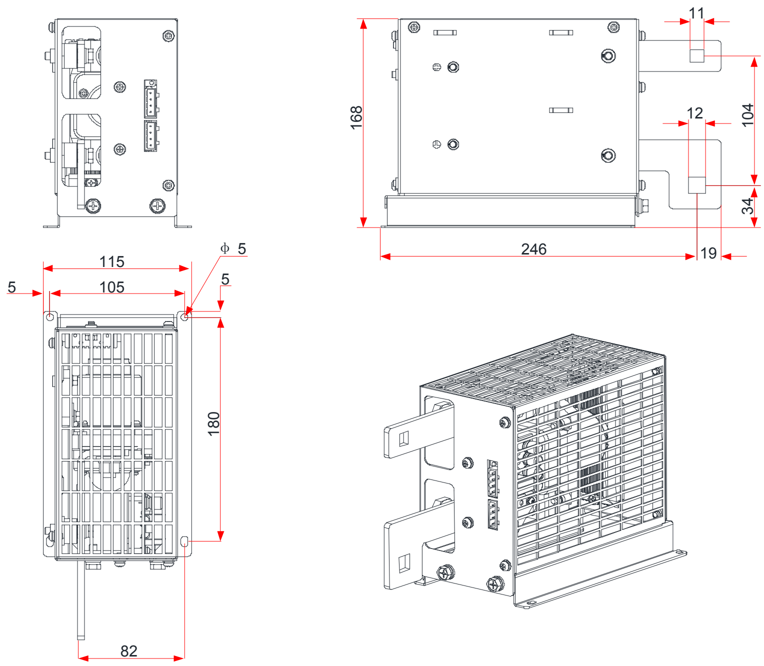


Figure 11-18 Overall dimensions of the HST-6004 DC soft charge unit

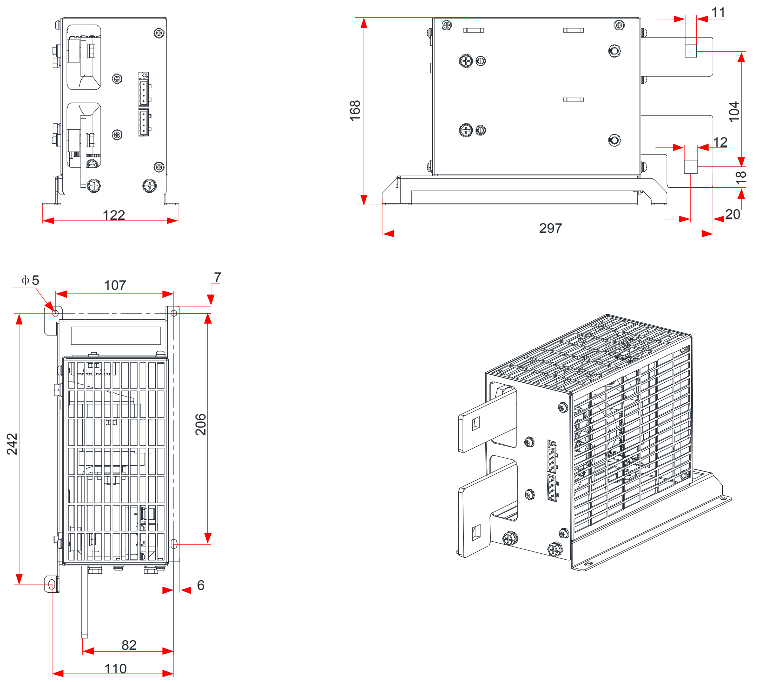


Figure 11-19 Overall dimensions of the HST-7004 DC soft charge unit

2) DC soft charge unit installation guide

■ The INOV-SU-30/INOV-SU-60/INOV-SU-100/INOV-SU-170 DC soft charge units can be installed with the MD810 series drive units, as shown in the following figure:

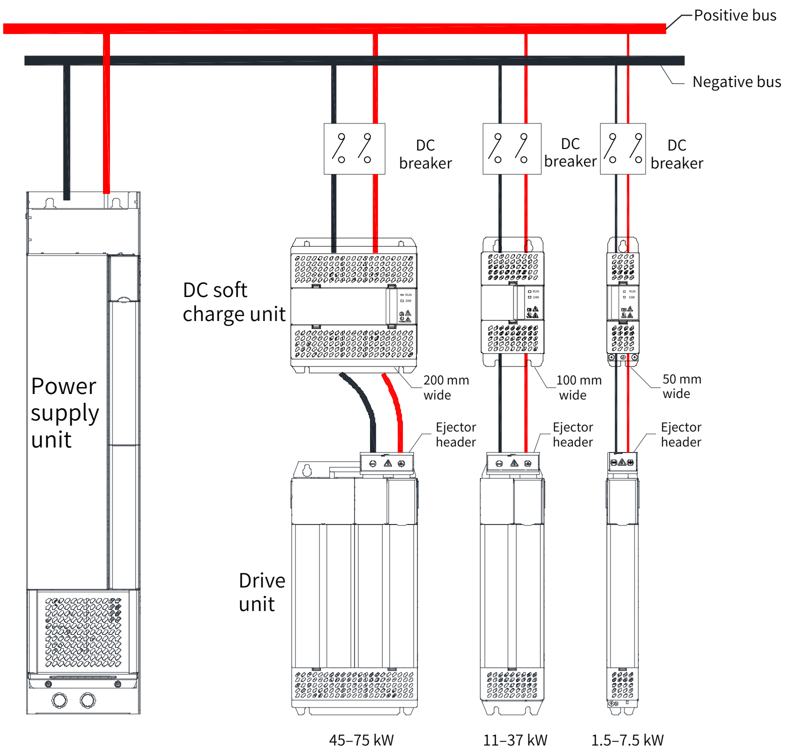


Figure 11-20 Installation diagram of the INOV-SU-30/INOV-SU-60/INOV-SU-100/INOV-SU-170 DC soft charge units

NOTE

◆ For the recommended models of DC circuit breakers in Figure 11-20, see "11.5.5 DC Circuit Breakers"

■ Install the HST-6004/HST-7004 DC soft charge unit and connect it to the drive unit by the following steps (the HST-6004 DC soft charge unit is used as an example):

1) As shown in Figure a, unscrew two M6 screws at the front end of the HST-6004 DC soft charge unit.

2) As shown in Figure b, rise the upper assembly a little to remove it.

3) Then, the HST-6004 DC soft charge unit is disassembled into an assembly and a base as shown in Figures c and d, respectively.

4) As shown in Figure e, connect the cables to the terminals on the DC soft charge unit.

5) As shown in Figure f, unscrew four M4 screws on the top and rear end of the assembly.

6) As shown in Figure g, fix the removed base into four M4 holes; then, install it in place as shown in Figure h.

7) Install the removed assembly to its original position on the base, and connect the terminals on the HST-6004 DC soft charge unit to the corresponding terminals on the drive unit. Fix the terminals at the bottom of the assembly to the negative terminals on the drive unit by using M10 x 30 square neck bolts (GB14), flat gaskets, spring gaskets, and nuts.

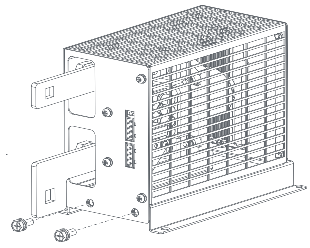


Figure a

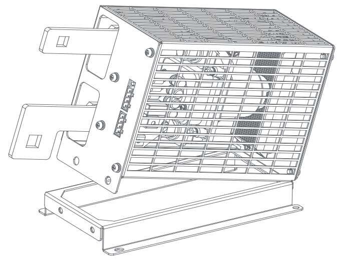


Figure b

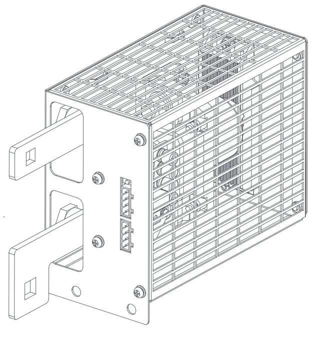


Figure c

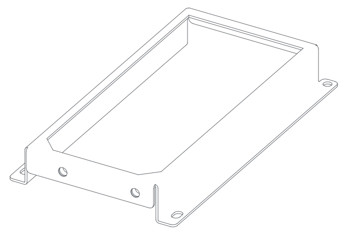


Figure d

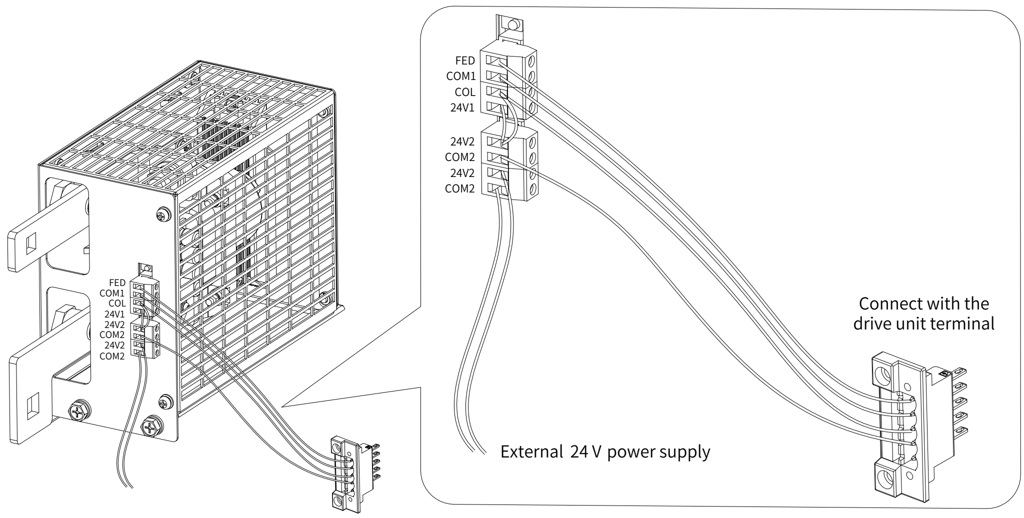


Figure e

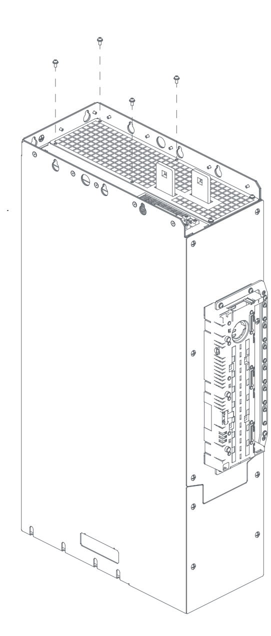


Figure f

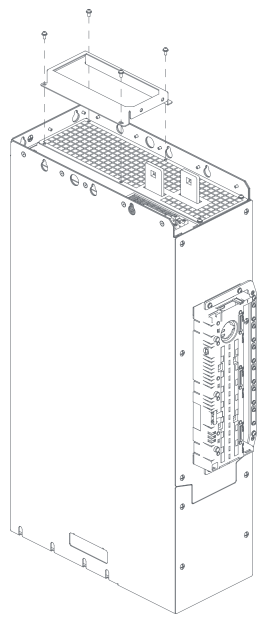


Figure g

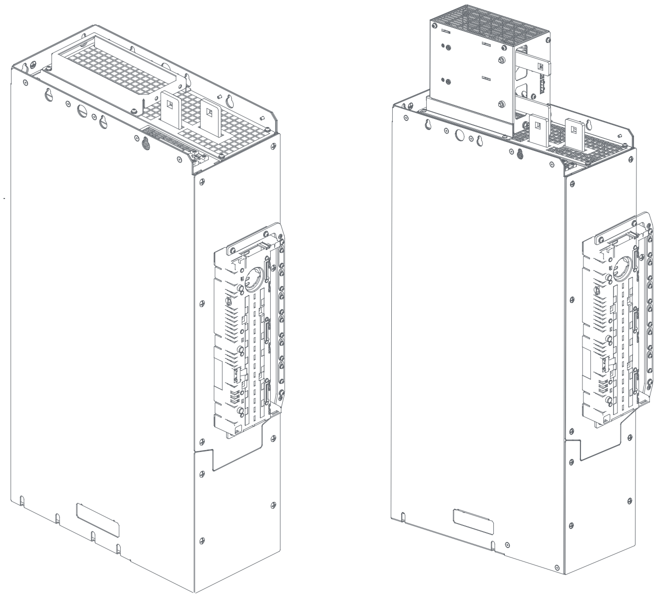


Figure h Figure i

Figure 11-21 Installation diagram of the HST-6004/HST-7004 DC soft charge units (example)

11.5.5 DC Circuit Breakers

After you select a DC soft charge unit, a DC circuit breaker must be arranged between the DC soft charge unit and the power supply unit. For details about wiring of the DC circuit breaker, see the example in "Figure 11-20 Installation diagram of the INOV-SU-30/INOV-SU-60/INOV-SU-100/INOV-SU-170 DC soft charge unit".

Table 11-17 DC circuit breaker models

DC Soft Charge Unit Model	Recommended DC Circuit Breaker (ABB) UL Certified	
	Rated Current (A)	Model
INOV-SU-30	40	S804S-UCK40
INOV-SU-60	80	S804S-UCK80
INOV-SU-100	125	S804S-UCK125
INOV-SU-170	250	T4DCN250TMA250FF3P

11.5.6 AC Input Reactor

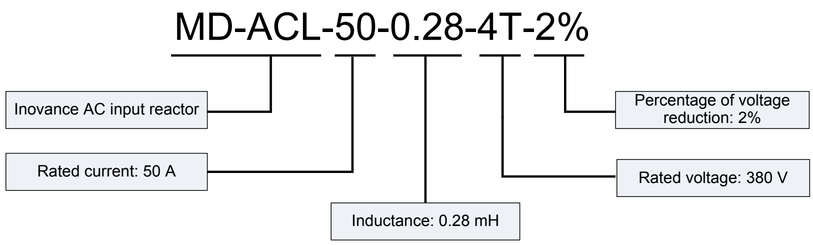
An AC input reactor is connected to suppress harmonic current on the input side. Install an AC reactor when the application has higher requirements on harmonic suppression. Ensure that the cabinet has sufficient space for installing the reactor. Table 9-12 lists the recommended AC reactor manufacturers and models.

Table 11-18 Recommended AC reactor manufacturers and models

Power Supply Unit Model	AC Input Reactor Model (Inovance)
MD810-20M4T22GXXX	MD-ACL-60-0.24-4T-2%
MD810-20M4T45GXXX	MD-ACL-120-0.12-4T-2%

Power Supply Unit Model	AC Input Reactor Model (Inovance)
MD810-20M4T110GXXX	MD-ACL-250-0.056-4T-2%
MD810-20M4T160GXXX(W)	MD-ACL-330-0.042-4T-2%
MD810-20M4T355GXXX	MD-ACL-800-0.017-4T-2%

1) Model description:



2) Overall dimensions of the AC input reactor:

■ Dimensions of the AC input reactor of 60 A

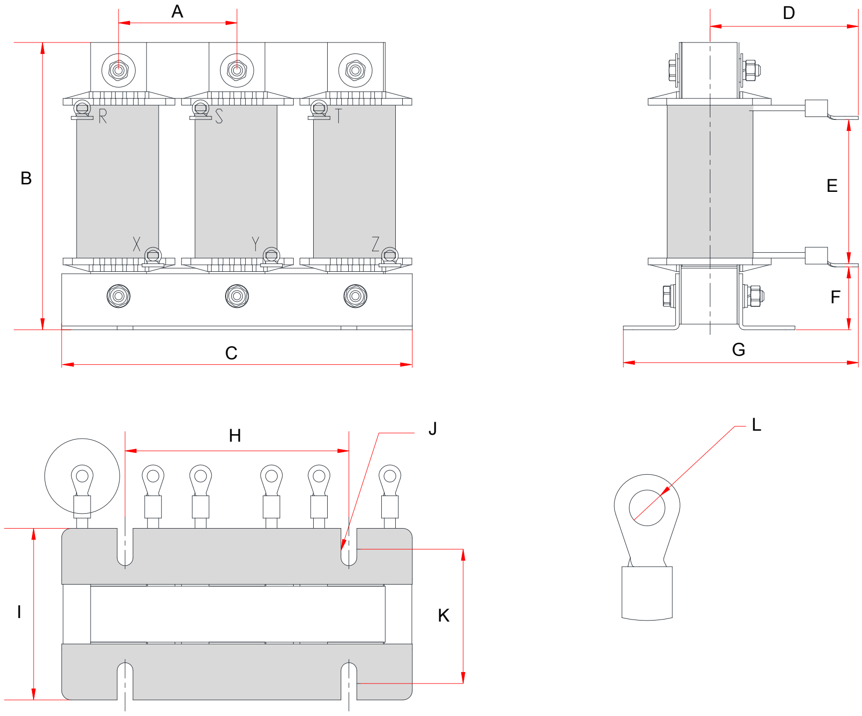


Figure 11-22 Dimensions of the AC input reactor of 60 A

Table 11-19 Dimensions of the AC input reactor of 60 A (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	I	J	K	L
60	64	160	195	80±10	75±5	35±5	135	120±1	92±2	Φ8.5*20	72±2	Φ6.4

■ Dimensions of the AC input reactor of 120 A

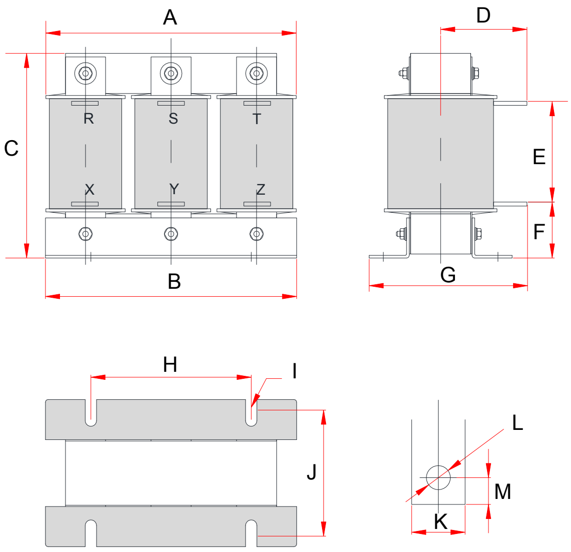


Figure 11-23 Dimensions of the AC input reactor of 120 A

Table 11-20 Dimensions of the AC input reactor of 120 A (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M
120	195	188±1	160	78±10	79±5	40±5	135	120±1	Φ8.5*20	92±2	20	Φ9	10

■ Dimensions of the AC input reactor of 250 A/330 A

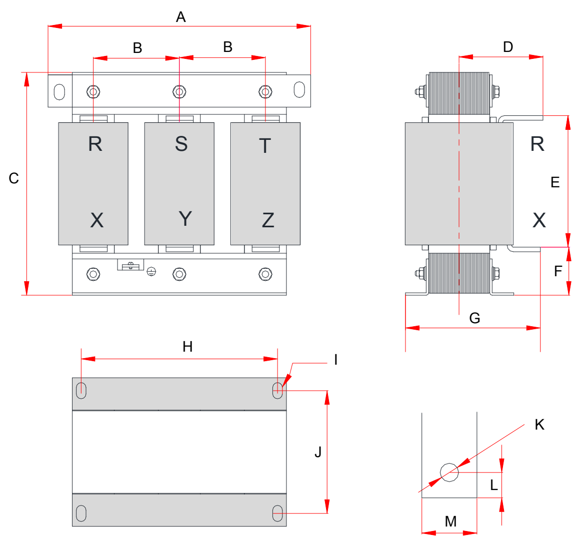


Figure 11-24 Dimensions of the AC input reactor of 250A/330A

Table 11-21 Dimensions of the AC input reactor of 250A/330A (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M
250	250	81±5	260	102±10	160±5	50±5	175	182±1	Φ11*18	96±2	Φ11	13	25
330	290	95±5	275	107±10	160±5	60±5	180	214±1	Φ11*18	100±2	Φ12	15	30

■ Dimensions of the AC input reactor of 800 A

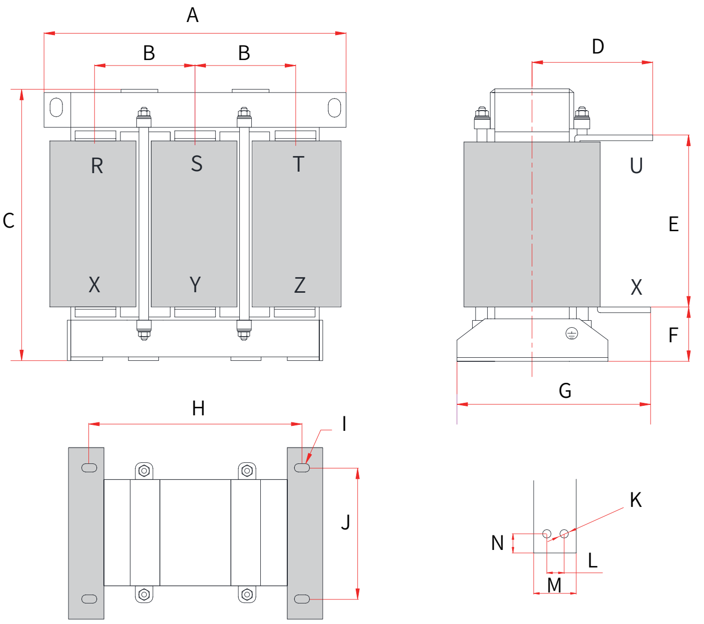


Figure 11-25 Dimensions of the AC input reactor of 800A

Table 11-22 Dimensions of the AC input reactor of 800A (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
800	385	123±5	390	142±10	238±5	70±5	250	260±2	Φ12*20	175±1	Φ12	22	50	23

11.5.7 AC Output Reactors

Depending on the actual conditions, an AC output reactor may be arranged on the output side of the drive. The connection cable between the drive and the motor cannot be too long to prevent high-order harmonic current that may be generated due to large distributed capacitance.

An output reactor must be used when the connection cable is too long. An AC output reactor must be arranged near the drive when the cable length is equal to or larger than the values listed in the following table.

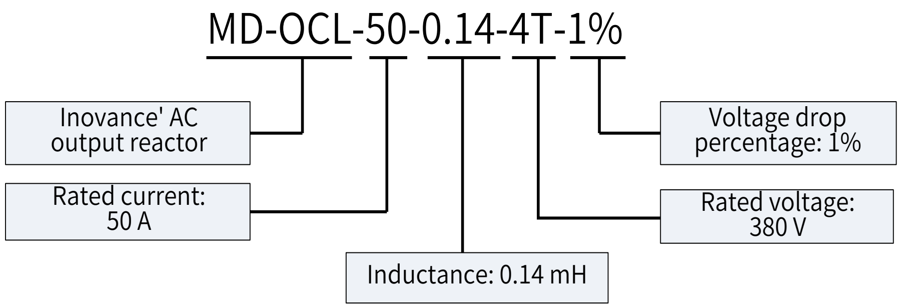
Table 11-23 Minimum cable length that requires an input reactor to be used

Drive Model	Rated Voltage (V)	Minimum Cable Length that Requires an Input Reactor to Be Used (m)
MD810-50M4T1.5GXXX	200~500	50
MD810-50M4T2.2GXXX	200~500	50
MD810-50M4T3.7GXXX	200~500	50
MD810-50M4T5.5GXXX	200~500	70
MD810-50M4T7.5GXXX	200~500	100
MD810-50M4T11GXXX	200~500	110
MD810-50M4T15GXXX	200~500	125
MD810-50M4T18.5GXXX	200~500	135
MD810-50M4T22GXXX	200~500	150
MD810-50M4T30GXXX	280~690	150
MD810-50M4T37GXXX	280~690	150
MD810-50M4T45GXXX	280~690	150
MD810-50M4T55GXXX	280~690	150
MD810-50M4T75GXXX	280~690	150
MD810-50M4T90GXXX	280~690	150
MD810-50M4T110GXXX	280~690	150
MD810-50M4T132GXXX	280~690	150
MD810-50M4T160GXXX	280~690	150
MD810-50M4T200GXXXH	280~690	150
MD810-50M4T250GXXXH	280~690	150
MD810-50M4T315GXXXH	280~690	150
MD810-50M4T355GXXXH	280~690	150
MD810-50M4TD1.5GXXX	200~500	50
MD810-50M4TD2.2GXXX	200~500	50
MD810-50M4TD3.7GXXX	200~500	50
MD810-50M4TD5.5GXXX	200~500	70
MD810-50M4TD7.5GXXX	200~500	100
MD810-50M4TD11GXXX	200~500	110
MD810-50M4TD15GXXX	200~500	125
MD810-50M4TD18.5GXXX	200~500	135

Table 11-24 Recommended AC output reactor manufacturers and models

Drive Model	AC Output Reactor Model (Inovance)
MD810-50M4T1.5GXXX	MD-OCL-5-1.4-4T-1%
MD810-50M4T2.2GXXX	MD-OCL-7-1.0-4T-1%
MD810-50M4T3.7GXXX	MD-OCL-10-0.7-4T-1%
MD810-50M4T5.5GXXX	MD-OCL-15-0.47-4T-1%
MD810-50M4T7.5GXXX	MD-OCL-20-0.35-4T-1%
MD810-50M4T11GXXX	MD-OCL-30-0.23-4T-1%
MD810-50M4T15GXXX	MD-OCL-40-0.18-4T-1%
MD810-50M4T18.5GXXX	MD-OCL-50-0.14-4T-1%
MD810-50M4T22GXXX	MD-OCL-60-0.12-4T-1%
MD810-50M4T30GXXX	MD-OCL-80-0.087-4T-1%
MD810-50M4T37GXXX	MD-OCL-90-0.078-4T-1%
MD810-50M4T45GXXX	MD-OCL-120-0.058-4T-1%
MD810-50M4T55GXXX	MD-OCL-150-0.047-4T-1%
MD810-50M4T75GXXX	MD-OCL-200-0.035-4T-1%
MD810-50M4T90GXXX	MD-OCL-250-0.028-4T-1%
MD810-50M4T110GXXX	MD-OCL-250-0.028-4T-1%
MD810-50M4T132GXXX	MD-OCL-330-0.021-4T-1%
MD810-50M4T160GXXX	MD-OCL-330-0.021-4T-1%
MD810-50M4T200GXXXH	MD-OCL-490-0.014-4T-1%
MD810-50M4T250GXXXH	MD-OCL-490-0.014-4T-1%
MD810-50M4T315GXXXH	MD-OCL-660-0.011-4T-1%
MD810-50M4T355GXXXH	MD-OCL-800-0.0087-4T-1%
MD810-50M4TD1.5GXXX	MD-OCL-5-1.4-4T-1%
MD810-50M4TD2.2GXXX	MD-OCL-7-1.0-4T-1%
MD810-50M4TD3.7GXXX	MD-OCL-10-0.7-4T-1%
MD810-50M4TD5.5GXXX	MD-OCL-15-0.47-4T-1%
MD810-50M4TD7.5GXXX	MD-OCL-20-0.35-4T-1%
MD810-50M4TD11GXXX	MD-OCL-30-0.23-4T-1%
MD810-50M4TD15GXXX	MD-OCL-40-0.18-4T-1%
MD810-50M4TD18.5GXXX	MD-OCL-50-0.14-4T-1%

1) Model description of the AC output reactor:



2) Dimensions of the AC output reactor:

■ Dimensions of the AC output reactor of 50 A to 90 A

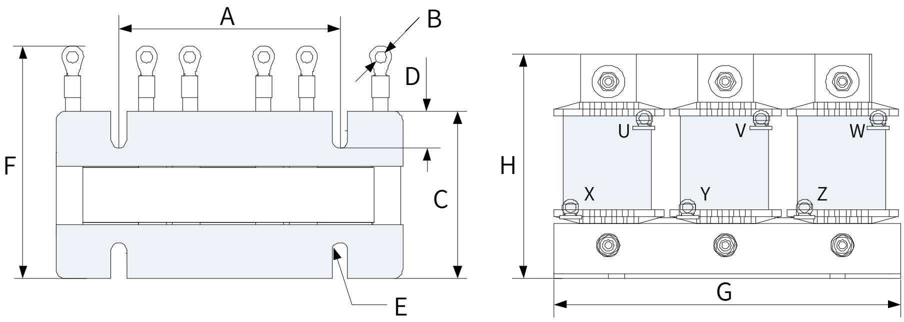


Figure 11-26 Dimensions of the AC output reactors of 50 A to 90 A

Table 11-25 Dimensions of the AC output reactors of 50 A to 90 A

Rated Current (A)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)
50	120±1	6 x φ6.4	92±2	20	4 x φ8.5	131±10	200	130
60	120±1	6 x φ6.4	92±2	20	4 x φ8.5	131±10	200	130
80	120±2	6 x φ6.4	92±2	20	4 x φ8.5	125±10	200	165
90	120±2	6 x φ6.4	92±2	20	4 x φ8.5	125±10	200	165

■ Dimensions of the AC output reactor of 120 A

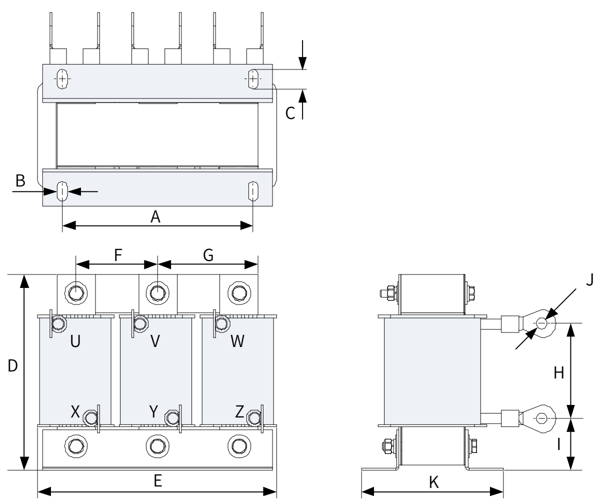


Figure 11-27 Dimensions of the AC output reactor of 120 A

Table 11-26 Dimensions of the AC output reactor of 120 A

Rated Current (A)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	I (mm)	J (mm)	K (mm)
120	150±1	8	15	165	195	64	79	75±5	40±5	6*Φ8.4	165

■ Dimensions of the AC output reactors of 150 A to 250 A

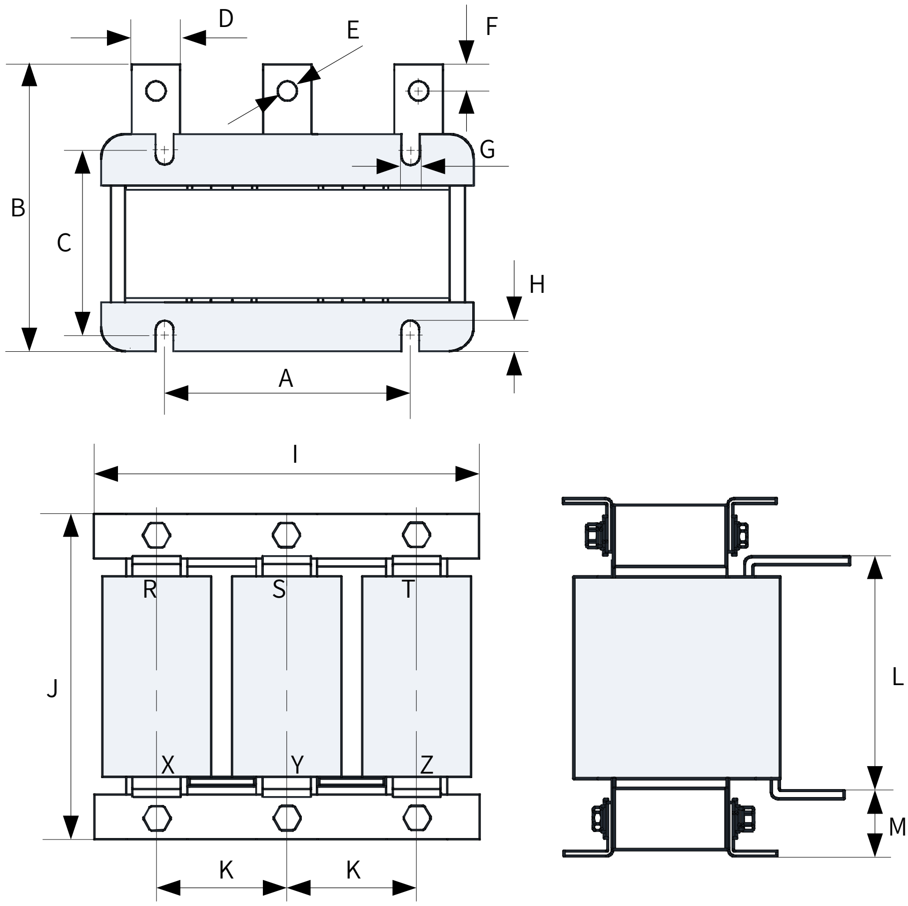


Figure 11-28 Dimensions of the AC output reactors of 150 A to 250 A

Table 11-27 Dimensions of the AC output reactors of 150 A to 250 A

Rated Current (A)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	I (mm)	J (mm)	K (mm)	L (mm)	M (mm)
150	120±1	155	92±2	20	Φ11	10	8.5	20	195	210	64±5	135±5	36±5
200	120±1	165	102±2	20	Φ11	10	8.5	20	195	210	64±5	145±5	30±5
250	120±1	165	102±2	20	Φ11	10	8.5	20	195	210	64±5	143±5	30±5

■ Dimensions of the AC output reactor of 330 A

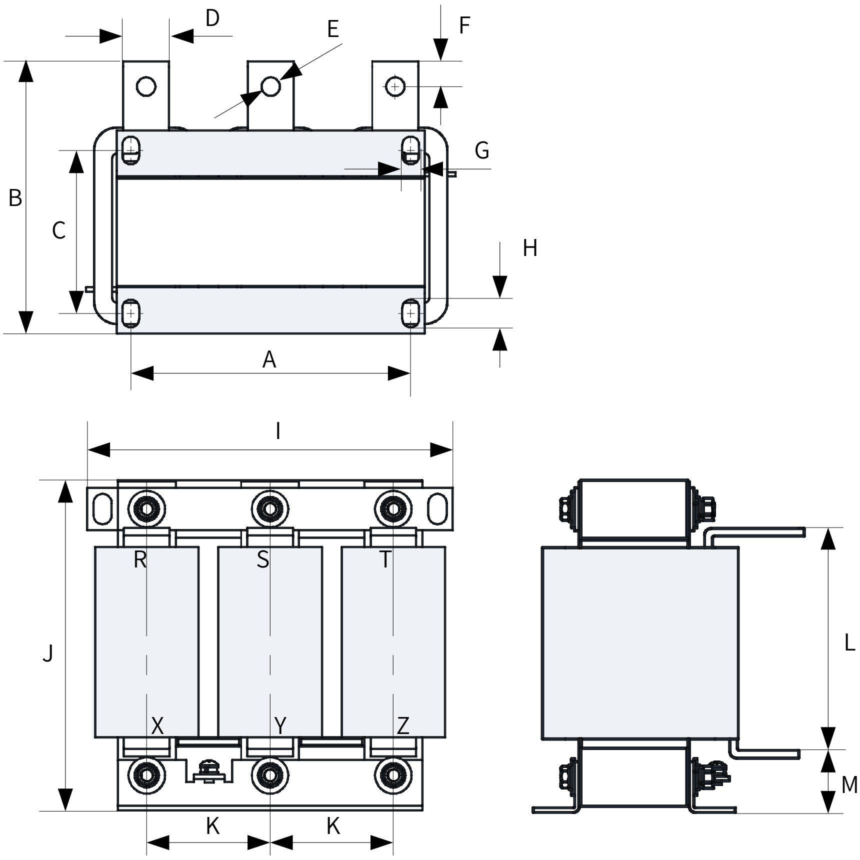


Figure 11-29 Dimensions of the AC output reactor of 330 A

Table 11-28 Dimensions of the AC output reactor of 330 A

Rated Current (A)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	I (mm)	J (mm)	K (mm)	L (mm)	M (mm)
330	182±1	175	91±2	30	ϕ12	15	11	18	255	240	81±5	155±5	43±5

11.5.8 dv/dt Reactors

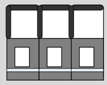
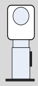
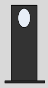
The dv/dt reactor connected on the output side of the drive can:

■ Reduce dv/dt when it is too high.

■ Protect the motor winding from insulation breakdown and lower the motor temperature to ensure long service life.

■ Reduce interference to the adjacent devices.

Table 11-29 Recommended dv/dt Reactor Models (SCHAFFNER)

Drive Model	Reactor	Rated Current at 40°C (A)	Typical Motor Rated Power (kW)	Rated Inductance (mH)	Loss (W)	Input/Output Terminal			Total (kg)
									
MD810-50M4T1.5GXXX	RWK 305-4-KL	4	1.5	1.47	22	KL	-	-	1.2
MD810-50M4T2.2GXXX	RWK 305-7.8-KL	7.8	3	0.754	25	KL	-	-	1.2
MD810-50M4T3.7GXXX	RWK 305-10-KL	10	4	0.588	30	KL	-	-	1.8
MD810-50M4T5.5GXXX	RWK 305-14-KL	14	5.5	0.42	34	KL	-	-	2.2
MD810-50M4T7.5GXXX	RWK 305-17-KL	17	7.5	0.346	38	KL	-	-	2.5
MD810-50M4T11GXXX	RWK 305-24-KL	24	11	0.245	45	KL	-	-	2.5
MD810-50M4T15GXXX	RWK 305-32-KL	32	15	0.184	55	KL	-	-	3.9
MD810-50M4T18.5GXXX	RWK 305-45-KL	45	18.5	0.131	60	KL	-	-	6.1
MD810-50M4T22GXXX	RWK 305-45-KL	45	22	0.131	60	KL	-	-	6.1
MD810-50M4T30GXXX	RWK 305-60-KL	60	30	0.098	65	KL	-	-	6.1
MD810-50M4T37GXXX	RWK 305-72-KL	72	37	0.082	70	KL	-	-	6.1
MD810-50M4T45GXXX	RWK 305-90-KL	90	45	0.065	75	KL	-	-	7.4
MD810-50M4T55GXXX	RWK 305-110-KL	110	55	0.053	90	KL	-	-	8.2
MD810-50M4T75GXXX	RWK 305-156-KS	156	75	0.038	120	-	KS	-	10.7
MD810-50M4T90GXXX	RWK 305-182-KS	182	90	0.032	140	-	KS	-	16
MD810-50M4T110GXXX	RWK 305-230-KS	230	110	0.026	180	-	KS	-	22
MD810-50M4T132GXXX	RWK 305-280-KS	280	132	0.021	220	-	KS	-	29
MD810-50M4T160GXXX	RWK 305-330-KS	330	160	0.018	240	-	KS	-	32
MD810-50M4T200GXXXH	RWK 305-400-S	400	200	0.015	330	-	-	S	34
MD810-50M4T250GXXXH	RWK 305-500-S	500	250	0.012	340	-	-	S	35
MD810-50M4T315GXXXH	RWK 305-600-S	600	315	0.01	380	-	-	S	37
MD810-50M4T355GXXXH	RWK 305-680-S	680	355	0.009	410	-	-	S	38
MD810-50M4TD1.5GXXX	RWK 305-4-KL	4	1.5	1.47	22	KL	-	-	1.2
MD810-50M4TD2.2GXXX	RWK 305-7.8-KL	7.8	3	0.754	25	KL	-	-	1.2
MD810-50M4TD3.7GXXX	RWK 305-10-KL	10	4	0.588	30	KL	-	-	1.8
MD810-50M4TD5.5GXXX	RWK 305-14-KL	14	5.5	0.42	34	KL	-	-	2.2
MD810-50M4TD7.5GXXX	RWK 305-17-KL	17	7.5	0.346	38	KL	-	-	2.5
MD810-50M4TD11GXXX	RWK 305-24-KL	24	11	0.245	45	KL	-	-	2.5
MD810-50M4TD15GXXX	RWK 305-32-KL	32	15	0.184	55	KL	-	-	3.9
MD810-50M4TD18.5GXXX	RWK 305-45-KL	45	18.5	0.131	60	KL	-	-	6.1

1) Overall dimensions and mounting dimensions

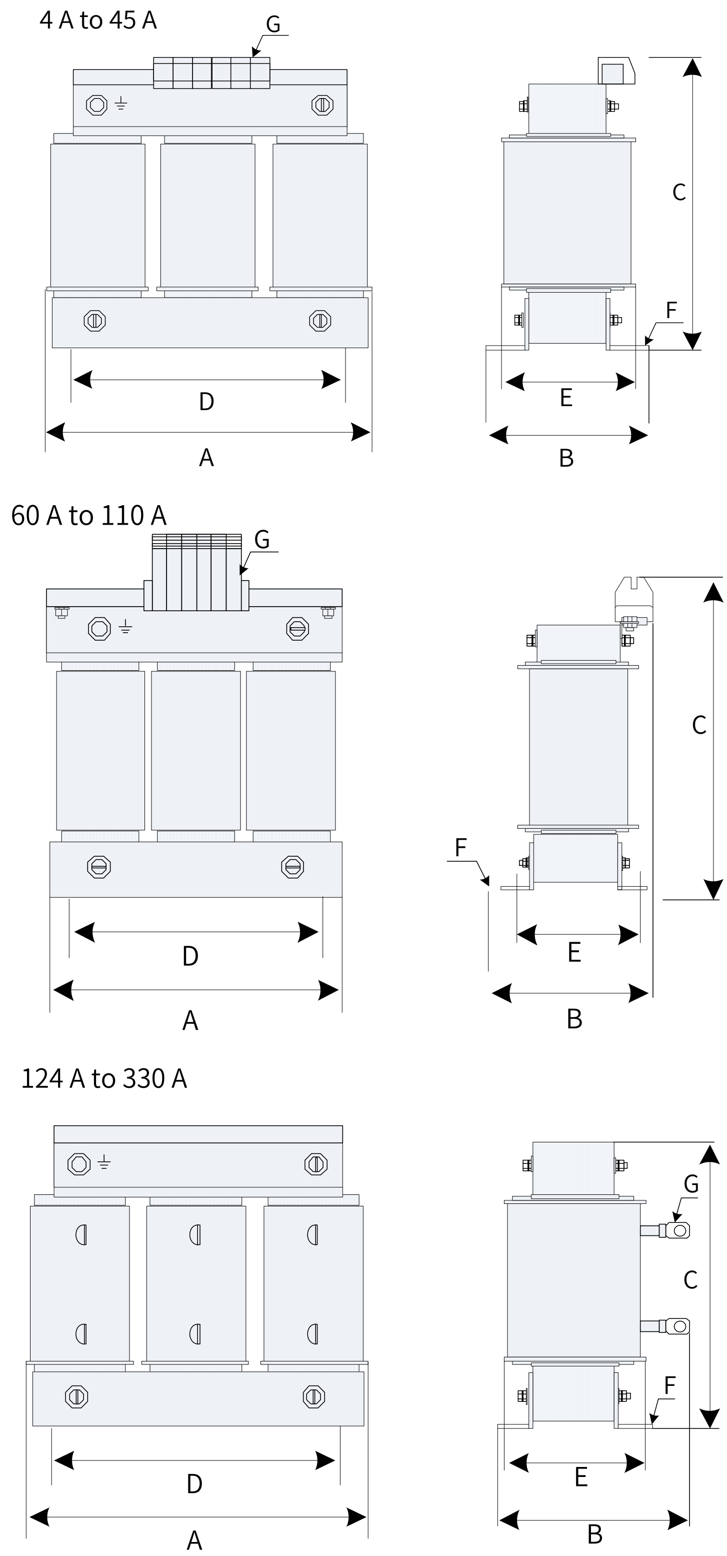


Figure 11-30 Dimensions of the dv/dt reactors

Table 11-30 Mounting dimensions of the dv/dt reactors (unit: mm)

Series	A	B	C	D	E	F	G
4 A and 7.8 A	100	max.60	max.115	56	34	4.8×9	2.5mm^2
10 A	100	max.70	max.115	56	43	4.8×9	2.5mm^2
14 A	125	max.70	max.135	100	45	5×8	2.5mm^2
17 A	125	max.75	max.135	100	55	5×8	2.5mm^2
24 A	125	max.75	max.135	100	55	5×8	4mm^2
32 A	155	max.95	max.170	130	56	8×12	10mm^2
45 A	155	max.110	max.190	130	72	8×12	10mm^2
60 A and 72 A	155	max.125	max.190	130	70	8×12	16mm^2
90 A	190	max.115	max.225	170	57	8×12	35mm^2
110 A	190	max.130	max.220	170	67	8×12	35mm^2
124 A	190	max.180	max.160	170	67	8×12	8
143 A	190	max.180	max.160	170	77	8×12	8
156 A and 170 A	190	max.180	max.160	170	77	8×12	10
182 A	210	max.180	max.185	175	97	8×12	10
230 A	240	220	-	190	119	11×15	12
280 A	240	235	-	190	133	11×15	12
330 A	240	240	-	190	135	11×15	12
400 A and 500 A	240	220	-	190	119	11×15	11
600 A and 680 A	240	230	-	190	128	11×15	11
790 A	300	218	-	240	136	11×15	11
910 A	300	228	-	240	148	11×15	11
1100 A	360	250	-	310	144	11×15	11

11.5.9 External EMC Filters

■ Standard external EMC filters

The standard external EMC filters meets the EN 61800-3 C2 emission requirement of CE certification. Connect the filter to ground reliably and ensure that the length of the cable connecting the power supply unit and filter is less than 30 cm.

NOTE

◆ The length of the cable connecting the power supply unit and filter must be less than 30 cm. The filter and power supply unit must be connected to the same ground reference plane, and the filter must be reliably connected to the ground. Failure to comply will diminish the filter effect.

◆ The power supply unit with built-in standard filter satisfies the European EMC directive 2014/30/EU and the standard EN 61800-3 Category C3. In this case the power supply unit can be used in the second environment.

■ Physical Appearance

Schaffner FN3258 series filters

Schaffner FN3359 series filters

Changzhou Jianli series filters

Figure 11-31 Physical appearance of standard external EMC filters

■ Selection Guidance

Schaffner and Jianli filters are recommended, as listed in the following table.

Table 11-31 Recommended external EMC filter manufacturers and models

Power Supply Unit Model	External EMC Filter Model (Schaffner)	External EMC Filter Model (Changzhou Jianli)
MD810-20M4T22GXXX	FN 3258-75-34	DL-65EBK5
MD810-20M4T45GXXX	FN 3258-100-35	DL-100EBK5
MD810-20M4T110GXXX	FN 3359-250-28	DL-250EBK5
MD810-20M4T160GXXX(W)	FN 3359-320-99	DL-400EBK3
MD810-20M4T355GXXX	FN 3359-800-99	DL-700EBK3

■ Mounting Dimensions

Dimensions of Schaffner FN 3258 series filters of 50 to 180 A

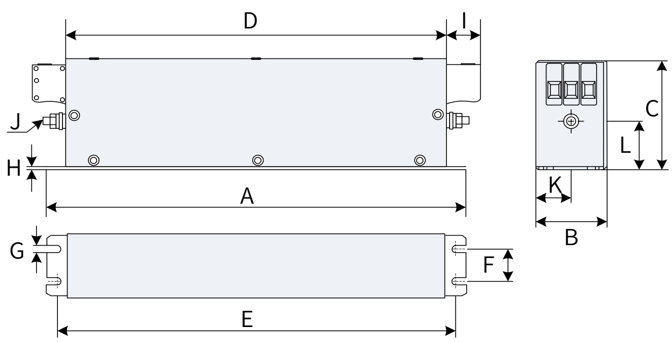


Figure 11-32 Dimensions of Schaffner FN 3258 series filters of 50 to 180 A (unit: mm)

Table 11-32 Dimensions of Schaffner FN 3258 series filters of 50 to 180 A (unit: mm)

Rated Current (A)	A	B	C	D	E	F	G	H	I	J	K	L
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
75	270	80	135	240	255	60	6.5	1.5	39	M6	40	70.5
100	270	90	150	240	255	65	6.5	1.5	45	M10	45	64
130	270	90	150	240	255	65	6.5	1.5	45	M10	45	64
180	380	120	170	350	365	102	6.5	1.5	51	M10	60	47

■ Dimensions of Schaffner FN 3359 series filters of 150 to 2500 A

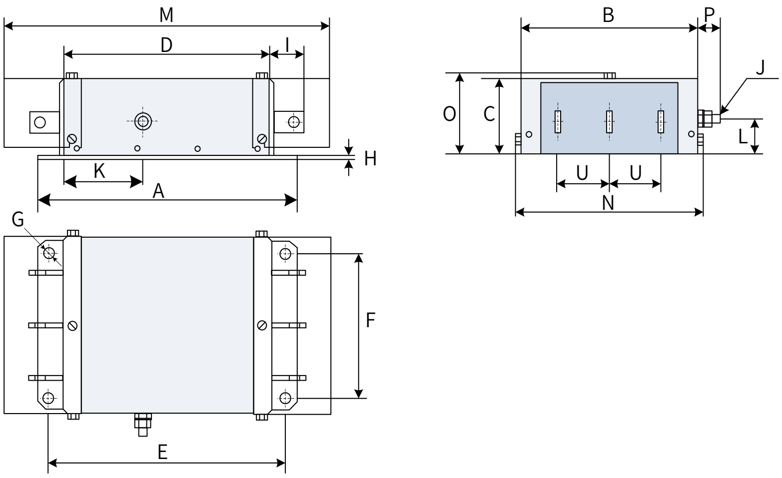


Figure 11-33 Dimensions of Schaffner FN 3359 series filters of 150 to 2500 A (unit: mm)

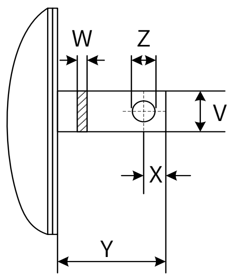


Figure 11-34 Dimensions of the copper bar (unit: mm)

Table 11-33 Dimensions of Schaffner FN 3359 series filters of 150 to 2500 A (unit: mm)

Mark	150 A	180 A	250 A	320 A	400 A	600 A	800 A	1000 A	1600 A	2500 A
A	300	300	300	300	300	300	350	350	400	600
B	210	210	230	260	260	260	280	280	300	370
C	120	120	125	115	115	135	170	170	160	200
D	160	160	180	210	210	210	230	230	250	300
E	120	120	120	120	120	120	145	145	170	250

Mark	150 A	180 A	250 A	320 A	400 A	600 A	800 A	1000 A	1600 A	2500 A
F	185	185	205	235	235	235	255	255	275	330
G	ϕ12	ϕ12	ϕ12	ϕ12	ϕ12	ϕ12	ϕ12	ϕ12	ϕ12	ϕ14
H	2	2	2	2	2	2	3	3	3	3
I	33	33	33	43	43	43	53	53	93	98
J	M10	M10	M10	M12	M12	M12	M12	M12	M12	M16
K	55	55	62.5	20	20	20	25	25	25	25
L	30	30	35	20	20	20	25	25	25	25
M	420	420	420	440	440	440	510	510	-	-
N	171	171	191	221	221	221	241	241	-	-
O	127	127	132	122	122	142	177	177	-	-
S	-	-	-	-	-	-	-	-	26	35
T	-	-	-	-	-	-	-	-	26	35
U	50	50	55	60	60	60	60	60	60	100
V	-	-	-	25	25	25	40	40	60	70
W	-	-	-	6	6	8	8	8	10	15
X	-	-	-	15	15	15	20	20	17	20
Y	-	-	-	40	40	40	50	50	90	95
Z	-	-	-	ϕ10.5	ϕ10.5	ϕ10.5	ϕ14	ϕ14	ϕ14	ϕ14

■ Dimensions of Jianli series filters of 50 to 200 A

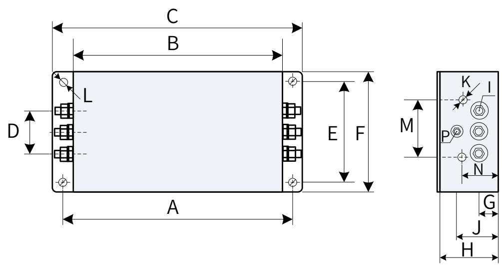


Figure 11-35 Dimensions of Jianli series filters of 50 to 200 A (unit: mm)

Table 11-34 Dimensions of Jianli series filters of 50 to 200 A (unit: mm)

Model	A	B	C	D	E	F	G	H	I	J	K	M	N	P	L
DL-25EBK5	243	224	265	58	70	102	25	92	M6	58	M4	74	49	M6	6.4×9.4
DL-35EBK5															
DL-50EBK5															
DL-65EBK5															
DL-80EBK5	354	323	388	66	155	188	30	92	M8	62	M4	86	56	M8	6.4×9.4
DL-100EBK5															
DL-130EBK5															
DL-160EBK5															
DL-200EBK5															

■ Dimensions of Jianli series filters of 250 to 800 A

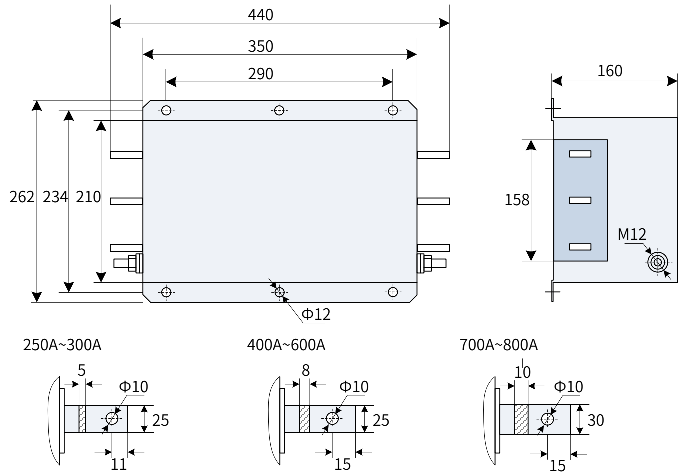


Figure 11-36 Dimensions of Jianli series filters of 250 to 800 A (unit: mm)

■ Dimensions of Jianli series filter of 1000 A

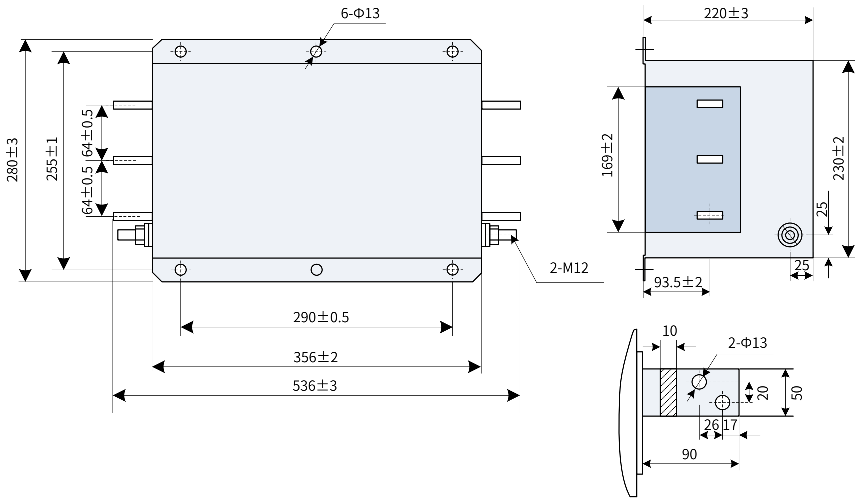


Figure 11-37 Dimensions of Jianli series filters of 1000 A (unit: mm)

■ Simple EMC input filters

A simple EMC input filter is installed to prevent the surrounding interference and prevent the interference from the power supply unit during running.

Connect the simple EMC filter to ground reliably and ensure that the length of the cable connecting the power supply unit and the filter is less than 30 cm.

Table 11-35 Recommended models of simple EMC input filters

Power Supply Unit Model	Simple EMC AC Input Filter Model
MD810-20M4T22GXXX	DL65EB1/10
MD810-20M4T45GXXX	DL-120EB1/10
MD810-20M4T110GXXX	/
MD810-20M4T160GXXX(W)	/
MD810-20M4T355GXXX	/
TD810-20M4T22GXXX	DL65EB1/10
TD810-20M4T45GXXX	DL-120EB1/10

Power Supply Unit Model	Simple EMC AC Input Filter Model
TD810-20M4T110GXXX	/
TD810-20M4T160GXXX(W)	/
TD810-20M4T355GXXX	/

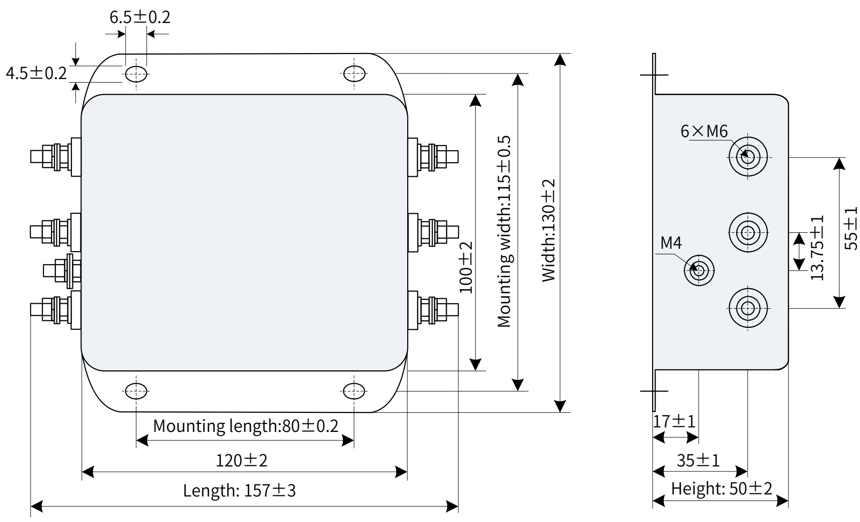


Figure 11-38 Mounting dimensions of the simple EMC filters (unit: mm)

Table 11-36 Overall dimensions and mounting dimensions of the simple EMC filters

Filter Model	Overall Dimensions (Length x Width x Height, in mm)	Mounting Dimensions (Mounting Length x Mounting Width, in mm)
DL-15EB1/10	157×130×50	80×115
DL-35EB1/10	218×140×80	184×112
DL-65EB1/10	218×140×80	184×112
DL-120EB1/10	334×185×90	304×155
DL-180EB1/10	388×220×100	354×190

11.5.10 Magnetic Rings

An output magnetic ring mainly reduces shaft current, and interference to the adjacent devices. It is installed on the output side of the drive and close to the drive.

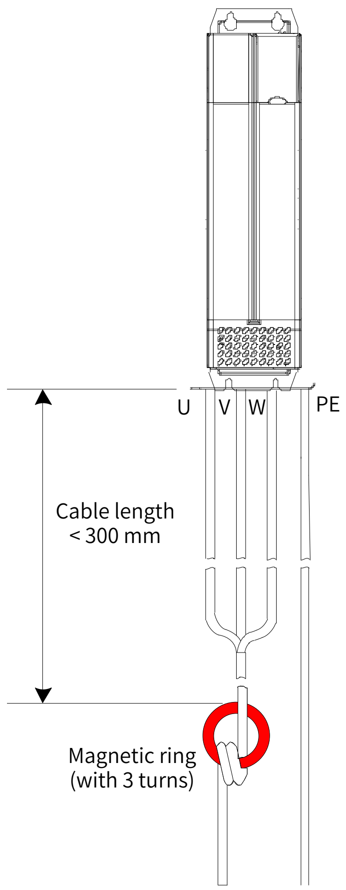


Figure 11-39 Installation diagram of the output magnetic ring (external)

11.6 Requirements of Liquid Cooled Models on the Coolant and Circulation System

■ Requirements on the radiator and pipes

1) The SS304 stainless steel or PE plastic radiator is recommended. Iron radiators are not allowed since rust will lower the water quality.

2) Carbon steel and cast iron pipes are not allowed. SS304 stainless steel, PVC, PPR pipes are recommended as the hard pipes. EPDM rubber, PU, and PE plastic pipes are recommended as the soft pipes.

3) Note that the pipes must be connected properly to prevent leakage. Generally, soldering, thread+sealing ring connection, splicing, and gluing are used for connecting hard pipes. For soft pipes, hose clamp connection and thread+sealing ring connection are used. After the pipes are connected for the first time, a pressure test must be performed to ensure that leakage does not occur.

■ Usage requirements on the coolant

1) The coolant must be circulated and isolated. Deionized water (purified water) must be used as the coolant.

2) A pressure relief device (such as a relief valve) is required for the cooling circuit to lower the water pressure. The operating water pressure must be lower than or equal to 0.1 MPa.

3) Coolant: The preservative must be added for the purified water. If the minimum ambient temperature in winter is lower than the freezing point, use the anti-freeze solution.

4) If the AC drive is stopped for more than two days, exhaust all water in the heatsink by applying 0.3 to 0.5 MP air to the water inlet for 5 to 10 minutes with the water outlet opened.

5) Check that the water cooled heatsink is watertight and meets protection requirements.

6) Generally, the coolant flow at the inlet of the water cooled heatsink is 16 L/min.

■ Requirements on the purified water and selection of the preservative and anti-freeze solution

1) Requirements on the purified water

Table 11-37 Requirements on the purified water

Item	Unit	Value Range
pH	-	6–8
Hardness	°dH	＜10
Conductivity	μS/cm	＜10
Chlorine element	mg /l	＜10
Iron element	mg /l	＜0.1
Maximum particle size	μm	＜300

2) Selection of the preservative: Add 0.03% to 0.05% sodium metasilicate to prevent corrosion of the aluminum parts.

3) Selection of the anti-freeze solution: The standard anti-freeze solutions used in the market are recommended. Generally, the freezing point of the anti-freeze solution must be 10°C to 15°C lower than the lowest ambient temperature where the AC drive is used in the winter. For example, if the lowest ambient temperature in the winter is -30°C , the freezing point of the anti-freeze solution should be lower than -45°C .

Table 11-38 Relationship between the ethylene glycol concentrations and freezing points

Freezing Point (°C)	Ethylene Glycol Concentration	Density (20°C) mg/cm^3
-10	28.4	1.0340
-15	32.8	1.0426
-20	38.5	1.0506
-25	45.3	1.0586
-30	47.8	1.0627
-35	50.0	1.0671
-40	54.0	1.0713
-45	57.0	1.0746
-50	59.0	1.0786
-45	80.0	1.0958
-30	85.0	1.1001
-13	100.0	1.1130

■ Maintenance requirements

The liquid cooled AC drive has high requirements on the water quality. Therefore, the water quality must be monitored periodically. It is recommended that the pH value and conductivity of the circulating water must be checked once every month to ensure that the water quality meets the requirements mentioned before. Otherwise, severe corrosion may occur on the liquid cooled heatsink, resulting in leakage eventually.

Appendix A Standards Compliance

A.1 CE Certification

Figure A-1 CE Mark

1) CE mark indicates compliance with European safety and environmental regulations. It is required for engaging in business and commerce in Europe. European standards include the Machinery Directive for machine manufacturers, the Low Voltage Directive for electronics manufacturers, and EMC guidelines for controlling noise.
2) This drive is marked with CE mark based on the following EMC guidelines and the Low Voltage Directive.

- 2014/35/EU: Low Voltage Directive
- 2014/30/EU: Electromagnetic compatibility

3) Machines and devices used in combination with this drive must also be CE certified and marked.
4) The integrator who integrates the drive with the CE mark into other devices has the responsibility of ensuring compliance with CE standards and verifying that conditions meet European standards.

A.1.1 CE Low Voltage Directive Compliance

This drive has been tested according to IEC 61800-5-1: 2007, and it complies with the Low Voltage Directive.

To enable machines and devices integrating this drive to comply with the Low Voltage Directive, be sure to meet the following conditions:

- Mounting Location

Mount the drive in places with pollution not higher than severity 2 and overvoltage category 3 in accordance with IEC60664.

- Installing Fuse on the Input Side

To prevent accidents caused by short circuit, install a fuse on the input side. The fuse must comply with the UL standard. Select the fuse according to Table A-1.

Table A-1 Options of the external fuse for the input side (primary side) of the power supply unit

Unit Model	Recommended Fuse in Compliance with UL Certification Manufacturer: Bussmann		
Three-phase 380 to 480 V, 50/60 Hz (47–63 Hz)	Rated Current (A)	Model	Quantity
MD810-20M4T45GXXX	150	FWH-150B	1
MD810-20M4T90GXXX	325	FWH-325A	1
MD810-20M4T110GXXX	500	FWH-500A	1
MD810-20M4T132GXXX	1000	170M5016	1

NOTE

◆ When the fuse burns or the circuit breaker trips, do not connect to power immediately or operate the machine. Check wiring and peripherals to identify the cause. If the cause cannot be identified, contact the agent or Inovance. Do not connect to power or operate the machine by yourself.

◆ Each input cable of the drive unit and power supply unit must be connected to a fuse. When a fuse burns, replace all other fuses.

■ Preventing Entry of Foreign Objects

The MD810 series drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations, and to relevant IEC requirements.

■ Grounding

If using a drive of the 400 V class, connect the neutral point of the drive to ground.

■ Cabling

For details about cabling that meets the Low Voltage Directive, see "Figure 3-1 Typical system wiring diagram".

A.1.2 EMC Guidelines Compliance

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. In other words, 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.

The drive with a built-in standard filter satisfies the European EMC directive 2014/30/EU and the standard EN 61800-3 Category C3. The drive can be applied to the second environment.

The drive with an external filter satisfies the European EMC directive 2014/30/EU and the standard EN 61800-3 Category C2. The drive can be applied to both the first environment and the second environment.

CAUTION

- Before measuring insulation resistance with megameter (500 VDC megameter recommended), disconnect the main circuit from the drive.
- Do not conduct the dielectric strength test. A high voltage (> 500 V) test is not required because it has been completed before delivery.

To satisfy the EMC directive and standard, install the EMC filter on the input side of the drive, connect a shielded cable on the output side, connect the filter to ground reliably, and connect the shield layer of output cable fully to ground. For details about EMC filter selection, see "10 Technical Specifications and Model Selection". For details about how to select and install drive cables on the output side, see "3 Electrical Installation".

The integrator of the system installed with the drive is responsible for compliance of the system with the European EMC directive and standard EN 61800-3 Category C2, C3, or C4 according to the system application environment.

A.1.3 Definition of Terms

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 1000 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 less 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

A.1.4 Cabling Requirements

1) The shielded cable must be used to satisfy EMC requirements of CE marking. Shielded cables are classified into three-conductor cables and four-conductor cables. If conductivity of the cable shield is not sufficient, add an independent PE cable, or use a four-conductor cable, of which one phase conductor is a PE cable. To suppress emission and conduction of radio frequency interference effectively, the shield of the cable is copper braid. Braided density of the copper braid must be greater than 90% to enhance shielding efficiency and conductivity. For details about selection and grounding of shielded cables, see "3.2.3 Main Circuit Cable Selection" and "3.2.4 System Grounding".
2) The motor cable and PE shielded conducting wire (twisted shielded) should be as short as possible to reduce electromagnetic radiation and external stray current and capacitive current of the cable. If the motor cable is longer than 100 meters, an output filter or dv/dt reactor is required.
3) It is recommended that all control cables be shielded.
4) Motor cables must be routed away from other cables. Motor cables of multiple drives can be routed in parallel.
5) It is recommended that motor cables, power input cables, and control cables be laid in different ducts. To avoid electromagnetic interference caused by rapid change of output voltage of the drive, do not lay motor cables and other cables side by side for a long distance.
6) If the control cable must run across the power cable, make sure they are arranged at an angle of close to 90° . Other cables are not allowed to run across the drive.
7) Power input and output cables of the drive and weak-current signal cables (such as control cable) must be laid perpendicularly (if possible) rather than in parallel.
8) Cable ducts must be in good connection and well grounded. Aluminum ducts can be used to improve electric potential.
9) The filter, motor, and drive must be connected to the system (machinery or appliance) properly, with coating protection at installation part and conductive metal in full contact.
10) For detailed cabling requirements, see "3 Electrical Installation".

A.1.5 Measures due to the Leakage Current

The drive unit and power supply unit output high-speed pulse voltage, producing high-frequency leakage current when the unit is operating (run state). Each drive produces more than 100 mA leakage current. Therefore, it is necessary to select a residual current circuit breaker with rated operating current of 100 mA or above. The drive generates DC leakage current in the protective conductor. Therefore, a time-delay B-type breaker must be used.

If multiple drives are required, each drive must be installed with a circuit breaker.

- Factors that influence the leakage current are as follows:

1) Drive capacity
2) Carrier frequency
3) Type and length of the motor cable
4) EMI filter

- When leakage current causes the circuit breaker to act, you must:

1) Increase sensitivity current of the circuit breaker.
2) Replace the circuit breaker with a new one with high-frequency suppression function.
3) Reduce carrier frequency.
4) Shorten length of the output cable.
5) Install a current leakage suppression device.

Recommended residual current circuit breaker manufacturers are Chint Electric and Schneider.

A.1.6 Solutions to Common EMC Interference Problems

The MD810 generates very strong interference. Although EMC measures are taken, interference may still exist due to improper cabling or grounding during use. When the power supply unit interferes with other devices, adopt the following solutions.

Table A-2 Solutions to common EMC interference problems

Interference Type	Solution
Leakage protection switch tripping	◆ Reduce carrier frequency. ◆ Shorten length of the drive cable. ◆ Wind a ferrite core around the power cable except the PE cable. ◆ When tripping at the moment of power-on, cut off the large capacitance to ground on the power input side by disconnecting the grounding terminal of the external or built-in filter and disconnecting the grounding terminal of Y capacitance to ground of input terminals. ◆ When tripping while the drive is running or enabled, take leakage current suppression measures (install a leakage current filter, safety capacitor + wind ferrite core, or wind ferrite core).
Drive interference during running	◆ Connect the motor housing to the PE of the drive. ◆ Connect the PE of the drive to the PE of the mains. ◆ Wind a ferrite core around the power cable except the PE cable. ◆ Add a safety capacitor or ferrite core to the interfered signal terminal. ◆ Add an extra common ground.
Communication interference	◆ Connect the motor housing to the PE of the drive. ◆ Connect the PE of the drive to the PE of the mains. ◆ Wind a ferrite core around the power cable except the PE cable. ◆ Add a termination resistor for the communication cable source and load. ◆ Add a common grounding cable besides the communication cable. ◆ Use a shielded cable as the communication cable and connect the cable shield to the common grounding point. ◆ Adopt the daisy chain mode for multi-node communication and reserve branch length of less than 30 cm.
I/O interference	◆ Enlarge capacitance at low-speed DI. A maximum of 0.1 uF capacitance is suggested. ◆ Enlarge capacitance at AI. A maximum of 0.22 uF is suggested.

Memo NO. ___________

Date / /

Appendix B Communication

B.1 Parameter Communication Address

Parameter communication addresses must be used to perform read-write and other operations on parameters of the MD810. This chapter mainly describes the method of obtaining communication addresses according to parameters as well as special parameter communication addresses for Modbus communication. Parameter communication addresses are often written as parameter addresses or function addresses in this chapter.

B.1.1 Parameter Introduction

The parameters of the MD810 are divided into basic function parameters and monitoring function parameters. They are stored in corresponding parameter groups.

Basic function parameters are stored in groups F and A, as shown in the following table:

MD810 Parameter Data	Group F (Read-write)	F0, F1, F2, F3, F4, F5, F6, F7, F8, F9, FA, FB, FC, Fd, FE, FF
	Group A (Read-write)	A0, A1, A2, A3, A4, A5, A6, A7, A8, A9, AA, AB, AC, AD, AE, AF
	Group B (Read-write)	B0, B1, B2

The following table shows the addresses used for the monitoring function parameters including the RUN command, running status, running parameters, and alarm information.

MD810 Monitoring Function Parameter	Status Data (Read-only)	U0, 8000H
	Control Parameter (Write-only)	U3, 1000H

B.1.2 Description of Parameter Communication Addresses

Each of groups F0 to FF, A0 to AF, and B0 to B2 include multiple function parameters. For example, F0-16 (Carrier frequency adjusted with temperature) indicates number 16 in group F0. High 16 bits of communication addresses of function parameters are function group numbers. Low 16 bits are the hexadecimal format of parameter numbers in function groups.

That is, the communication address of F0-16 (Carrier frequency adjusted with temperature) is 0xF010.

In addition, writing basic function parameters and performing power-off save cause frequent operations on EEPROM, reducing the service life of EEPROM. Therefore, some basic function parameters are modified by changing the values in RAM through communication without being stored.

See the following table.

For parameters in groups F0 to FE, corresponding RAM addresses are obtained by replacing F by 0 in the upper 4 bits of the address.

For parameters in groups A0 to AF, corresponding RAM addresses are obtained by replacing A by 4 in the upper 4 bits of the address.

That is, the communication RAM address of F3-12 (Oscillation suppression gain function) is 0x030C; the communication RAM address of A0-05 (Speed limit digital setting) is 0x4005.

Parameter Group No.	Communication Access Address	Modified RAM Parameter Address through Communication
Groups F0 to FE	0xF000 to 0xFEFF	0x0000 to 0x0EFF
Groups A0 to AF	0xA000 to 0xACFF	0x4000 to 0x4CFF
Groups B0 to BF	0xB000 to 0xBFFF	0x5000 to 0x5FFF
Group U0	0x7000 to 0x70FF	

NOTE

- Group FF: Parameters cannot be read and changed.
- Group U0: Parameters can be read, but cannot be changed.
- 1000H and 8000H are Modbus-specific communication addresses. Some functions are the same as group U.
- Only the write operation can be performed on communication RAM addresses. They are invalid addresses during the read operation.
- Some parameters cannot be changed when the drive is in running state.
- Some parameters cannot be changed regardless of the state of the drive.
- When changing a parameter, pay attention to the range, unit, and related description of the parameter.

B.1.3 Modbus-Specific Parameter Communication Addresses

Parameter Address	Parameter Description
Communication Monitoring Parameters	
1000H	*Communication setting value (decimal) -10000 to 10000 Communication setting values are percentage of relative values. 10000 and -10000 correspond to 100.00% and -100.00%, respectively. For frequency dimension data, this percentage is a percentage of relative maximum frequency (F0-10). For torque dimension data, this percentage is F2-10 [Digital setting of torque upper limit (monitoring)].
Control commands are input to the drive: (Write-only)	
7311H	0000: Stop by a stop method set in F6-10 (Stop mode) 0001: Forward running 0002: Reverse running 0003: Forward jogging 0004: Reverse jogging 0005: Coast to stop 0006: Decelerate to stop 0007: Fault reset
Reading the drive status	
703DH	0001: Forward running 0002: Reverse running 0003: Stop 0004: Auto-tuning 0005: Fault
Parameter locking password check	
1F00H	Parameter locking password check: If an actual password value is returned, the password is active (locked). (If no password is available, i.e. the password is 0, 0000H is returned.)
DO control	
7312H	BIT0: DO1 output control BIT1: DO2 output control BIT2: RELAY1 output control BIT3: Reserved BIT4: FMR output control BIT5 to BIT9: Reserved
AO control	
7313H	0 to 7FFF indicate 0% to 100%.

Parameter Address	Parameter Description
Pulse output control	
7315H	0 to 7FFF indicate 0% to 100%.
Description of faults	
8000H	0000: No fault 0001: Hardware fault 0002: Overcurrent during acceleration 0003: Overcurrent during deceleration 0004: Overcurrent at constant speed 0005: Overvoltage during acceleration 0006: Overvoltage during deceleration 0007: Overvoltage at constant speed 0009: Undervoltage fault 000A: Drive overload 000B: Motor overload 000C: Input phase loss 000D: Output phase loss 000E: IGBT overheat 000F: External fault 0010: Communication fault 0013: Motor auto-tuning fault 0014: Encoder/PG card fault 0015: Parameter read-write abnormality 0016: Motor auto-tuning result abnormality 0017: Motor short circuit to ground 0018: Inter-phase short circuit 0019: Power supply unit fault 001A: Running time reached 001B: User-defined fault 1 001C: User-defined fault 2 001D: Power-on time reached 001E: Load lost 001F: PID feedback lost during running 002A: Excessive speed deviation 002B: Motor overspeed 002D: Motor overtemperature 0050: Fan fault

B.2 Modbus Communication

B.2.1 Network Configuration

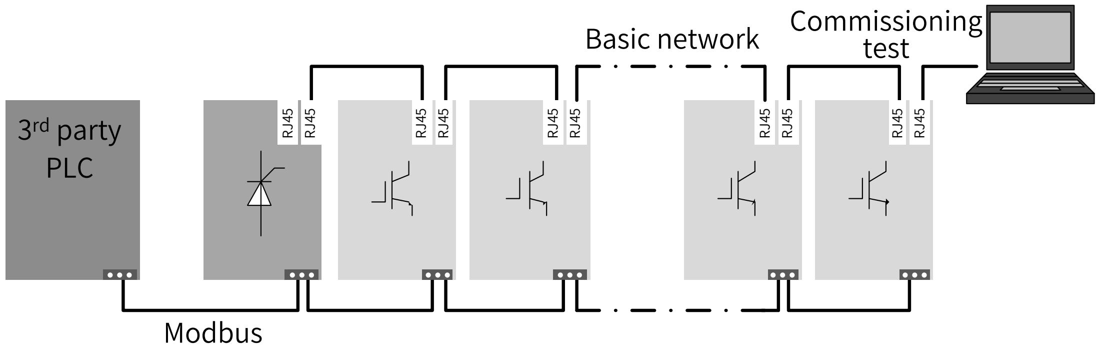


Figure B-1 Modbus communication network configuration

B.2.2 Interface Description

The terminal names of 3-pin connection terminals are C485+, C485-, and CGND from left to right, as shown in the following figure:

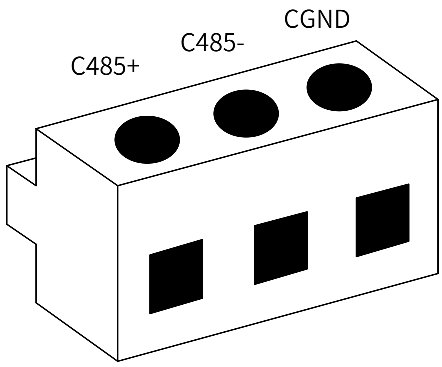


Figure B-2 3-pin connection terminals

B.2.3 Communication Performance

1) Up to 128 nodes can be connected with a maximum baud rate of 115.2 kbps. The maximum communication distance is 1 km with a cable cross sectional area of AWG26.
2) The maximum transmission distance corresponding to the baud rate of 19.2 kbps is 1 km.

B.2.4 Related Parameters

Parameter No.	Parameter Name	Default	Setting Range		Parameter Description
Fd-00	Modbus baud rate	5	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 a data transmission rate between the host controller and the drive. The larger the baud rate is, the faster the communication speed is. Note that the baud rate of the host controller must be consistent with that of the drive. Otherwise, communication cannot be performed.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
Fd-01	Modbus data format	0	0: No check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: 8-N-1	The set data format of the host controller must be consistent with that of the drive. Otherwise, communication cannot be performed.
Fd-02	Modbus local address	1	1 to 247. The value 0 is a broadcast address.	When the local address is set to 0 (broadcast address), the broadcasting function of the host controller is implemented. The local address is unique (except the broadcast address) and is the basis to implement point-to-point communication between the host controller and the drive.
Fd-03	Modbus response delay	2	0 ms to 20 ms	Interval time from the end of data receiving by the drive data to data sending to the host controller. If the response delay is less than the system processing time, the former is subject to the latter. If the response delay is greater than the system processing time, the system sends data to the host control only after the response delay time reaches after data processing is complete.
Fd-04	Modbus communication timeout	0.0	0.0 (invalid), 0.1s to 60.0s	When it is set to 0.0s, the communication timeout is invalid. It is generally set to 0.0s. This parameter is used to monitor communication status in a system with continuous communication. When it is set to an effective value, if communication interval time between one communication and the next communication exceeds Fd-04 (communication timeout), the system will report a communication fault error (Err16).
Fd-94	Modbus software version	0．00	0．00 to 655.35	It indicates the Modbus communication software version.

B.2.5 Modbus Communication Protocol

The MD810 series AC drive provides RS485 communication interfaces and supports the Modbus-RTU slave communication protocol. You can implement centralized control with a computer or PLC. You can set the drive RUN command, modify or read parameters, and read the operating state and fault information of the drive using this communication protocol.

This protocol defines the content and format of transmitted messages during serial communication, including the master polling (or broadcasting) format and master coding method (parameter for the action, transmission data, and error check). The slave response uses the same structure including action confirmation, data return, and error check. If an error occurs when the slave receives information, or if the slave cannot finish an action required by the master, a fault message will be responded to the master.

1) Application mode

The drive is connected to the "single-master multi-slave" PC/PLC control network with an RS485 bus as a communication slave.

2) Bus structure

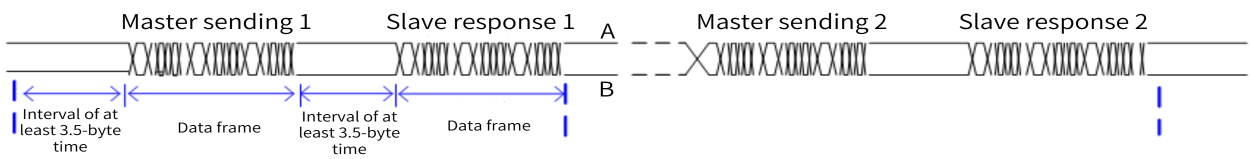
■ Topological structure

The system consists of a single master and multiple slaves. In the network, each communication device has a unique slave address. A device is the master (a PC, PLC, or HMI) and initiates communication to perform parameter read or write operations on slaves. The other devices (slaves) provide data to respond to query or operations from the master. At the same moment, either the master or the slave transmits data and the other can only receive data.

The address range of the slaves is 1 to 247, and 0 is the broadcast address. A slave address must be unique in the network.

■ Communication transmission mode

The asynchronous serial and half-duplex transmission mode is used. During asynchronous serial communication, data is sent frame by frame in the form of message. In Modbus-RTU protocol, an interval of at least 3.5-byte time marks the end of the previous message. A new message starts to be sent after this interval.

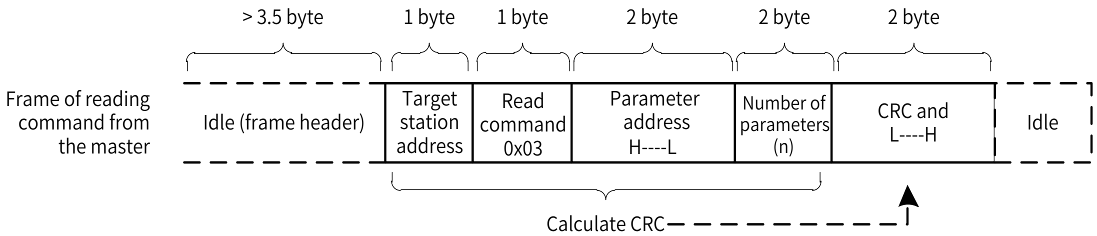


The communication protocol used by the drive is the Modbus-RTU slave communication protocol, which allows the drive to provide data to respond to "query/command" from the master or execute the action according to "query/command" from the master.

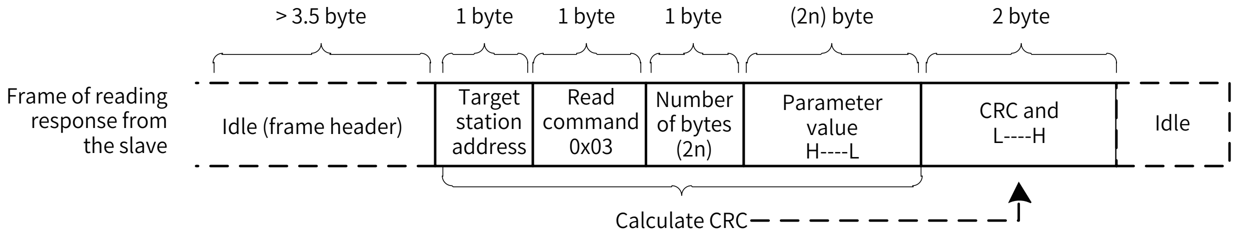
The master can be a PC, an industrial device, or a PLC. The master can communicate with a single slave or send broadcast messages to all slaves. When the master communicates with a single slave, the slave needs to return a message (response) to "query/command" from the master. For a broadcast message sent by the master, the slaves should not return a response.

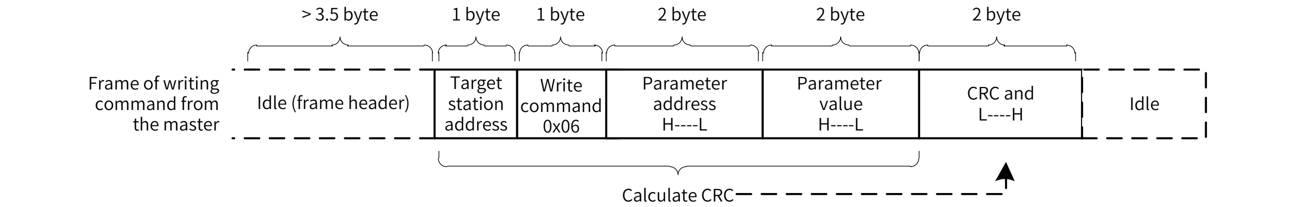
B.2.6 Data Format

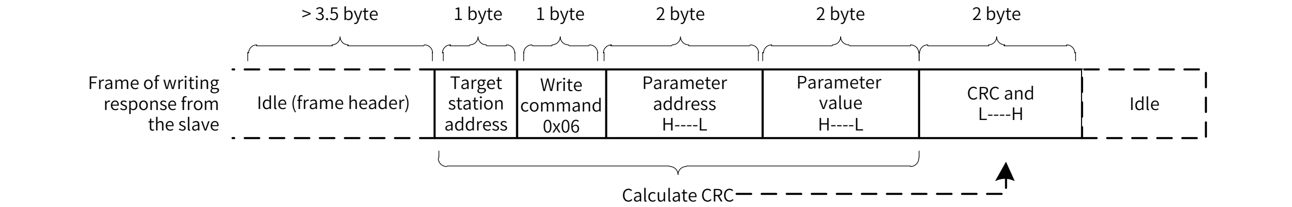
The Modbus-RTU protocol communication data format of the drive is as follows. The drive supports reading and writing of word-type parameters only. The reading command is 0x03, writing command is 0x06, and multi-writing command is 0x10. It does not support reading and writing of bytes or bits.

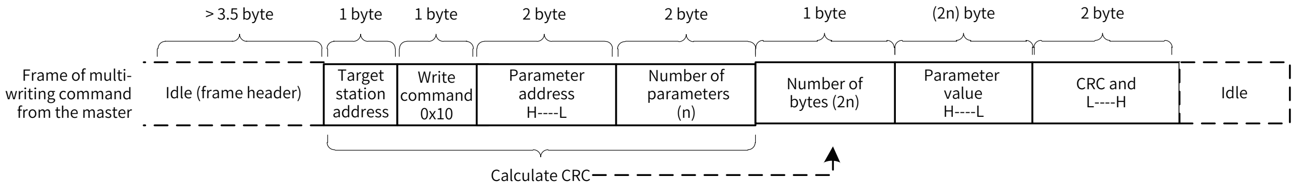


In theory, the host controller can read several consecutive parameters (n can reach up to 12) but the last parameter it reads must not jump to the next parameter group. Otherwise, an error occurs on the response.

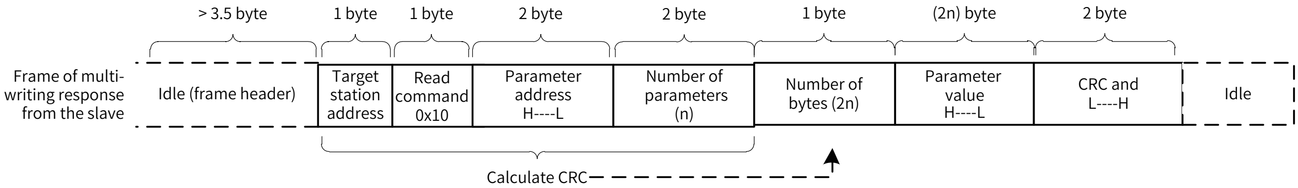








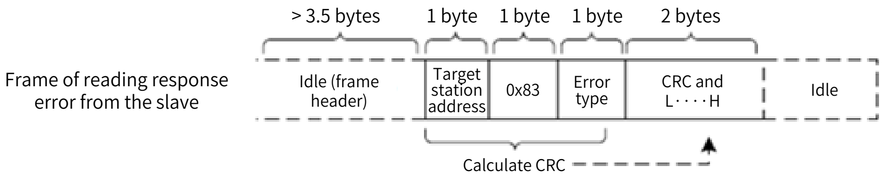
A maximum of 12 parameters can be processed for multi-reading, which is the same as multi-writing.

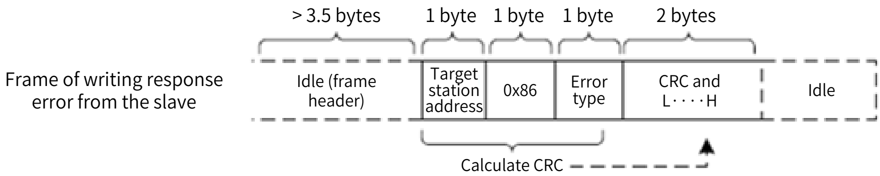


If the slave detects reading/writing failure caused by a communication frame error or by other reasons, an error frame will be returned.

Note: An error frame will not be returned for a CRC error.

The slave read response error command is 0x83. The write response error command is 0x86. The multi-write response error command is 0x90.





Error type:
01: Command code error
02: Address error
03: Data error
04: Command cannot be processed

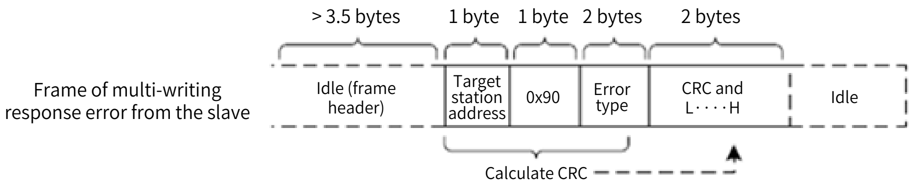


Table B-1 Description of data frame field

Frame Header (START)	Greater than the 3.5-byte transmission idle time
Slave Address (ADR)	Communication address: 1 to 247; 0: Broadcast address
Command Code (CMD)	03: Read slave parameters; 06: Write slave parameters; 10: Multi-write slave parameters
Parameter Address (H)	It is the internal parameter address of the drive, expressed in hexadecimal format. The parameters include functional parameters and non-functional parameters (such as running status and running command). For details, see the definition of address. During transmission, low-order bytes follow the high-order bytes.
Parameter Address (L)	
Number of Parameters (H)	It is the number of parameters read by this frame. If it is 1, one parameter is read. During transmission, low-order bytes follow the high-order bytes. In the present protocol, only one parameter is rewritten once, and this field is unavailable.
Number of Parameters (L)	
Data Bytes	The data length is twice the number of parameters.
Data (H)	It is the response data or data to be written. During transmission, low-order bytes follow the high-order bytes.
Data (L)	
CRC CHK Low Bytes	Detection value: CRC16 verification value During transmission, high-order bytes follow the low-order bytes. For the calculation method, see CRC below.
CRC CHK High Bytes	
END	It is 3.5-byte transmission time.

■ CRC

CRC (Cyclical Redundancy Check) uses the RTU frame format. A Modbus message includes an error detection domain based on the CRC method. The CRC field checks the content of the entire message. The CRC field is two bytes, containing a 16-bit binary value. The CRC field is calculated by the transmitting device, and then added to the message. The receiving device recalculates CRC of received messages that is compared with the value in the received CRC domain. If both CRC values are unequal, a transmission error has occured.

The CRC is first stored to 0xFFFF. Then a procedure is invoked to process the successive 8-bit bytes in the message and the value in the register. Only the eight bits of each character are used for the CRC. The start bit, stop bit, and the parity bit do not apply to the CRC.

During generation of the CRC, exclusive-OR (XOR) is applied between the content of the register and each byte of the communication frame. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into 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 until eight shifts have been performed. After the last (eighth) shift, exclusive-OR (XOR) is applied between the register's current content and the next byte of the communication frame, and the process repeats for eight more shifts as described above. The final value of the register, after all the bytes of the message have been applied, is the CRC value.

When CRC is added in a message, high order bytes follow low order bytes. The CRC simple function 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）；
 }
```

B.3 CANopen/CANlink Communication

The CANopen communication protocol is an international general standard protocol. The CANlink communication protocol is a special protocol based on the CAN bus application and independently developed by Inovance. This protocol can communicate with only Inovance's PLCs such as H2U and H3U.

B.3.1 Network Configuration

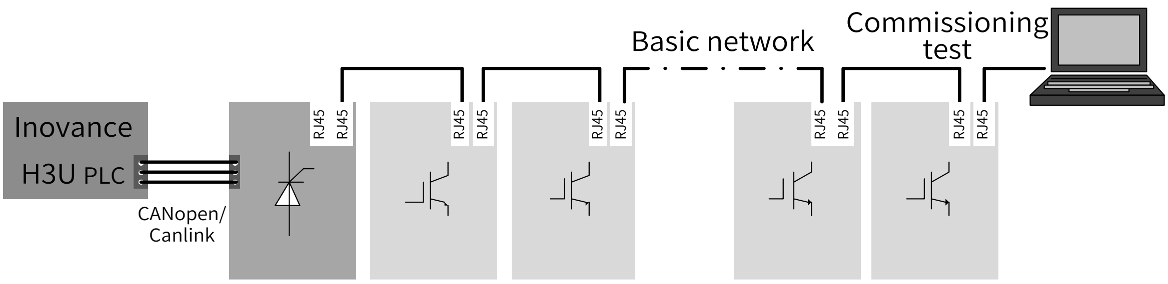


Figure B-3 CANopen/CANlink communication network configuration

NOTE

- ◆ Ensure that termination resistors are located at both ends of the CAN bus.
- ◆ A computer or commissioning software can be connected at the end of the CAN network.

B.3.2 Interface Description

The dual RJ45 terminals of the MD810 series AC drive are used for CANopen/CANlink protocol communication interfaces. The following figure shows the communication terminals.

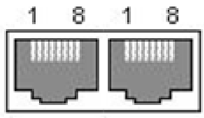


Figure B-4 CANopen/CANlink communication terminals

Pins of both interfaces are internally connected together. The following table shows the definition of the interfaces.

Table B-2 Definition of RJ45 interfaces

Pin No.	Signal	Description
1	CANH	CAN bus high level
2	CANL	CAN bus low level
3	CGND	Common ground of communication
4	Reserved by the manufacturer	
5	Reserved by the manufacturer	
6	Unconnected	Reserved
7	Unconnected	Reserved
8	CGND	Common ground of communication

B.3.3 CAN Bus Topology

The following figure shows the CAN bus connection topology. It is recommended that the CAN bus be connected using STP. Two 120 Ω termination resistors must be connected at both ends of the bus respectively to avoid signal reflection. Reliable single-point grounding is often used for shielded layers.

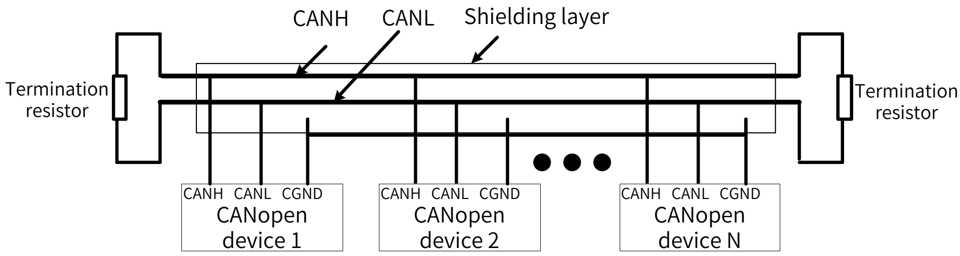


Figure B-5 CAN bus connection topology

B.3.4 CAN Transmission Distance

The transmission distance of the CANopen/CANlink bus has a direct relation with the baud rate and communication cable. The following table shows the relation between the maximum bus line length and the baud rate.

Table B-3 Baud rate and bus length

Baud Rate (bps)	1 M	500 K	250 K	125 K	100 K	50 K	20 K
Length (m)	25	100	250	500	500	1000	1000

B.3.5 Related Parameters

To use CANopen/CANlink, set the power supply unit parameters as shown in the following table.

Table B-4 Related equipment parameters

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
Fd-09	Communication status	0	Ones position: CANopen 0: Disabled 1: Initialization 2: Pre-operational 8: Operational Tens position: CANlink 0: Disabled 1: Initialization 2: Pre-operational 8: Operational Hundreds position: PROFIBUS-DP 0: Disabled 1: Initialization 2: Pre-operational 8: Operational	This read-only parameter is used to monitor communication status.
Fd-10	CANopen/CANlink switchover	1	1: CANopen 2: CANlink	CAN communication protocol selection: If it is set to 1, CANopen communication is selected. If it is set to 2, CANlink communication is selected.
Fd-11	CANopen402 mode selection	1	0: Disabled 1: Enabled	CANopen mode selection. When it is set to 0, ordinary mode is selected. When it is set to 1, CiA402 mode is selected.
Fd-12	CAN baud rate	5	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mkbps	CAN communication baud rate, for both CANlink and CANopen. In the same network, baud rates of all stations must be consistent, otherwise communication is abnormal.
Fd-13	CAN station No.	1	1 to 127	CAN station No., for both CANlink and CANopen. In the same network, station Nos. of all stations must be consistent, otherwise communication is abnormal.
Fd-14	Number of CAN frames received within unit time	0	0 to 65535	It is used to monitor the bus load. This parameter indicates the number of CAN frames received by this station each second.
Fd-15	Maximum value of node receiving error counter	0	0 to 65535	It is used to monitor bus errors. This parameter indicates the maximum value of CAN reception error counter in this node.
Fd-16	Maximum value of node sending error counter	0	0 to 65535	It is used to monitor bus errors. This parameter indicates the maximum value of CAN sending error counter in this node.

Parameter No.	Parameter Name	Default	Setting Range	Parameter Description
Fd-17	Bus disconnection times within a period	0	0 to 65535	It is used to monitor bus errors. This parameter indicates the CAN bus trip count in this node.
Fd-18	Power supply unit No.	1	1 to 99	Common bus network group No. It is used for networking of multiple groups of common buses. The same number must be set for the network with the same group of common buses. Numbers cannot be the same for networks with different common buses.
Fd-34	CANopen mode	0	0: Common mode 1: Expert mode	The common mode is the standard CANopen mode. In the expert mode, the current node can send and receive PDOs according to the mapping configured in the parameter group AF.
Fd-35	CANopen disabling time	0	0: Disabled 1 to 65535: TPDO disabling time (unit: 100 us)	This parameter is disabled when it is set to 0. When it is set to a non-zero value, its value will be used when the master does not set the disabling time for a TPDO.
Fd-36	CANopen event time	0	0: Disabled 1 to 65535: TPDO event time (unit: ms)	This parameter is disabled when it is set to 0. When it is set to a non-zero value, its value will be used when the master does not set the event time for a TPDO.
Fd-95	CANlink software version	0．00	0.00 to 655.35	CANlink communication software version No.
Fd-96	CANopen software version	0．00	0.00 to 655.35	CANopen communication software version No.

B.3.6 Description of CANopen Communication Protocol Application

1 Software feature

The MD810-CANopen supports six protocols as follows:

- Supports the Node Guard protocol. The master uses this function to query the equipment status.
- Supports the Heartbeat protocol. The slave regularly reports the current status to the master.
- SDO supports only the acceleration transmission mechanism. One parameter or one object dictionary is transmitted every time.
- Supports four TPDOs (sending PDO) and four RPDOs (receiving PDOs).
- Supports emergency objects.
- Supports synchronous mode.

2 Communication object COB-ID

CANopen provides multiple communication objects. Every communication object has different features (For details, see "B.3.7 CANopen Communication Protocol". You can cherry-pick a communication object according to different applications. This communication interface uses predefined COB-ID. Specific rules are as follows:

- NMT object: 0x000
- SYNC object: 0x080

- SDO object:

SDO sending — 0x600+Node-Id

SDO receiving — 0x580+Node-Id

- PDO object:

RPDO1 — 0x200+Node-Id

RPDO2 — 0x300+Node-Id

RPDO3 — 0x400+Node-Id

RPDO4 — 0x500+Node-Id

TPDO1 — 0x180+Node-Id

TPDO2 — 0x280+Node-Id

TPDO3 — 0x380+Node-Id

TPDO4 — 0x480+Node-Id

- EMCY object: 0x80+Node-Id

Node-Id: Equipment ID (station address) set by Fd-13 (CAN station No.)

3 Parameter operations

A correspondence method between the various parameters (including parameters of the drive unit and power supply unit) and the object dictionary is specified. You can simply and directly determine the relation between the parameters and the object dictionary by this method. This facilitates parameter operations.

- Relation between the parameters and CANopen object dictionary indexes

1) Correspondence method

The parameter groups correspond to the indexes 0x2000 to 0x20FF of the CANopen object dictionary. The correspondence method is as follows: An object dictionary index is the upper 16 bits of the parameter address plus 0x2000; an object dictionary sub-index is the lower bits plus 1. For example, for drive parameter F0-03 (Main frequency source X selection) and communication address 0xF003, the corresponding object dictionary index and sub-index are 0x20F0 and 0x04, respectively.

2) Relation list

The parameter groups of the MD810 series drive are divided into groups F0 to FF, A0 to AF, and U0 to UF.

According to the preceding correspondence method, for parameter read/write operations, the relation between the parameter group numbers and the object dictionary indexes is as follows:

Parameter Group	CANopen Object Dictionary Index
F0–FF	0x20F0–0x20FF
A0–AF	0x20A0–0x20AF
U0–UF	0x2070–0x207F

The sub-index is the lower 16 bits of a parameter address plus 1, so the relation between the parameter group numbers and the object dictionary indexes is as follows:

Parameter Index	CANopen Object Dictionary Subindex
0x0–0xFE	0x1–0xFF

Take F0-17 (Acceleration time 1) as an example. When the F0-17 parameter value is read, the parameter address is 0xF011. Therefore, its object dictionary index number and sub-index number are 0x20F0 and 0x12, respectively.

■ SDO read operation

A CANopen data service object (SDO) is used to perform the read operation on the drive unit or power supply unit. The following table shows the data format sent from the master.

Take F0-02 (Command source selection) as an example. According to the relation described in the preceding section, the index and sub-index are 0x20F0 and 0x03, respectively.

Table B-5 SDO object sent during the read operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x600+Node-ID	Depends on node address setting on the equipment.
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code (0x40)	0x40 read command
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Upper byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Reserved "0"
	DATA5	Data 2	Reserved "0"
	DATA6	Data 3	Reserved "0"
	DATA7	Data 4	Reserved "0"

The following table shows the SDO slave response data during the read operation.

If the operation is successful, the command code return value is "0x4B"; the index and subindex remain unchanged; the read data is returned to DATA4 and DATA5; "0" is returned to DATA6 and DATA7.

If the operation fails, the command code return value is "0x80"; the index and subindex remain unchanged; SDO failure error codes are returned to DATA4, DATA5, DATA6, and DATA7. (For error codes, see c.)

Table B-6 SDO object returned during the read operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x580+Node-ID	Depends on node address setting on the equipment.
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code return	Success: "0x4B" Failure: "0x80"
	DATA1	Low byte of index	Parameter group (group F0 "0xF0")
	DATA2	High byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Lower byte of data
	DATA5	Data 2	Upper byte of data
	DATA6	Data 3	Success: "0" Failure: SDO operation failure error code (see "B.3.7 CANopen Communication Protocol".)
	DATA7	Data 4	

■ SDO write operation

A CANopen data service object (SDO) to perform the write operation on the drive unit or power supply unit. The following table shows the data format sent from the master.

Table B-7 SDO object sent during the write operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x600+Node-ID	Depends on node address setting on the equipment.
RTR	RTR	0	Remote frame flag "0"

CAN Frame		CANopen Data	Description
8-byte frame data	DATA0	Command code	0x2B
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Upper byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Lower byte of data
	DATA5	Data 2	Upper byte of data
	DATA6	Data 3	Reserved "0"
	DATA7	Data 4	Reserved "0"

The following table shows the SDO slave response data during the write operation.

If the operation is successful, the command code return value is "0x60"; the index and subindex remain unchanged; "0" is returned to DATA4, DATA5, DATA6, and DATA7.

If the operation fails, the command code return value is "0x80"; the index remains unchanged; SDO failure error codes are returned to DATA4, DATA5, DATA6, and DATA7. (For error codes, see "9.4 Fault Codes and Solutions".)

Table B-8 SDO objects returned during the write operation

CAN Frame		CANopen Data	Description
COB-ID	11-bit ID	0x580+Node-ID	DIP switch setting of Node-ID equipment address
RTR	RTR	0	Remote frame flag "0"
8-byte frame data	DATA0	Command code return	Success: "0x60" Failure: "0x80"
	DATA1	Lower byte of index	Parameter group (group F0 "0xF0")
	DATA2	Upper byte of index	0x20
	DATA3	Sub-index	Parameter No. + 1 ("0x03")
	DATA4	Data 1	Success: 0
	DATA5	Data 2	Failure: SDO operation failure error code
	DATA6	Data 3	(See "B.3.7 CANopen Communication Protocol")
	DATA7	Data 4	Reserved "0"

■ Examples of read and write operations

This section takes the F0-02 (Command source selection) read and write operations as an example. The CANopen address of the drive is set to "0x06".

3) Read the command source (F0-02)

Read the drive parameter F0-02 (Command source selection). The following table shows a CANopen packet sent from the master.

Table B-9 Packet sent from the master when reading F0-02 (Command source selection)

Packet ID (Hex)	RTR	Data (Hex)
0x606	0	40 F0 20 03 00 00 00 00

The following table shows a CANopen response packet of the drive. The current value of F0-02 is "0x0002", indicating that the current command source of the drive is a communication command channel.

Table B-10 Response packet of the drive to read F0-02 (Command source selection)

Packet ID (Hex)	RTR	Data (Hex)
0x586	0	4B F0 20 03 02 00 00 00

4) Set the command source (F0-02) to the operating panel

To set the command source to the operating panel, write F0-02 (Command source selection) as "0" by sending a CANopen packet from the master, as shown in the following table.

Table B-11 Packet sent from the master to write F0-02 (Command source selection)

Packet ID (Hex)	RTR	Data (Hex)
0x606	0	2B F0 20 03 00 00 00 00

The following table shows the CANopen response packet of the drive. F0-02 (Command source selection) is rewritten as "0", i.e. the current command source is set to the operating panel.

Table B-12 Response packet of the drive when writing F0-02 (Command source selection)

Packet ID (Hex)	RTR	Data (Hex)
0x586	0	60 F0 20 03 00 00 00 00

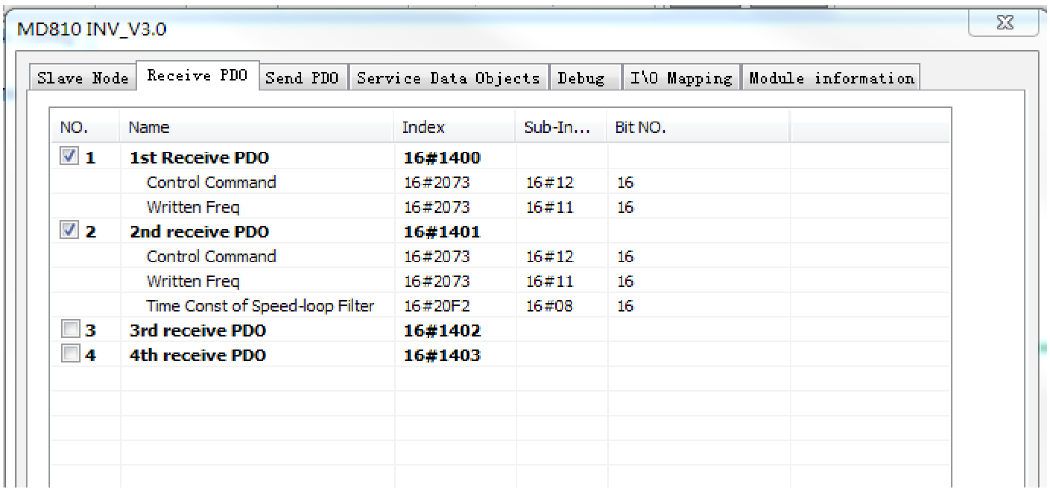
■ PDO configuration

The 810 series power supply unit supports four RPDOs (RPOD1, RPDO2, RPDO3, and RPDO4) and four TPDOs (TPOD1, TPDO2, TPDO3, and TPDO4). You can configure them as required.

The PDO mapping can be set from the CANopen master or directly configured on the slave. It is generally recommended to use the CANopen master to configure a mapping.

5) Configure a slave PDO on the master

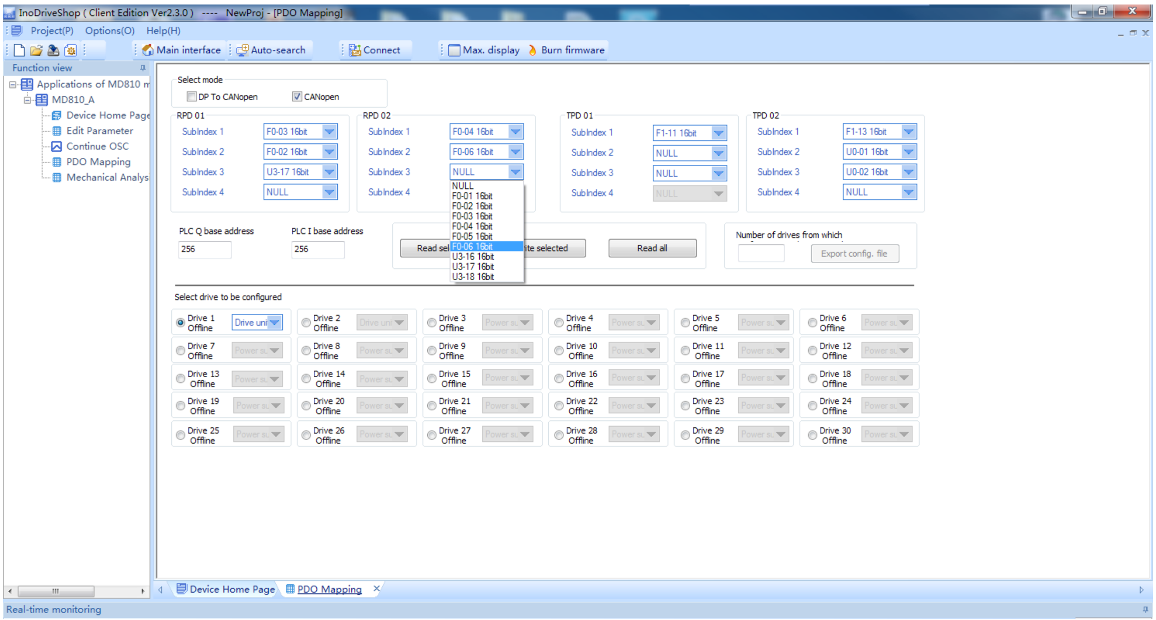
Directly select an object to be configured on the master operation background and the master uses an SDO to write a PDO mapping to the nodes, as shown in the following figure.



6) Directly configure a slave PDO

i. Configure a PDO using the commissioning software

When using a master that cannot configure a slave PDO mapping, you can directly configure the slave using the CANopen configuration interface of the commissioning software InoDriveShop of the MD810 series drive, as shown in the following figure:



NOTE

◆ Any modification operation through the commissioning software must be finished before a CANopen remote node is started up.

ii. Manually configure a PDO using the operating panel

The MD810 also supports any manual modification to parameters in group AF to configure a PDO mapping. The following table shows the mapping relation of every PDO.

Table B-13 PDO mapping table

RPDO	Group AF Address		TPDO	Group AF Address	
RPDO1	Sub-index 1	AF-00	TPDO1	Sub-index 1	AF-32
		AF-01			AF-33
	Sub-index 2	AF-02		Sub-index 2	AF-34
		AF-03			AF-35
	Sub-index 3	AF-04		Sub-index 3	AF-36
		AF-05			AF-37
	Sub-index 4	AF-06		Sub-index 4	AF-38
		AF-07			AF-39
RPDO2	Sub-index 1	AF-08	TPDO2	Sub-index 1	AF-40
		AF-09			AF-41
	Sub-index 2	AF-10		Sub-index 2	AF-42
		AF-11			AF-43
	Sub-index 3	AF-12		Sub-index 3	AF-44
		AF-13			AF-45
	Sub-index 4	AF-14		Sub-index 4	AF-46
		AF-15			AF-47
RPDO3	Sub-index 1	AF-16	TPDO3	Sub-index 1	AF-48
		AF-17			AF-49
	Sub-index 2	AF-18		Sub-index 2	AF-50
		AF-19			AF-51
	Sub-index 3	AF-20		Sub-index 3	AF-52
		AF-21			AF-53
	Sub-index 4	AF-22		Sub-index 4	AF-54
		AF-23			AF-55

RPDO	Group AF Address		TPDO	Group AF Address	
RPDO4	Sub-index 1	AF-24	TPDO4	Sub-index 1	AF-56
		AF-25			AF-57
	Sub-index 2	AF-26		Sub-index 2	AF-58
		AF-27			AF-59
	Sub-index 3	AF-28		Sub-index 3	AF-60
		AF-29			AF-61
	Sub-index 4	AF-30		Sub-index 4	AF-62
		AF-31			AF-63

One PDO can be configured with four mappings. Configuring one mapping requires operating two parameters in group AF to achieve 32-bit data whose upper 16 bits are an object dictionary index and lower 16 bits (parameter No.) are the object dictionary sub-index and object length. The object length is calculated in bits. Mapping object format is required as follows:

31 16 15 8 7 0

Index	Sub-index	Object Length
Group AF upper bits	Group AF lower bits	

MLB LSB

According to the preceding relation between the parameters and the object dictionary, when a parameter needs to be mapped to a PDO, you need only to write into group AF an object dictionary index and sub-index and data length corresponding to a parameter according to the preceding rules.

For example, you want to configure two mappings in RPDO1, one directs at F0-01 (1st motor control mode) and the other is an object dictionary object 0x6060-00. The operation is as follows:

Table B-14 Example of group AF mapping

Assumed Address	Group AF Address	Contents	Remarks
F0-01	AF-00	0x20F0	Parameter address index Equal to group No. F0 + 0x2000
	AF-01	0x0210	Upper bit 02: Parameter group No. offset + 1; Lower bit 10: 16-bit parameter length.
0x6060-00	AF-02	0x6060	Object dictionary index
	AF-03	0x0008	Upper bit 00: Object dictionary sub-index; Lower bit 08: 8-bit object length.

NOTE

◆ Any write operation through the commissioning software or operating panel must be finished before a CANopen remote node is started up.

1) Expert mode

You can select the exert mode by setting Fd-34 (CANopen mode) to 1 (Expert mode). In the expert mode, the PDO mapping is determined by the settings in the parameter group AF rather than the settings in the CANopen master station. Note: Although the mapping set in the CANopen master station is not used, the number and length of PDOs must be consistent with those set in the parameter group AF. Otherwise, an error will occur during configuration.

Using the expert mode, you can manually set the PDOs through the method described in "Manually configure a PDO using the operating panel" above when no settings on the master is available. The MD810 series power supply unit will start communication according to the mapping set in the parameter group AF after receiving a start command.

2) Manually configuring disabling time/event time

You can manually set the disabling time or event time by setting Fd-35 (CANopen disabling time) and Fd-36 (CANopen event time). How to set the disabling time is described below as an example.

When Fd-35 is set to 0, this parameter is invalid.

When Fd-35 is set to non-zero value, a TPDO (for example, TPDO1) will communicate based on the disabling time set on the master if available and based on the disabling time set by Fd-35 if its disabling time is not set on the master.

The settings of Fd-36 is similar to Fd-35.

Note that the unit of Fd-35 (CANopen disabling time) is 100 μs and the unit of Fd-36 (CANopen event time) is ms.

B.3.7 CANopen Communication Protocol

1 Overview of CANopen Communication Protocol

CANopen is an application layer protocol of network transmission system based on the CAN serial bus. The CAN bus follows an ISO/OSI standard model. This protocol defines the data link layer and some physical layers in the OSI model. It can adopt multi-master mode, in which any node in the network can send a message to other nodes. Network nodes are classified with different priorities based on the system real-time requirements, reducing the bus arbitration time in case of a transmission collision. The CAN network cancels the traditional address coding that is replaced with communication data block coding. With data block coding, the number of nodes in the network is not limited theoretically, and different nodes can receive the same data. This coding mode also features short transmission byte, fast speed, good fault tolerance, and reliable data transmission, making it suitable for industrial control and distributed real-time control. The following figure shows a CANopen equipment model.

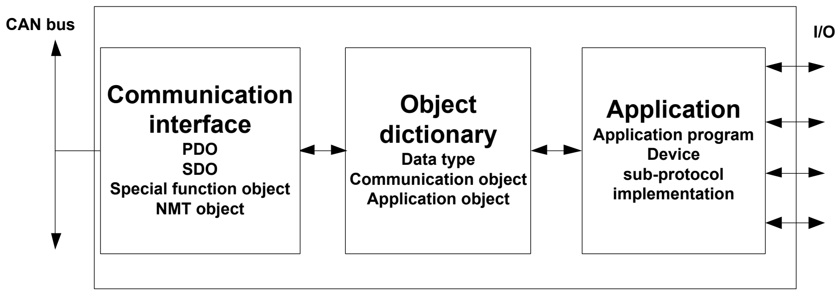


Figure B-6 CANopen equipment model

2 Object dictionary

Object dictionary is the most important part in the device profile. It is an ordered set of parameters and variables, and includes all parameters of the device profile and device network state. A set of objects can be accessed by using the ordered pre-defined method.

The CANopen protocol uses an object dictionary with 16-bit index and 8-bit sub-index. The following table shows the structure of the object dictionary. One master node or configuration tool can access all values in a slave node object dictionary.

Index	Object
000	Unused
0001—001F	Static data type (Standard data type such as Boolean and Integer16)
0020—003F	Complex data type (Predefine a structure into which simple types are combined, such as PDOCommPar and SDOParmeter)
0040—005F	Complex data type specified by the manufacturer
0060—007F	Static data type specified by the device sub-protocol
0080—009F	Complex data type specified by the device sub-protocol
00A0—0FFF	Reserved
1000 —1FFF	Communication sub-protocol area (e.g. device type, error register, and supported PDO quantity)
2000 —5FFF	Manufacturer-specific sub-protocol area
6000 —9FFF	Standard device sub-protocol area (e.g. "DSP-401 I/O module device sub-protocol": Read State 8 Input Lines)
A000—FFFF	Reserved

Figure B-7 Structure of object dictionary

3 Commonly-used communication object

■ NMT

An NMT includes Boot-up messages, Heartbeat protocol, and NMT messages. Based on master-slave mode, an NMT is used to manage and monitor nodes in the network and mainly implements three functions: node status control, error control, and node activation.

■ SDO

An SDO enables you to access items in the equipment object dictionary using an index and sub-index.

An SDO is achieved through a CMS object of the multi-element domain in CAL and allows transmitting data in any length. (When exceeding four bytes, data are broken into several packets.)

The SDO protocol produces a response for every request. SDO request and response packets always contain eight bytes.

■ PDO

A PDO is used to transmit real-time data from one node to one or multiple nodes. The data length ranges from one to eight bytes.

Every CANopen device contains eight default PDO channels, four TPDO channels, and four RPDO channels.

A PDO contains synchronous and asynchronous transmission modes that depend on the corresponding communication parameter of this PDO.

The contents of a PDO message are pre-defined and depend on the corresponding mapping parameter of this PDO.

■ SYNC object

An SYNC object is a packet that is broadcast to the CAN bus periodically by the CANopen master. It is used to achieve basic network clock signals. Every device determines whether to perform synchronous communication with other network devices using this event according to its own configurations.

4 Description of CANopen packet format

■ NMT module control packet

Only an NMT-Master node can send an NMT Module ControlNMT packet. "Table B-15 NMT packet" shows the packet format. COB-ID is fixed to "0x000". Data0 is a command word occupying one byte, as shown in "Table B-16 NMT packet command". Data1 is a CANopen network device address occupying one byte. When it is "0", it indicates a broadcast message that is valid for all slave devices in the network.

For example, set a device with device address "6" to operable state. The command is "0x000 0x01 0x06".

Table B-15 NMT packet

COB-ID	RTR	Data0	Data1
0x000	0	Command word	Node ID

Table B-16 NMT packet command

Command	Description
0x01	Start Remote Node
0x02	Stop Remote Node
0x80	Enter Pre-operational State
0x81	Reset Node
0x82	Reset Communication

■ NodeGuarding packet

The current state of each node can be checked by using the node protection service NodeGuarding. Especially, this service is relevant when these nodes have no data to be transmitted.

The standard protocol object 0x100C sets Guard Time and 0x100D sets a product factor of Guard Time. Both jointly determine the node protection time period.

The following table shows a remote frame sent from the NMT master node.

Table B-17 NodeGuarding packet sent from the master node

COB-ID	RTR
0x700+Node-ID	1

"Table B-18 NodeGuarding response packet returned from a slave" shows a response packet returned from an NMT slave node. A status word has one byte. "Table B-19 NodeGuarding return status" shows the format.

Table B-18 NodeGuarding response packet returned from a slave

COB-ID	RTR	Data0
0x700+Node-ID	0	Status word

Table B-19 NodeGuarding return status

Data Bit	Description
bit7	"0" or "1" must be alternatively set every time.
bit6 to bit0	State: 4: Stopped 5: Operational 127: Pre-operational

■ Heartbeat packet

The nodes can be configured to generate periodically a Heartbeat packet. The status word bit7 is "0" and bit6 to bit0 are the same as those described in "Table B-19 NodeGuarding return status" for NodeGuarding. Heartbeat time is set in the standard protocol object 0x1017. One node cannot support both NodeGuarding and Heartbeat mechanisms simultaneously.

Table B-20 Heartbeat packet

COB-ID	RTR	Data0
0x700+Node-ID	0	Status word

B.4 PROFIBUS-DP Communication

B.4.1 Network Configuration

If more than 32 nodes are deployed, relays are required. With two relays, a maximum of 32 nodes (including the relays) can be connected.

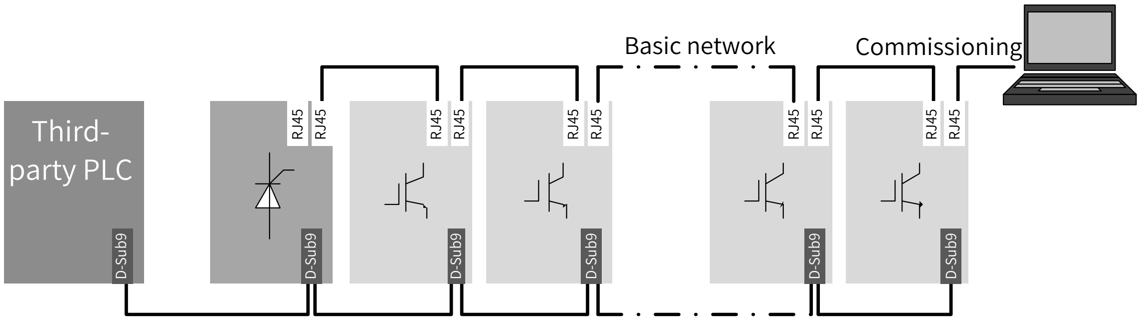


Figure B-8 PROFIBUS-DP communication network configuration

B.4.2 Interface Description

Description of PROFIBUS-DP 9PIN standard interfaces

MD810 power supply unit/drive can be connected to the PROFIBUS-DP master station using the standard DB9 connector. The pin signal definition and arrangement of the DB9 socket follow Siemens standard, as shown in the following figure.

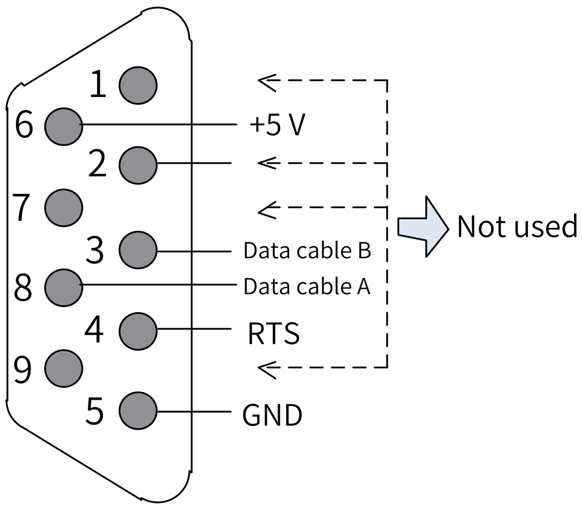


Figure B-9 DB9 interface pins

Table B-21 DB9 control terminal functions

Category	Terminal ID	Terminal Name	Function Description
PROFIBUS-DP communication terminal	1, 2, 4, 7, and 9	NC	Not used
	3	TR+	Positive of PROFIBUS-DP bus
	5	CGND	PROFIBUS-DP bus power ground
	6	C5V	PROFIBUS-DP bus power supply
	8	TR	Negative of PROFIBUS-DP bus

B.4.3 Baud Rate and Communication Distance

Baud Rate (bps)	12M	6M	3M	1.5M	500K	187.5K	19.2K	9.6K
Length (m)	100	100	100	100	200	600	1200	1200

B.4.4 Relevant Parameters

Parameter	Function	Default Value	Setting Range	Parameter Description
Fd-20	PROFIBUS-DP communication address	1	0: PROFIBUS-DP function disabled 1–125: PROFIBUS-DP communication address	Indicates the slave station number for PROFIBUS-DP communication. When this parameter is set to 0, the PROFIBUS-DP communication function is disabled. On the same network, all station numbers must be different. Otherwise, communication fails.
Fd-97	PROFIBUS-DP software version	0.00	0.00–655.35	Indicates the version number of PROFIBUS-DP communication software.

B.4.5 PROFIBUS-DP Communication Protocol Description

■ Data transmission format

In the PROFIdrive protocol, parameter/process data object (PPO) is used as the data transmission format, including PPO1, PPO2, PPO3, PPO4, and PPO5. MD810 supports all data formats.

Table B-22 Functions of PPO data formats

Data Format	Supported Function	Data Format	Supported Function
PPO1	Single function parameter operation Drive command and frequency settings Drive state and running frequency reading	PPO4	Drive command and frequency settings Drive state and running frequency reading Periodic writing of four function parameters Periodic reading of four function parameters
PPO2	Single function parameter operation Drive command and frequency settings Drive state and running frequency reading Periodic writing of four function parameters Periodic reading of four function parameters	PPO5	Single function parameter operation Drive command and frequency settings Drive state and running frequency reading Periodic writing of 10 function parameters Periodic reading of 10 function parameters
PPO3	Drive command and frequency settings Drive state and running frequency reading		

Data blocks of the PPO data formats are divided into two zones, including the PKW zone (parameter zone) and PZD zone (process data zone). The following figure shows the PPO data formats supported by MD810, and Table 6-23 lists the data length in different data zones.

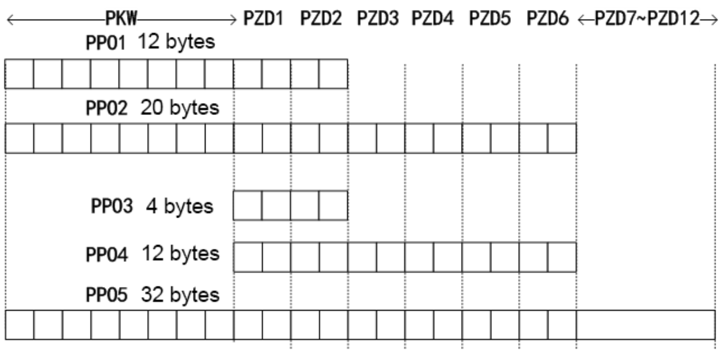


Figure B-10 PPO data formats

Table B-23 PPO data length

PPO Data Format	Length in the PKW Zone (Byte)	Length in the PZD Zone (Byte)	Total PPO Data Length (Byte)
PPO1	8	4	12
PPO2	8	12	20
PPO3	0	4	4
PPO4	0	12	12
PPO5	8	24	32

■ PKW data description

PKW data is used by the master station to read/write a single parameter of the drive. Communication addresses of the drive parameters are directly determined by communication data. PKW data functions as follows:

1) Reading drive function parameters

2) Modifying drive function parameters

Data format

The PKW data includes three groups of arrays, including PKE, IND, and PWE. The PKE, IND, and PWE data length are two bytes, two bytes, and four bytes, respectively. The following table describes the data formats.

	PKW Data Sent by the Master Station	Drive PKW Response Data
Operation command	PKE	PKE
Parameter address	IND	IND
Reserved	IND	IND
	PWE	PWE
	PWE	PWE
Write: parameter value Read: none	PWE PWE	-
Success: value returned Failure: error information	-	PWE PWE

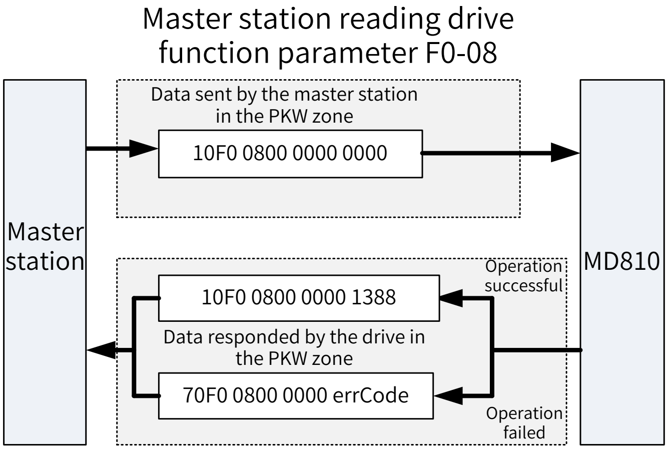
Data description

PKW Data Sent by the Master Station		Drive PKW Response Data	
PKE	Four higher bits: command code **0**: no request **1**: reading parameter data **2**: modifying parameter data (The preceding command code is in decimal format.) Four lower bits: reserved Eight lower bits: high-order bits of the parameter address	PKE	Four higher bits: response code 0: no request 1: correct parameter operation 7: execution failed Eight lower bits: high-order bits of the parameter address
IND	Eight higher bits: low-order bits of the parameter address Eight lower bits: reserved	IND	Eight higher bits: low-order bits of the parameter address Eight lower bits: reserved

PKW Data Sent by the Master Station		Drive PKW Response Data	
PWE	16 higher bits: reserved 16 lower bits: unused in the read request, and indicating the parameter value in the write request	PWE	Request successful: parameter value Request failed: error code (consistent with standard Modbus) **1**: invalid command **2**: invalid address **3**: invalid data **4**: other error

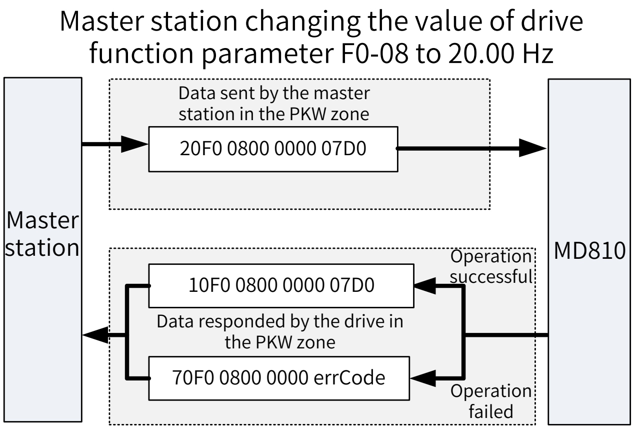
Example:

The following figure shows the PKW data sent by the master station and PKW response data sent by the drive when the master station reads the drive function parameter F0-08 (Preset frequency).



1) Example PKW data sent by the master station when reading a drive parameter

The following figure shows the PKW data sent by the master station and PKW response data sent by the drive when the master station modifies the drive function parameter F0-08 (Preset frequency).



2) Example PKW data sent by the master station when modifying a drive parameter

PKW data exchange with the drive is performed circularly. If the write command (PKE=0x20xx) is continuously used on EEPROM, the service life of the drive's main control chip will be shortened. Therefore, to modify drive parameters it is recommended to avoid periodic write operations or to use RAM addresses in PKW. The following table lists RAM addresses of parameters.

Parameter Group	Address
F0–FF	0x00–0x0F
A0–AF	0x40–0x4F
B0–BF	0x50–0x5F
C0–CF	0x60–0x6F

The hexadecimal value converted from the digits in the parameter group are the eight lower bits of the RAM address. For example, the RAM address of F0-10 (Maximum frequency) is 0x000A.

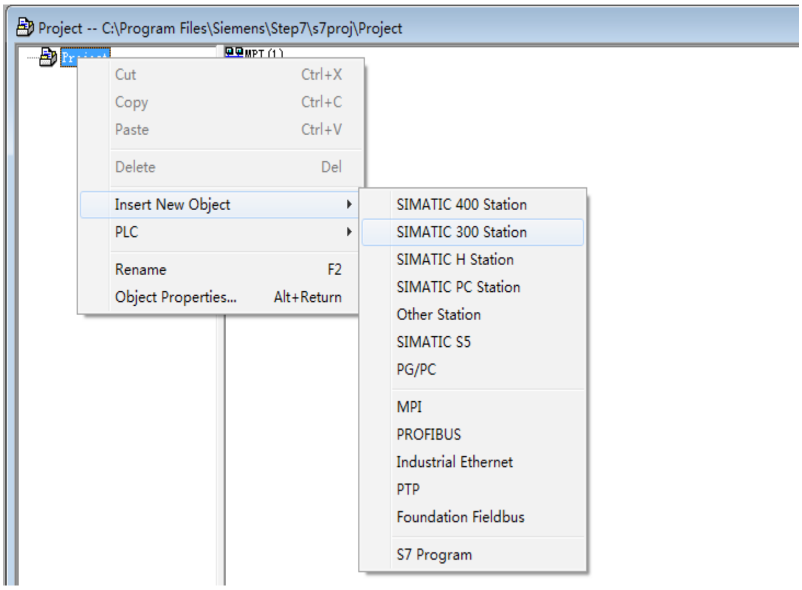
■ PZD data description

The PZD data is used for the master station to modify and read drive data in real time and perform periodic data exchange. Data communication addresses are directly configured by PROFIBUS-DP network parameters. Specific data definition of PZD1 to PZD12 is determined by PZD configuration. For details about PZD configuration, see step 5 in the next part.

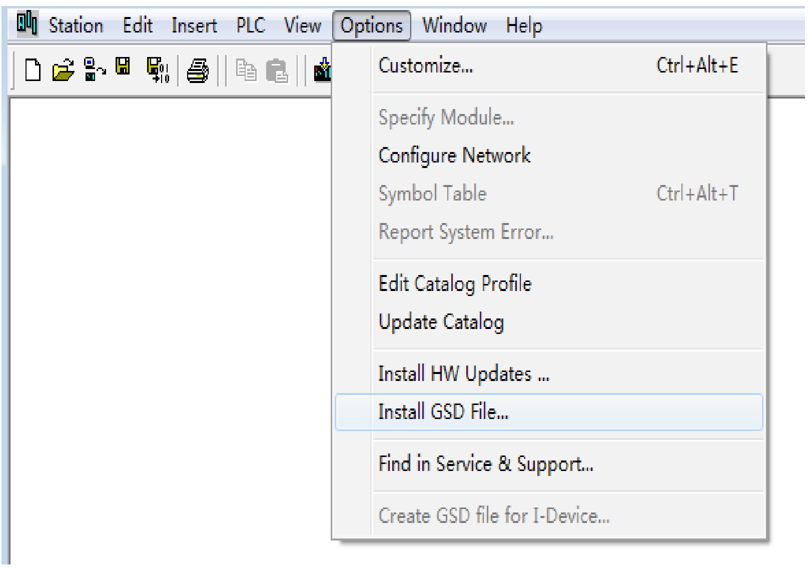
■ Configuring a slave station on the S7-300 master station

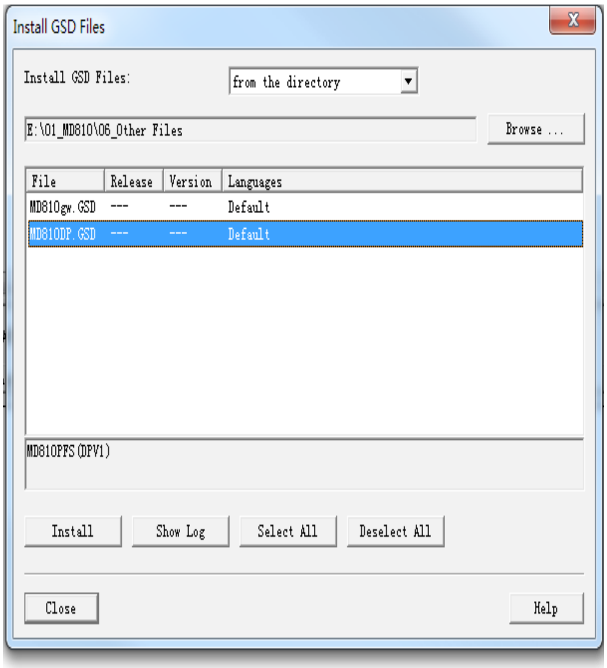
When using the PROFIBUS-DP master station, configure the GSD file (obtained from Inovance's agency or manufacturer) of the slave station first to add the slave device to the master station system. If a slave device exists, skip step 2. To configure a slave station, perform the following steps:

Step 1: Open STEP 7, create a project, and add the S7-300 master station to the project, as shown in the following figure.

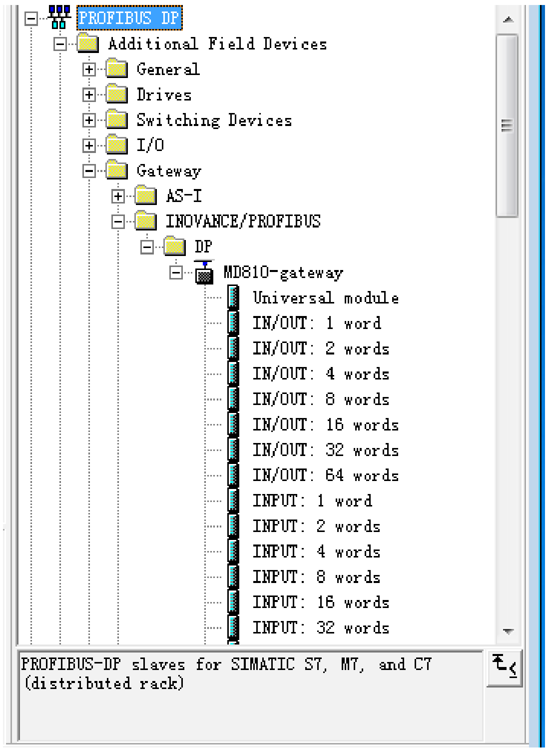


Step 2: Double-click Hardware to access the HW Config window. In the HW Config window, add the MD810DP.GSD file, as shown in the following figure.

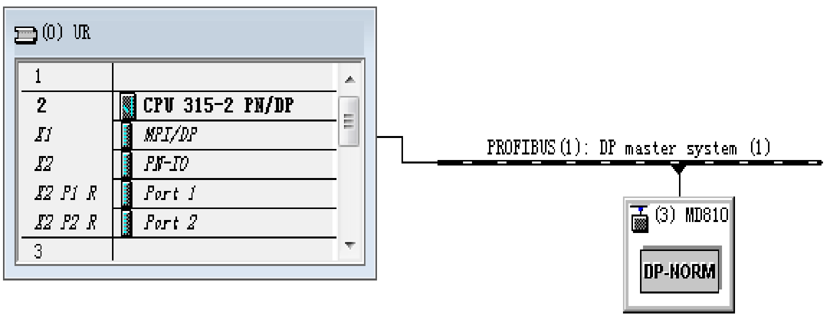




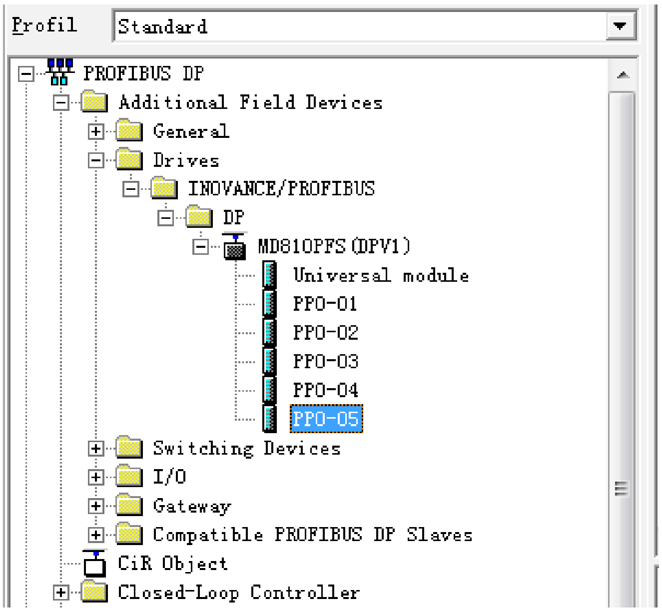
Click Install. After installation is complete, the PROFIBUS-DP module of MD810DP is displayed, as shown in the following figure.



Step 3: Configure the actual hardware system, as shown in the following figure.

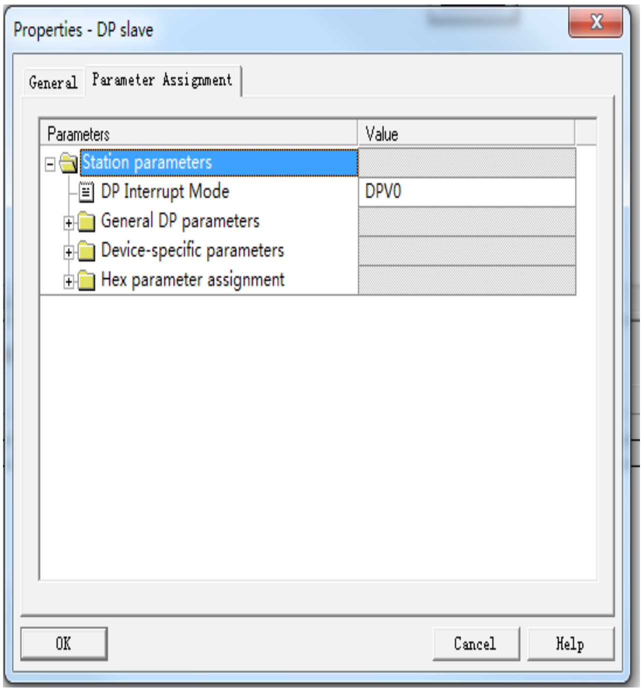


Step 4: Configure data features of the slave station.

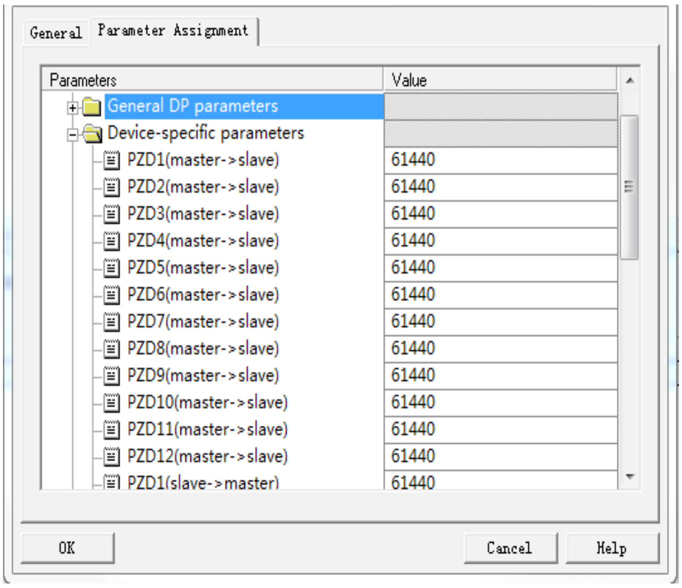


Step 5: Configure the PZD.

Two PROFIBUS-DP interruption modes are provided, including DPV0 and DPV1. For all Inovance DP, only DPV0 can be selected. By default, DPV0 is selected in STEP 7, and DPV1 is selected in Portal. Therefore, you need to change DPV1 to DPV0 if Portal is used.



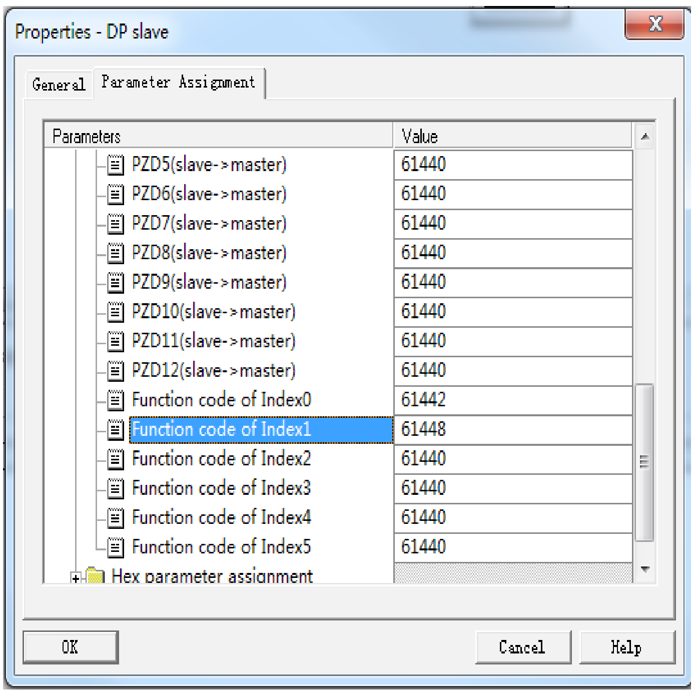
Parameters PZD1 to PZD12 are for customized periodic data exchange. They can be configured in hardware configuration. Double-click the MD810DP sign in HW Config, click "Device-specific parameters", and configure corresponding parameter addresses as required.



PZDx(master->slave) indicates the address used by the master station to write the slave station, and PZDx(slave->master) indicates the address used by the master station to read the slave station. PZD1 to PZD12 displayed in decimal are available. To set PZD3(master->slave) to F0-12 (Frequency reference upper limit), enter 61452.

By default, all PZDs of MD810 are set to F0-00, G/P type display (61440 in decimal). For unused PZDs, modification is not required and default values can be retained. PZD mapping relationships must be set independently for each slave station as required (if mapping relationships of various slave stations are the same, you can select one configured slave station, press Ctrl+C, select the PROFIBUS-DP bus in the configuration, press Ctrl+V, and modify the station number).

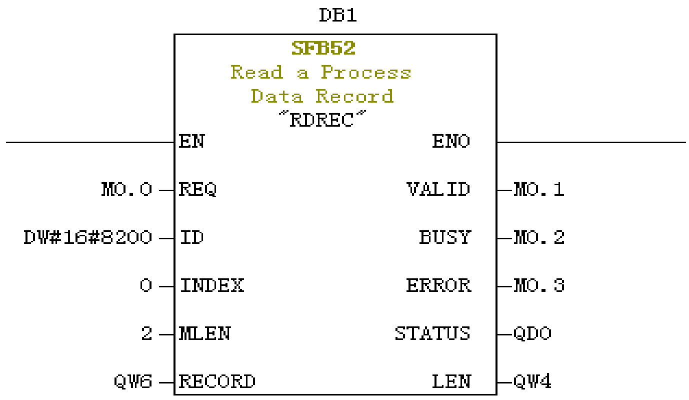
To enable the non-periodic read and write parameter function of DPV1, set corresponding parameters in customized indexes at the end of "Device-specific parameters". MD810 provides six customized indexes numbered from 0 to 5, as shown in the following figure. For example, indexes 0 and 1 are set to F0-02 (Command source selection) and F0-08 (Preset frequency), respectively.



After all the preceding operations are complete, the PROFIBUS-DP slave station is configured. Now, you can compile programs in S7-300 to control the drive.

■ Non-periodic reading and writing on the PROFIBUS-DP slave station of the drive

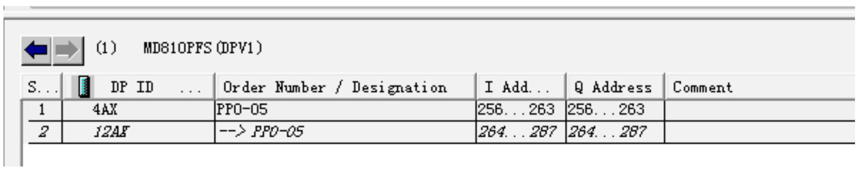
To perform non-periodic reading and writing on the PROFIBUS-DP slave station of the drive, Siemens' system function modules SFB52 (for reading) and SFB53 (for writing) are required. Create an organization block in the program, and add relevant function blocks and programs in the organization block.



After M0.0 is set, the function block reads F0-02 (Command source selection) (Index 0 has been set to F0-02 before) of the drive No. 3 and saves it in QW6. Field definitions are as follows:

REQ: Command enable. When this field is set to 1, the function block is enabled.

ID: Logic address. To specify this field, convert any bit in the Q address of the corresponding drive slave station to a decimal value, and set bit 15 of the value to 1. For example, after Q512 is converted to the decimal value H200, and bit 15 is set to 1, H8200 is obtained.



(1) MD810PFS (DPV1)

S...	DP ID ...	Order Number / Designation	I Add...	Q Address	Comment
1	4AX	PPO-05	256...263	256...263	
2	12AF	--> PPO-05	264...287	264...287	

INDEX: Index ranging from 0 to 5. This field can be customized to an index mapping address of a slave station as required.

MLEN: Maximum length of the data to be obtained. For MD38DP2, this field must be set to 2.

RECORD: Target region of an obtained data record. This field is used to store read data when the read operation is performed and sent data when the write operation is performed.

VALID: New data record received and valid.

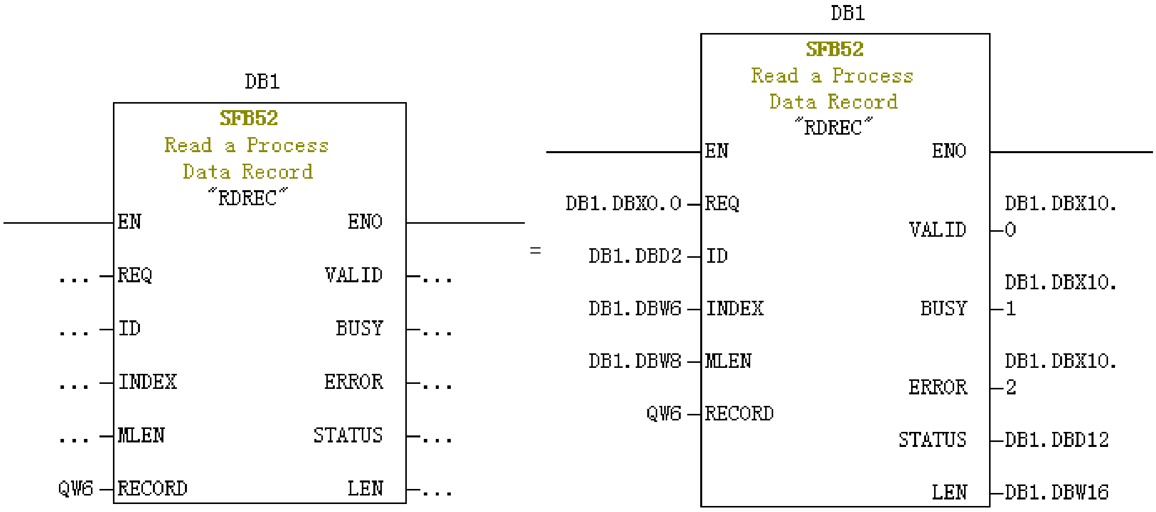
BUSY: When the field value is ON, operations are not completed.

ERROR: When the field value is ON, an error occurs.

STATUS: Block status or error information.

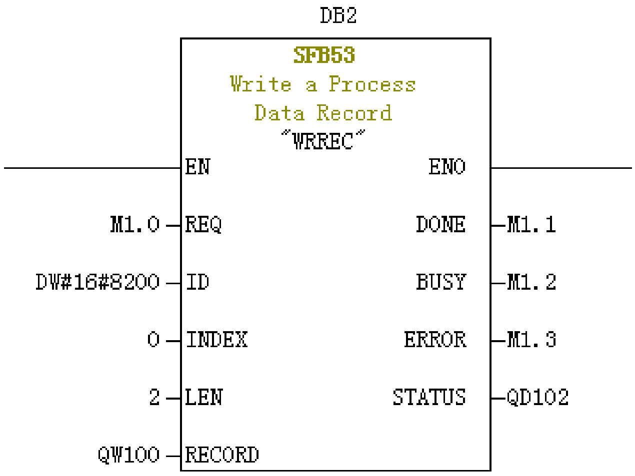
LEN: Obtained data record length.

During invocation, you can customize parameters or use partial or all default parameters, as shown in the following figure.



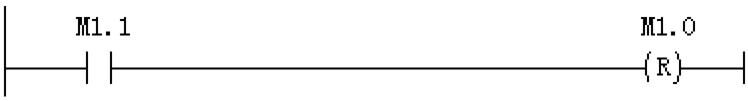
In the preceding figure, default parameters are used on the left, that is, parameters are set according to the information shown on the right. You can customize parameters or use default parameters for corresponding blocks as required. However, if multiple invocations are involved, you need to customize parameters to avoid invocation errors caused by default parameters (note: RECORD must be customized).

Non-periodic write operations are similar to non-periodic read operations. The RECORD field stores data to be written, as shown in the following figure.



Note that before running an organization block, you need to download data blocks (above the function block with DB1 and DB2 used as examples) to the PLC. Otherwise, the DB block unloading error will be generated.

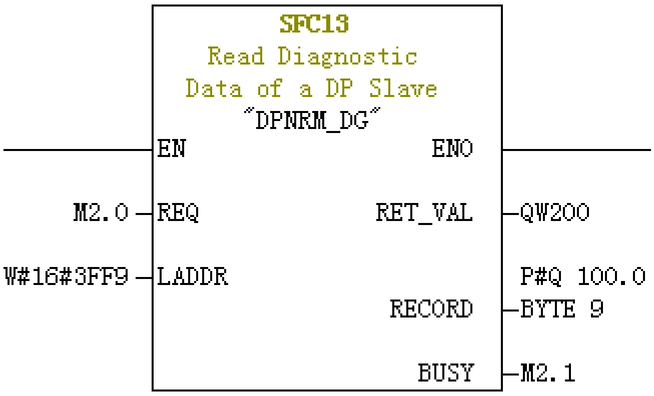
SFB53 is used to perform operations on the EEPROM. Therefore, the program is required to invoke relevant operations when required and disable relevant operations in time. After the write operation is completed (M1.1 is set to 1), the program is invoked to reset M1.0, as shown in the following figure.



Execution of SFB52 and SFB53 requires invoking relevant blocks for multiple times each time. Therefore, do not invoke them when single execution is required.

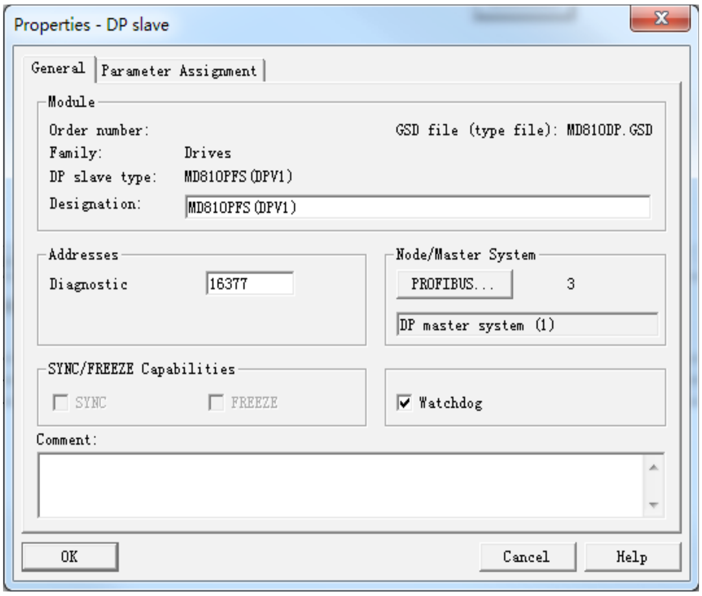
■ Diagnosis

Use SFC13 in the program to obtain specific diagnosis information of each slave station, as shown in the following figure.



REQ: Command enable. When this field is set to ON, diagnosis information reading is initiated.

LADDR: Configured diagnosis address of the slave DP station. The actual value is shown in the following figure. For SFC13, the address must be specified in hexadecimal.



RET_VAL: Error code (negative) displayed when invocation errors occur and actual transmitted data length (positive) displayed when no error occurs.

RECORD: Target region of the read diagnosis data. The value must be in byte data type with 10 bytes. Otherwise, an error will be generated during invocation. Byte definitions are as follows:

Byte	Definition
Byte 0–2	Station status
Byte 3	Master station number
Byte 4	Supplier ID (high byte)
Byte 5	Supplier ID (low byte)
Byte 6–9	Dedicated device diagnosis information

BUSY: When this field is 1, reading is not completed.

Dedicated device diagnosis provides relevant drive fault information, which is consistent with the value of U0-45 (Fault subcode).

B.5 EtherCAT Communication

B.5.1 Networking

The EtherCAT communication topology structure features high flexibility. It supports various topological structures including star, bus, and tree topologies and their combination. This enables flexible and convenient equipment connection and wiring. The specific EtherCAT-IN and EtherCAT-OUT I/O interfaces and bus connections of the MD810 drive unit are shown in the following figure.

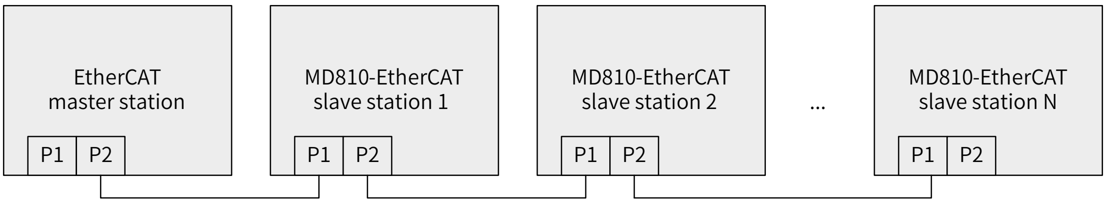


Figure B-11 Bus topology

B.5.2 Interface Description

The MD810-ECAT drive unit is connected to the EtherCAT master station using the standard Ethernet RJ45 socket. Its pin signal definitions are the same as those of the standard Ethernet pins. They can be connected using crossover cables or straight-through cables. The electrical characteristics are compliant with IEEE 802.3 and ISO 8877 standards.

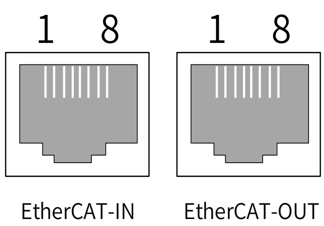


Table B-24 Pin signal definitions

Pin	Definition	Description
1	TX+	Data transmit+
2	TX-	Data transmit-
3	RX+	Data receive+
4	Null	Null
5	Null	Null
6	RX-	Data receive-
7	Null	Null
8	Null	Null

NOTE

◆ Note that the input (EtherCAT-IN) and output (EtherCAT-OUT) interfaces cannot be connected inversely. The Cat5e shielded twisted pair (STP) network cable must be used for ensuring stability.

B.5.3 Communication Performance

Transmission rate	2 x 100 Mbit/s (high-speed Ethernet, full duplex mode).
Synchronization	The synchronization jitter is shorter than 1 μs when two devices has a distance of 300 nodes and 120 m cable length.
Update time	◆ 256 digital I/O: 11 μs ◆ 1000 digital I/Os distributed in 100 nodes:30 μs = 0.03 ms ◆ 200 analog I/Os (16-bit): 50 μs, sampling rate 20 kHz ◆ 100 servo axes (8 byte IN+OUT for each): 100 μs = 0.1 ms ◆ 12000 digital I/O: 350 μs

B.5.4 Related Parameters

The following parameters must be set to enable normal communication between the MD810 drive unit and the EtherCAT fieldbus network.

Parameter No.	Parameter Name	Setting Range	Value	Meaning
F0-02	RUN command selection	0: Operating panel 1: Terminal 2: Serial communication	2	Running command given through communication
F0-03	Main frequency reference input selection	0: Digital setting (non-retentive at power failure) 1: Digital setting (retentive at power failure) 2: AI1 3: AI2 4: Reserved 5: Pulse reference (DIO1) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication setting 10: Synchronous control	9	Target frequency given through communication

■ Parameters related to communication control

Parameter No.	Name	Setting Range	Decimal Address
U3-16	Frequency setting	-Maximum frequency to +Maximum frequency 0.01 Hz	29456
U3-17	Control command	0001: Forward running 0002: Reverse running 0003: Forward jogging 0004: Reverse jogging 0005: Coast to stop 0006: Decelerate to stop 0007: Fault reset	29457

Parameter No.	Name	Setting Range	Decimal Address
U3-18	DO control	BIT0: DO1 control BIT1: DO2 control BIT2: RELAY1 control BIT3: RELAY2 control BIT4: FMR output control BIT5: VDO1 BIT6: VDO2 BIT7: VDO3 BIT8: VDO4 BIT9: VDO5	29458
U3-19	AO1 control	0 to 7FFF indicate 0% to 100% .	29459
U3-20	AO2 control	0 to 7FFF indicate 0% to 100% .	29460
U3-21	FMP control	0 to 7FFF indicate 0% to 100% .	29461
U3-22	Reserved	Reserved	
U3-23	Speed control	Signed data, 1 rpm	29463

When MD810-ECAT communication is used, the written PDO1 and PDO2 are mapped to U3-17 and U3-16 respectively by default. Note that the first two items of TxPDO configured on the master station must be U3-17 and U3-16 in turn. Besides, if the eight higher bits of U3-17 are written with any non-zero value, a communication fault will be reported.

■ Parameters related to communication monitoring

Parameter No.	Name	Unit	Decimal Address
U0-00	Running frequency (Hz)	0.01 Hz	28672
U0-01	Frequency reference (Hz)	0.01 Hz	28673
U0-02	Bus voltage (V)	0.1 V	28674
U0-03	Output voltage (V)	1 V	28675
U0-04	Output current (A)	0.01 A	28676
U0-05	Output power (kW)	0.1 kW	28677
U0-06	Output torque (%)	0.1%	28678
U0-07	DI state	1	28679
U0-08	DO state	1	28680
U0-09	AI1 voltage (V)	0.01 V	28681
U0-10	AI2 voltage (V)	0.01 V	28682
U0-11	Motor speed	1 rpm	28683
U0-12	Count value	1	28684
U0-13	Length value	1	28685
U0-14	Load speed display	1	28686
U0-15	PID reference	1	28687
U0-16	PID feedback	1	28688
U0-17	PLC stage	1	28689
U0-18	Pulse input frequency (Hz)	0.01 kHz	28690
U0-19	Feedback speed (Hz)	0.01 Hz	28691
U0-20	Remaining running time	0.1 min	28692
U0-21	AI1 voltage before correction	0.001 V	28693
U0-22	AI2 voltage before correction	0.001 V	28694
U0-24	Linear speed	1 m/min	28696
U0-25	Current power-on time	1 min	28697
U0-26	Current running time	0.1 min	28698
U0-27	Pulse input frequency	1 Hz	28699
U0-28	Communication reference	0.01%	28700

Parameter No.	Name	Unit	Decimal Address
U0-29	Encoder feedback speed	0.01 Hz	28701
U0-30	Main frequency X display	0.01 Hz	28702
U0-31	Auxiliary frequency Y display	0.01 Hz	28703
U0-33	Synchronous motor rotor position	0.1°	28705
U0-34	Motor temperature	1°C	28706
U0-35	Target torque (%)	0.1%	28707
U0-37	Power factor angle	0.1°	28709
U0-39	Target voltage upon V/F separation	1 V	28711
U0-40	Output voltage upon V/F separation	1 V	28712
U0-41	DI state display	1	28713
U0-42	DO state display	1	28714
U0-45	Fault subcode	1	28717
U0-46	Heatsink temperature	1°C	20718
U0-47	Voltage before PTC correction	0.001 V	20719
U0-48	Voltage after PTC correction	0.001 V	20720
U0-49	Pulses for position lock deviation	1	20721
U0-58	Z signal counting	1	28730
U0-59	Rated frequency (%)	0.01%	28731
U0-60	Running frequency (%)	0.01%	28732
U0-61	AC drive state	1	28733
U0-62	Fault code	1	28734
U0-68	AC Drive state 2	1	28740
U0-69	Feedback speed (Hz)	0.01 Hz	28741
U0-74	Target torque in torque mode	0.1%	28746
U0-75	Real-time target torque in torque mode	0.1%	28747
U0-76	Target torque upper limit	0.1%	28748
U0-77	Regenerative torque upper limit	0.1%	28749

When MD810-ECAT communication is used, the read PDO1 and PDO2 are mapped to U0-68 and U0-69 respectively by default. Note that the first two items of TxPDO configured on the master station must be U0-68 and U0-69 in turn.

B.5.5 EtherCAT Communication Protocol

In the DC mode, the DC synchronous mode period must be at least 1 ms but shorter then 100 ms. Otherwise, an EtherCAT communication fault will occur.

■ State machine

The EtherCAT state machine support four states and coordinates the state relationship between the master and slave applications during initialization and operation. The four states are: Init (I), Pre-Operational (P), Safe-Operational (S), and Operational (O).

Transition from Init state to Operational state must be in the sequence of Init, Pre-Operational, Safe-Operational, and then Operational step by step. In transition from Operational state to Init state, certain steps can be skipped. The following figure shows the state transition diagram of the EtherCAT state machine.

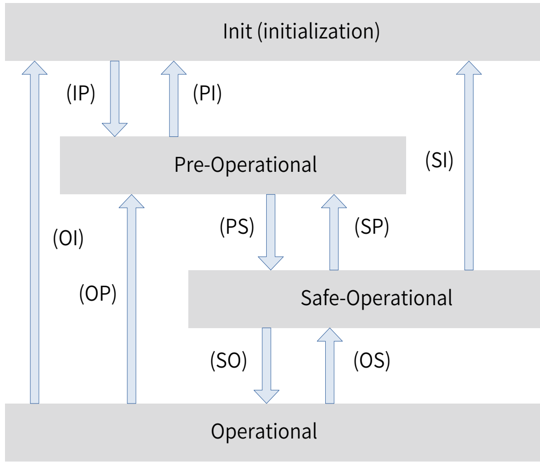


Figure B-12 EtherCAT state machine

■ Communication structure

Multiple protocols can be transmitted using EtherCAT. The IEC 61800-7–CANopen motion control protocol is used for the MD810 drive unit. The following figure shows the EtherCAT communication structure at the CANopen application layer.

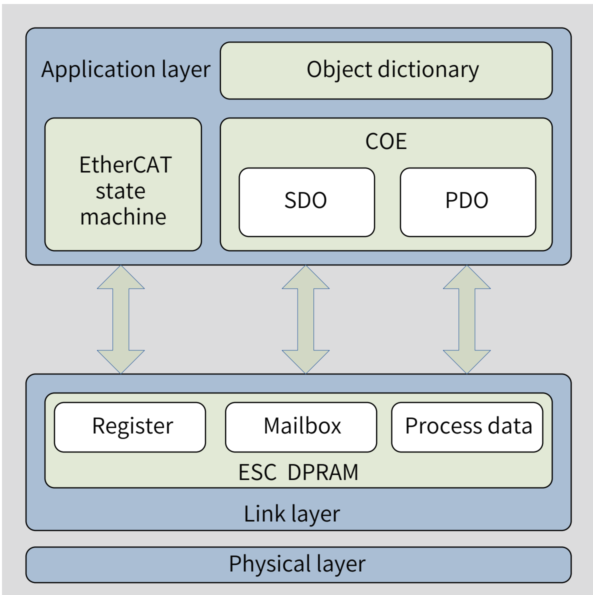


Figure B-13 EtherCAT communication structure at CANopen application layer

The object dictionary at the application layer contains communication parameters, application data, and PDO mapping data. The PDO process data object, which contains real-time data during the operation of the drive, periodically performs read and write operations. The SDO communication aperiodically accesses and modifies some communication parameter objects and PDO process data objects.

■ PDO data description

The PDO data is used for the master station to modify and read AC drive data in real time and perform periodic data exchange. Data communication addresses are directly configured by the AC drive. It mainly includes:

1) Real-time setting of AC drive control command and target frequency
2) Real-time reading of AC drive current state and running frequency
3) Function parameter and monitor data real-time exchange between the AC drive and EtherCAT master station

The PDO process data is used for periodic data exchange between the master station and AC drive, as described in the following table.

Master sending PDO (1600h)		
Fixed RPDO		Variable RPDO
AC drive command	AC drive target frequency	Modifying function parameters of AC drive in real time
RPDO1	RPDO2	RPDO3 to RPDO12
AC drive response data PDO (1A00h)		
AC drive state	AC drive running frequency	Reading function parameters of AC drive in real time
TPDO1	TPDO2	TPDO3 to TPDO12

■ Data sent by the master station

Master sending data RPDO	
RPDO1	AC drive command word (command source set to "communication")
	01: Forward running 02: Reverse running 03: Forward jogging 04: Reverse jogging 05: Coast to stop 06: Stop according to F4-10 (Stop mode) 07: Fault reset
RPDO2	AC drive target frequency (frequency source set to "communication")
	The frequency reference ranges from -100.00% to +100.00%. When the frequency reference exceeds this range, the frequency reference is not written to the AC drive.
RPDO3 to RPDO12	Modifying the function parameter values (groups F and A) in real time, not written into EEPROM
	FE-02 to FE-11 correspond to RPDO3 to RPDO12 respectively. For the configuration method, see PDO data configuration.

■ AC drive response data

AC drive response data TPDO	
TPDO1	AC drive running state
	AC drive running state determined by the bits as follows: Bit0: 0: AC drive stop; 1: AC drive running Bit1: 0: Forward running; 1: Reverse running Bit2: 0: No fault; 1: AC drive fault Bit3: 0: Running frequency not reached; 1: Running frequency reached
TPDO2	AC drive running frequency (unit: 0.01 Hz)
	The current AC drive running frequency is returned as 16-bit signed data.
TPDO3 to TPDO12	Reading function parameter values (groups F and A) and monitor parameter values (group U) in real time
	FE-22 to FE-31 correspond to TPDO3 to TPDO12 respectively. For the configuration method, see PDO data configuration.

■ Service data object (SDO)

EtherCAT SDO is used to transfer non-cyclic data, such as communication parameter configuration and servo drive running parameter configuration. The CoE service type includes: 1) emergency message, 2) SDO request, 3) SDO response, 4) TxPDO, 5) RxPDO, 6) remote TxPDO transmit request, 7) remote RxPDO transmit request, 8) SDO information.

Currently, the MD810 drive supports 2) SDO request and 3) SDO response. For details about the parameters, see Appendix C.

- Distributed clock (DC)

The DC enables all EtherCAT devices to use the same system time and implement synchronization between the devices. A slave produces the synchronization signal according to the synchronized system time. The MD810 drive unit only supports the DC synchronization mode. The synchronization cycle is determined by SYNC0. The cycle varies according to the motion mode.

B.6 Network Architecture of PROFIBUS-DP to CANopen Gateway

B.6.1 Networking

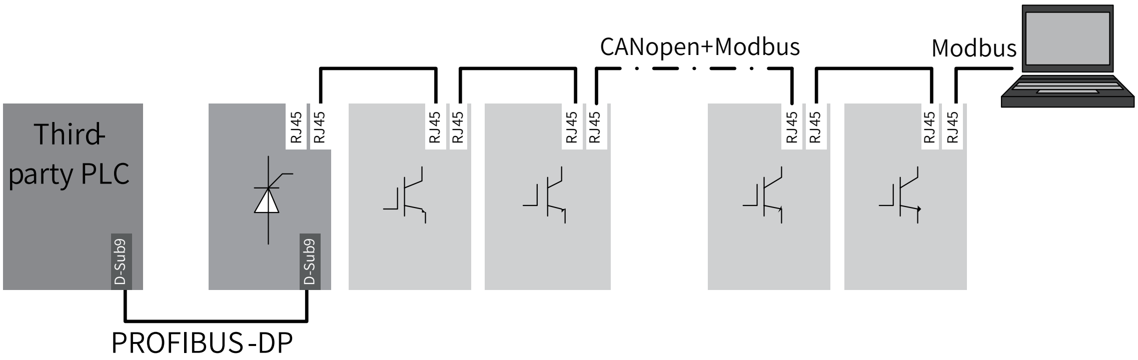


Figure B-14 Network architecture of PROFIBUS-DP to CANopen gateway

B.6.2 Interface Description

The PROFIBUS-DP terminal interface is the same as the standard PROFIBUS-DP definition. For details, see "B.4 PROFIBUS-DP Communication".

The CANopen terminal interface is the same as the standard CANopen definition. For details, see "B.3 CANopen/CANlink Communication".

B.6.3 Communication Performance

One gateway unit (PROFIBUS-DP slave) can be connected with 30 CANopen slaves. Note: The gateway unit itself is also a CANopen slave.

Data sent/received by one gateway unit (PROFIBUS-DP slave) with a PLC contains up to 122 parameters.

Data sent/received by every CANopen slave contains up to eight parameters.

The communication distance is the same as the standard PROFIBUS-DP and CANopen networks. For details, see "B.3 CANopen/CANlink Communication" and "B.4 PROFIBUS-DP Communication".

B.6.4 Related Parameters

Parameter No.	Parameter Name	Default	Setting Range	Remarks
Fd-09	Communication status	0	Ones position (CANopen) 0: Stop 1: Initialization 2: Pre-running 8: Running Hundreds position (PROFIBUS-DP) 0: Stop 1: Initialization 8: Running	The tens position is used for CANlink. Read-only, used to monitor communication status.
Fd-10	CANopen/ CANlink switchover	1	1: CANopen 3: PROFIBUS-DP gateway function (power supply unit)	In the power supply unit, set this parameter to 3 to enable the PROFIBUS-DP gateway function. In the drive unit, set this parameter to 1 to enable the CANopen mode.
Fd-12	CAN baud rate	5	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps	CAN communication baud rate of the power supply and drive units Note: After the network runs, modify the baud rate of the power supply and drive units and it will take effect immediately. In addition, the network will detect an error and the error must be manually cleared. Use the default if there is no special application.
Fd-13	CAN station No.	1	0 to 127	Configure the CANopen slave address.
Fd-20	PROFIBUS-DP communication address	1	0 to 125 (0: broadcast address)	Set to enable the PROFIBUS-DP function of the AC drive. Configure the PROFIBUS-DP node address.
Fd-22	Gateway mode	0	0: Unable to communicate 1: Able to communicate	Specially designed for the power supply unit. It is used to select whether to normally establish communication when the number of slaves configured in the PLC does not match with that in the actual network.
Fd-23	Number of online slaves	0	0 to 29	Specially designed for the power supply unit. It indicates the number of online slaves after communication is established. It is used to check whether the number of online slaves is consistent with that in the actual network when Fd-22 is set to 1.
Fd-24	Gateway power-on delay	8	5 to 20 (unit: s)	Specially designed for the power supply unit. It indicates the gateway power-on delay. When there are many common bus drive slaves, the power-on time becomes long and the gateway communicates first, but slaves are not ready, causing errors. In this case, set this parameter to a large value.
Fd-25	Online status of slaves 1-15	0	0 to 65535	Specially designed for the power supply unit. Bit 1: Gateway itself. Bit 2: Slave 2. The rest of bits 3-15 indicate slaves 3-15 respectively. The values 0 and 1 indicate offline and online, respectively.

Parameter No.	Parameter Name	Default	Setting Range	Remarks
Fd-26	Online status of slaves 16-30	0	0 to 65535	Specially designed for the power supply unit. Bit 0: Slave 16; Bit 1: Slave 17. The rest of bits 3-15 indicate slaves 18-30 respectively. The values 0 and 1 indicate offline and online, respectively.
Fd-33	Gateway communication period	0	0 to 65535 ms	Process data exchange period in the gateway mode.
Fd-96	CANopen software version	0.00	0.00 to 655.35	Version number of the CANopen communication software.
Fd-98	PROFIBUS-DP gateway software version	0.00	0.00 to 655.35	Version number of the PROFIBUS-DP-to-CANopen gateway communication software.
AF-00 to AF-31	Process data mapping received by the drive unit or power supply unit			Process data mapping from the PLC to the drive unit or power supply unit. For the specific configuration method, see "B.3.6 Description of CANopen Communication Protocol Application".
AF-32 to AF-63	Process data mapping sent from the drive unit or power supply unit			Process data mapping from the drive unit or power supply unit to the PLC. For the specific configuration method, see "B.3.6 Description of CANopen Communication Protocol Application".
AF-66	Amount of process data mapping received by the drive unit or power supply unit			Effective number of mappings in this station and corresponds to OUT of the PLC.
AF-67	Amount of process data mapping sent from the drive unit or power supply unit			Effective number of mappings in this station and corresponds to IN of the PLC.

B.6.5 Fault Description

The fault codes of the power supply unit are as follows:

Error Code	Description	Troubleshooting
E16.31	PROFIBUS-DP slave communication timeout	Check the connection of the PROFIBUS-DP cable.
E16.34	CAN slave offline in the network using PROFIBUS-DP to CANopen gateway function	Check whether the value of "The number of devices" in the special device parameter of the PLC is consistent with the actual number of stations or whether the setting of the slave station No. is correct.
E16.35	Incorrect configuration of the drive units in the network using PROFIBUS-DP to CANopen gateway function	According to the diagnosis packet of the PLC, check whether the IN/OUT values of "NO. n" in the special device parameter of the PLC is consistent with AF-66/67 (Number of valid RPDOs/Number of valid TPDOs) of the slave.

Error Code	Description	Troubleshooting
E16.42	Incorrect configuration parameters of the power supply unit in the network using PROFIBUS-DP to CANopen gateway function	According to the diagnosis packet of the PLC, check whether the IN/OUT values of "NO. 1" in the special device parameter of the PLC is consistent with AF-66/67 (Number of valid RPDOs/Number of valid TPDOs) of the gateway unit.

NOTE

◆ In case of configuration errors, the PROFIBUS-DP is reconfigured only after the error of the gateway unit is reset.

The fault codes of the drive unit are as follows:

Error Code	Description	Troubleshooting
E16.11	CANopen slave communication timeout	Check the connection of the cable.
E16.12	CANopen configuration mappings inconsistent with actual transmission mappings	Check mappings in group AF.
E16.13	Communication failure between the power supply and drive units	1: Check whether the cable is correctly connected. 2: Check whether the termination resistor of the network is correct. The termination resistors should be connnected at both ends of the network. 3: Check whether Fd-12 (CAN baud rate) is consistent.

B.6.6 Description of Application

1) Configuring parameters of the power supply unit or drive unit

Step 1: Set the power supply unit as a gateway.

■ Set Fd-10 (CANopen/CANlink switchover) to 3 (gateway mode).

■ In Fd-20 (PROFIBUS-DP communication address), set a PROFIBUS-DP slave No., which is consistent with the station No. in the PLC slave system.

■ Configure interaction data between the gateway unit and the PLC by setting AF-00 (RPDO1-SubIndex0-H) to AF-63 (TPDO4-SubIndex3-L). The default is empty. The default parameter can be directly used. The gateway unit generally does not need to perform data interaction with the PLC. For the specific setting, see "B.5.7 CANopen Slave Configuration Description".

Step 2: Set other slave units that can be drive or power supply units.

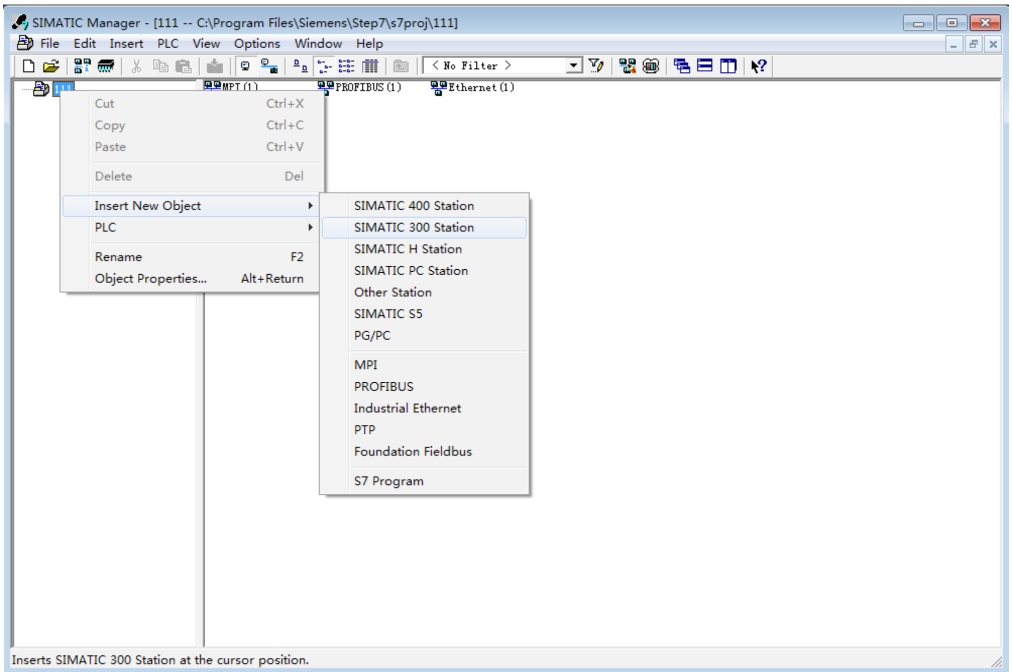
■ Set the station No. of every slave unit in Fd-13 (CAN station No.). The station No. must start with 2 and be sequentially set without being repeated. If there are any needless power supply or drive unit in the network and networking control is not required, this parameter does not need to be set, i.e. the default value 1 is used.

■ Configure interaction data between the gateway unit and the PLC by setting AF-00 (RPDO1-SubIndex0-H) to AF-63 (TPDO4-SubIndex3-L). The drive unit may directly use default parameters. For specific setting, see "B.3.6 Description of CANopen Communication Protocol Application".

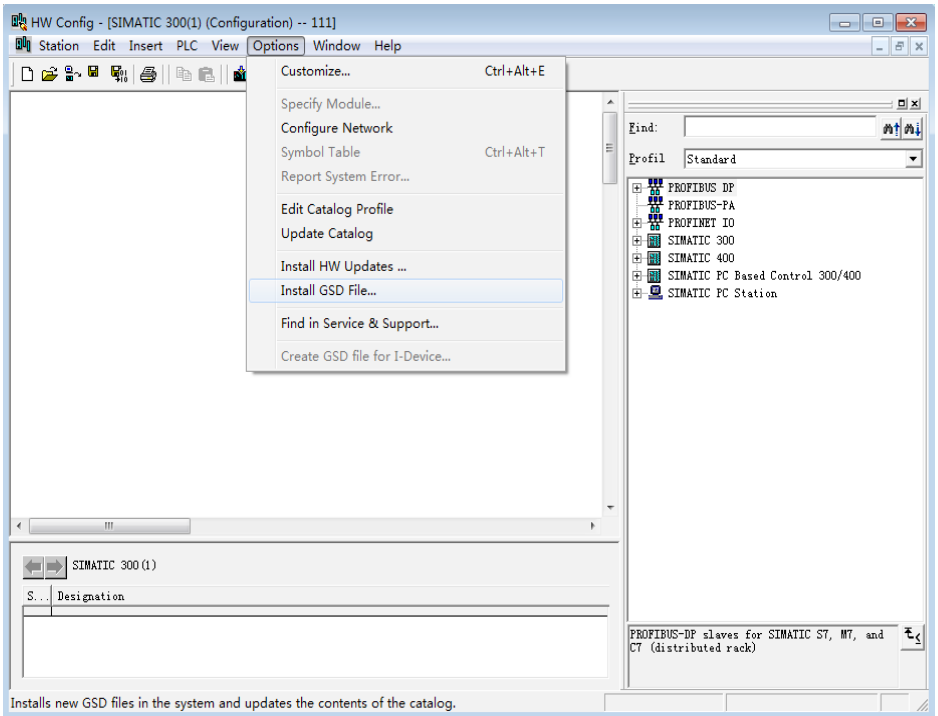
2) Master configuration on S7-300

When using in the PROFIBUS-DP master, a slave GSD file must be configured first so that corresponding slave devices can be added in the master system. If the file exists, skip Step 2. The GSD file is available from an Inovance agent or manufacturer. Specific operations are as follows:

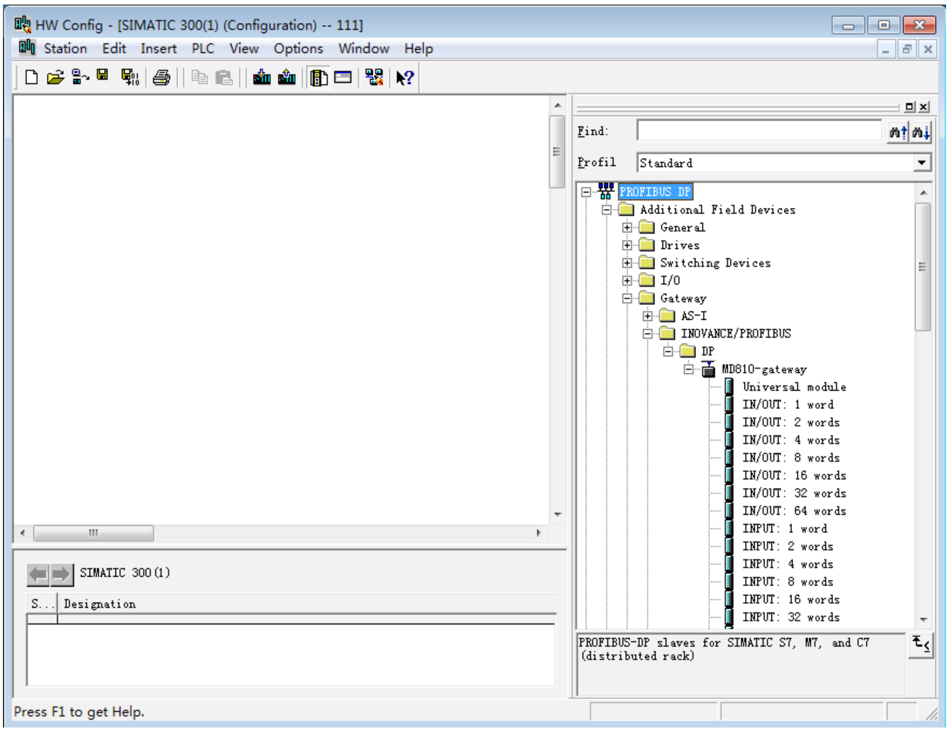
Step 1: Establish a project in STEP7. Add an S7 -300 master in the project, as shown in the following figure:



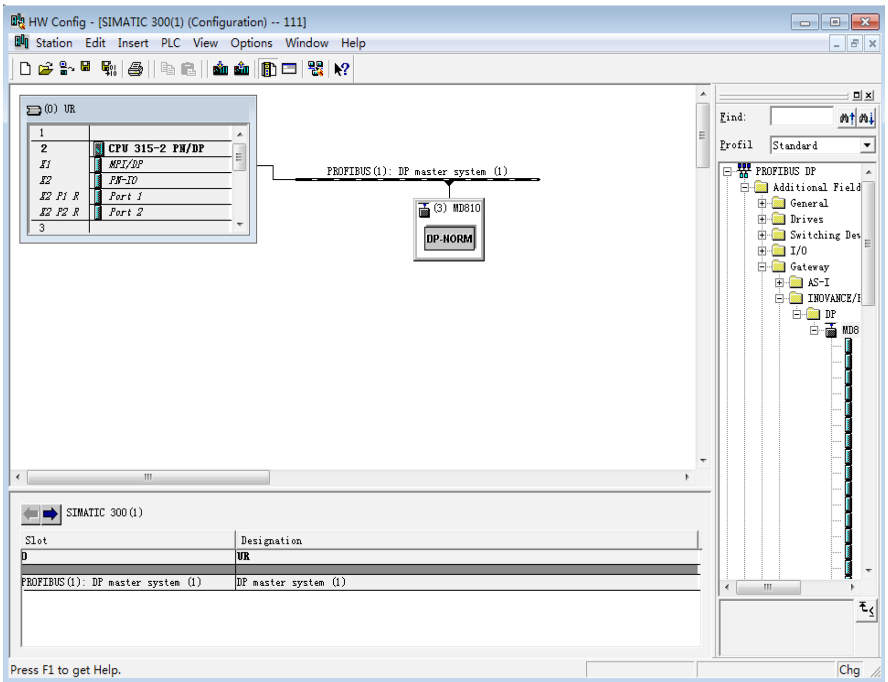
Step 2: Double-click the hardware icon to enter the HW config configuration interface where the MD810DP.GSD file is added. The operations are as follows:



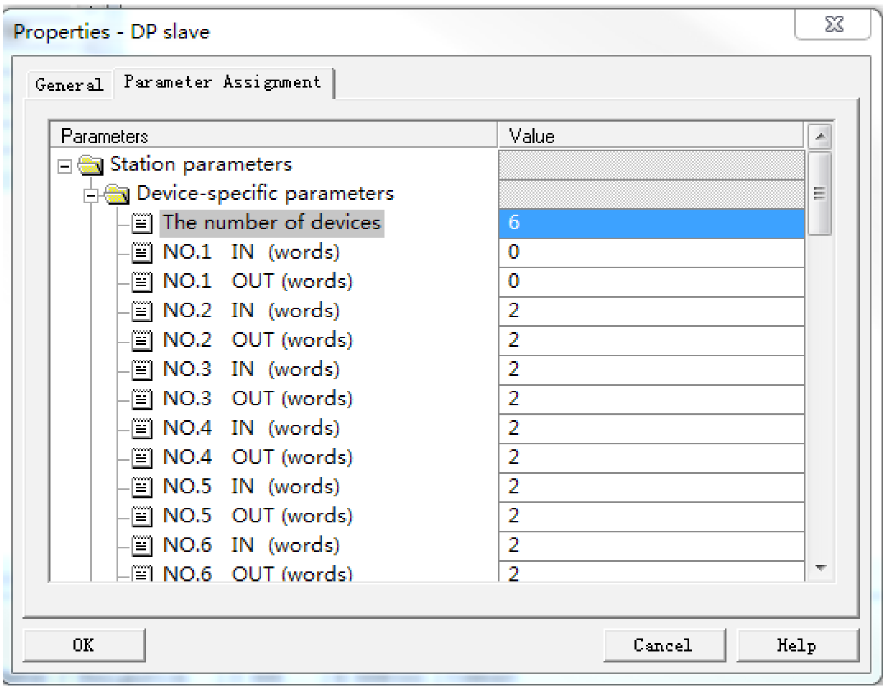
Click Install. After the installation is finished, the MD810-gateway module will emerge under Gateway, as shown in the following figure:



Step 3: Establish a slave system, as shown in the following figure. The establishment of the master is not described here.



Step 4: Configure PROFIBUS-DP slave parameters. Double-click the MD810 slave, as shown in the following figure:

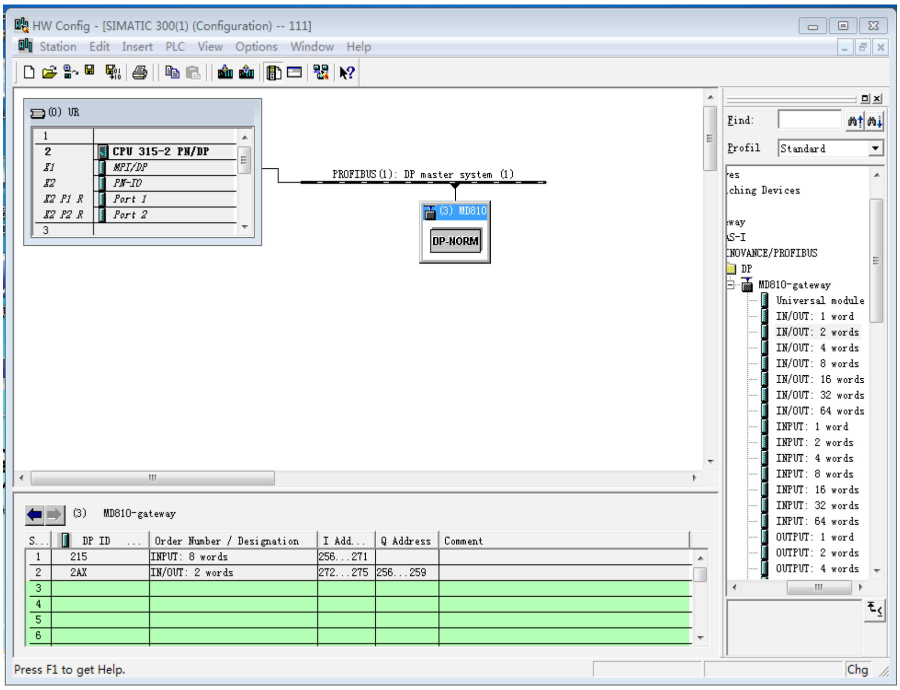


- "The number of devices": Number of stations in the network, up to 30, including the gateway itself. Assume that one power supply unit (gateway) plus five drive units use this function. This value is equal to 6.
- "NO.1, NO.2, NO.3...": NO.1 is the gateway. NO.2 is a slave with No. 2 address when Fd-13 (CAN station No.) is set to 2. NO.3 is a slave with No. 3 address when Fd-13 (CAN station No.) is set to 3. NO.n can be done in the same manner.
- "IN, OUT": IN: Data from the drive to the PLC, OUT: Data from the PLC to the drive.
- According to the preceding information, NO.2 IN indicates the amount of data from the drive of No.2 station to the PLC, in unit of byte; NO.2 OUT indicates the amount of data from the PLC of No.2 station to the drive, in unit of byte.

NOTE

- ◆ For specific IN and OUT values, view the parameters of every station. OUT and IN correspond to AF-66 (Number of valid RPDOs) and AF-67 (Number of valid TPDOs), respectively.
- ◆ Values of AF-66 (Number of valid RPDOs) and AF-67 (Number of valid TPDOs) are equal to the sum of bits. For example, if AF-66 is 0012, OUT is 3 (1 + 2 = 3).

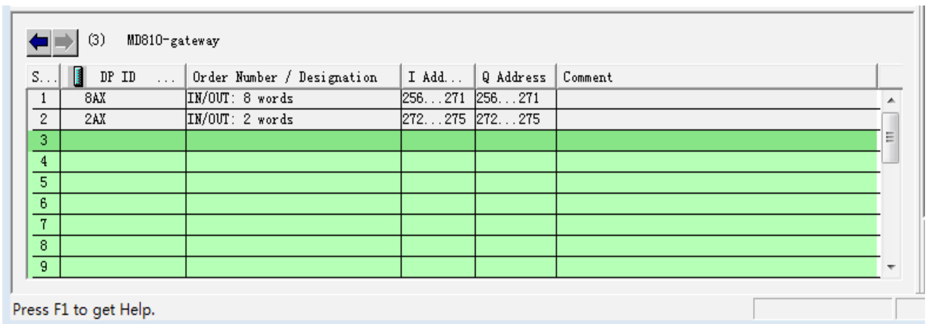
Step 5: Configure INPUT and OUTPUT data length.

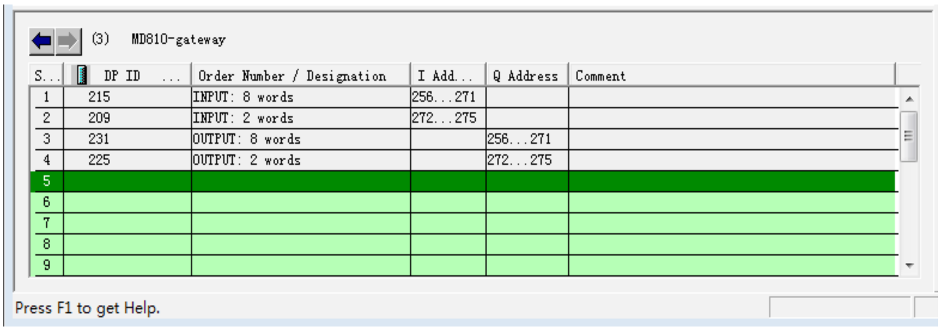


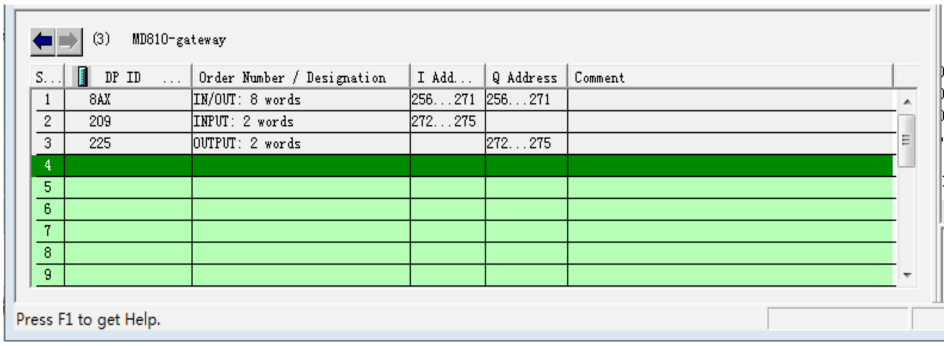
- "IN/OUT 1 word, IN/OUT 2 words...": It indicates the combination of INs and OUTs. 1 word indicates one IN and one OUT. 2 words indicate two INs and two OUTs. n words can be done in the same manner.
- "INPUT 1 word, INPUT 2 words...": It indicates independent INs. 1 word indicates one IN. 2 words indicate two INs. n words can be done in the same manner.
- "OUTPUT 1 word, OUTPUT 2 words...": The same as above.

The slot IN and OUT quantity is equal to the sum of INs and OUTs of valid stations in the special device parameter in step 4. If "The number of devices" is 6, the sum of INs equals to NO.1 IN + NO.2 IN +...NO.6 IN and the sum of OUTs equals to NO.1 OUT + NO.2 OUT +...NO.6OUT. The value shown in the preceding figure is for reference, i.e. the sum of INs = 10 and the sum of OUTs = 10.

Insert ten INs and Ten OUTs in corresponding slots in independent, combination, or independent + combination mode. See the following figure.







NOTE

◆ Any inserted I and Q addresses must be continuous. In addition, insertion must sequentially start with slot 1. There is no limitation on the number of slots. In addition, the total of INs and OUTs in the slot must be the same as the calculated total of INs and OUTs in the special device parameter, otherwise communication cannot be established.

Step 6: For obtaining the process data relation between the PLC I/Q address and the drive process data, see "B.3.6 Description of CANopen Communication Protocol Application".

B.6.7 CANopen Slave Configuration Description

1 Process data mapping

Every CANopen slave supports sending and receiving up to 16-byte process data, i.e. sending and receiving eight parameters, respectively. Any mapping is allowed. Both the sum of sent process data and received process data cannot exceed 244 bytes.

OUT: PLC -> Drive; IN: Drive -> PLC

■ Manual modification using the keypad

You can select received/sent parameters by modifying parameters in group AF of the drive. Take the following table as an example. The method of configuring F0-01 (1st motor control mode) in OUT1 is as follows:

1) Enter the parameter group No. of received/sent parameters plus 0x2000 in the first parameter in group AF of corresponding INPUT or OUTPUT. For example, F0 corresponds to 0x20F0. Enter it in AF-00 (RPDO1-SubIndex0-H).

2) After the group No. of received/sent parameters plus 1 is finished, convert the result into a hexadecimal number and enter the high bits of the second parameter in group AF of corresponding INPUT or OUTPUT; convert the parameter data length into a hexadecimal number and enter the low bits of the second parameter in group AF of corresponding INPUT or OUTPUT.

For example, if the parameter data length of F0-01 (1st motor control mode) is 16 bits, enter 0x0210.

Target Parameter No.	Group AF Address	Setting Value	Remarks
F0-01	AF-00	0x20F0	Parameter address index Equal to group No. F0 + 0x2000
	AF-01	0x0210	Upper byte 02: Parameter number in the group + 1 (offset) Lower byte 10: parameter length (16 bit) For example, this value is 20 for a 32-bit parameter. Note: The values must be converted into hexadecimal.

You can also map the CANopen object dictionary to group AF. Except that object dictionary sub-index must be set without adding 1, other steps are similar, as shown in the following table:

Target Object Dictionary	Group AF Address	Setting Value	Remarks
0x2073-12.	AF-00	0x2073	Object dictionary index
	AF-01	0x1210	Upper byte 12: Object dictionary sub-index; Lower byte 10: 16-bit object length.

The following table shows the relation between the parameters in group AF and INPUT/OUTPUT.

	Group AF Address		Drive Default Parameters			Group AF Address		Drive Default Parameters	
OUT	OUT 1	AF-00	0x2073	0x7311 (Control word)	IN	IN 1	AF-32	0x2070	0x7044 (Status word)
		AF-01	0x1210				AF-33	0x4510	
	OUT 2	AF-02	0x2073	0x7310 (Frequency setting)		IN 2	AF-34	0x2070	0x7045 (Running frequency)
		AF-03	0x1110				AF-35	0x4610	
	OUT 3	AF-04				IN 3	AF-36		
		AF-05					AF-37		
	OUT 4	AF-06				IN 4	AF-38		
		AF-07					AF-39		
	OUT 5	AF-08				IN 5	AF-40		
		AF-09					AF-41		
	OUT 6	AF-10				IN 6	AF-42		
		AF-11					AF-43		
	OUT 7	AF-12				IN 7	AF-44		
		AF-13					AF-45		
	OUT 8	AF-14				IN 8	AF-46		
		AF-15					AF-47		

NOTE

◆ The power supply unit has no default settings.

◆ If received or sent data needs to be reserved, the power supply and drive units use Fd-93 (Reserved DP network bridge address). Assume that the first received data reserved by the power supply unit corresponds to AF-00 (RPDO1-SubIndex0-H) and AF-01 (RPDO1-SubIndex0-L). In this case, set AF-00 (RPDO1-SubIndex0-H) to 0x20Fd and AF-01 (RPDO1-SubIndex0-L) to 0x5E10 .

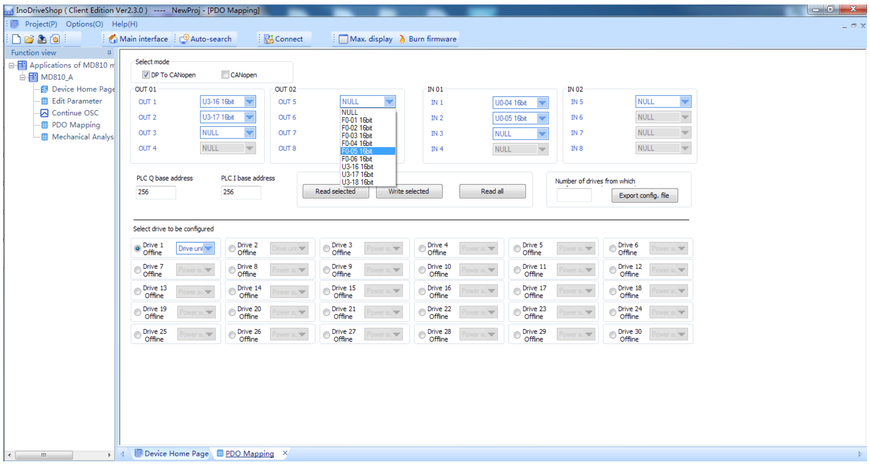
AF-00 = 0x2000 + Fd = 0x20Fd;

AF-01 upper 8 bits = 93+1 = 0x5E;

AF-01 lower 8 bits = 0x10;

■ Modification using the commissioning software

You can also configure slave process data using the commissioning software of the MD810, as shown in the following figure.



2 Mapping relation between PLC I/Q addresses and process data

The PLC I address corresponds to the slave INPUT, indicating power supply unit -> PLC. The PLC Q address corresponds to the slave OUTPUT, indicating PLC -> power supply unit. The PLC I/Q addresses are sorted according to the station No. with data and the increasing sequence of the IN/OUT No. of corresponding stations. The minimum PLC I address is 256, corresponding to IN1 of station 2 and then 258 corresponding to IN2, as shown in the following figure. Because station 2 has only two INs, the next PLC I address corresponds to IN1 of station 3 and so on.

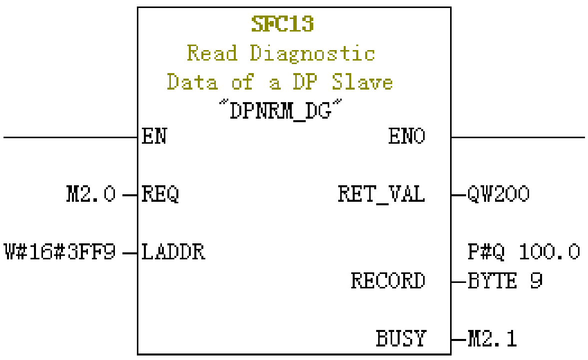
Station No.	Parameter	Value						PLC Q Address						PLC I Address
	The number of devices	30												
1	NO.1 IN (words)	2	OUT	OUT 1	U3-16	AF-00 : 0x2073	AF-01 : 0x1110	256	IN	IN 1	U0-04	AF-32 : 0x2070	AF-33 : 0x0510	256
				OUT 2	U3-17	AF-02 : 0x2073	AF-03 : 0x1210	258		IN 2	U0-05	AF-34 : 0x2070	AF-35 : 0x0610	258
				OUT 3						IN 3				
				OUT 4						IN 4				
	NO.1 OUT (words)	2		OUT 5						IN 5				
				OUT 6						IN 6				
				OUT 7						IN 7				
				OUT 8						IN 8				
2	NO.2 IN (words)	0	OUT	OUT 1					IN	IN 1				
				OUT 2						IN 2				
				OUT 3						IN 3				
				OUT 4						IN 4				
	NO.2 OUT (words)	0		OUT 5						IN 5				
				OUT 6						IN 6				
				OUT 7						IN 7				
				OUT 8						IN 8				
3	NO.3 IN (words)	0	OUT	OUT 1					IN	IN 1				
				OUT 2						IN 2				
				OUT 3						IN 3				
				OUT 4						IN 4				
	NO.3 OUT (words)	0		OUT 5						IN 5				
				OUT 6						IN 6				
				OUT 7						IN 7				
				OUT 8						IN 8				

This table can be generated in the "Export profile" option in the PDO mapping configuration interface of the commissioning software. The PLC I/Q base address, i.e. the address with the minimum value, must be entered before export.

B.6.8 PLC Fault Diagnosis

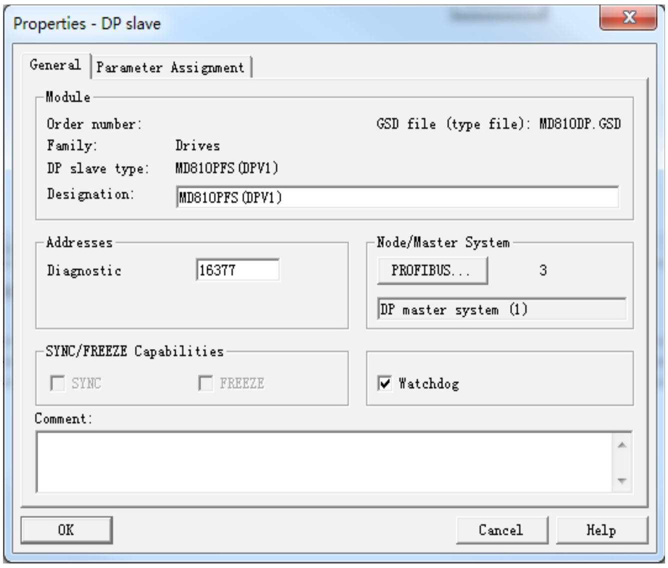
PROFIBUS-DP master diagnosis information

Specific diagnosis information of slaves can be read using SFC13 in the program, as shown in the following figure:



REQ: Command enable. Diagnosis information reading is enabled when it is set to ON.

LADDR: Diagnosis address of configured PROFIBUS-DP slaves. The following figure shows the actual value. The hexadecimal format of this address, i.e. hexadecimal 3FF9 of 16337, must be filled in SFC13.



RET_VAL: Error code (negative) displayed when invocation errors occur and actual transmitted data length (positive) displayed when no error occurs.

RECORD: Target region of the read diagnosis data. The value must be in byte data type with 10 bytes. Otherwise, an error will be generated during invocation. Byte definitions are as follows:

Byte	Definition
Byte 0–2	Station status
Byte 3	Master station number
Byte 4	Supplier ID (high byte)
Byte 5	Supplier ID (low byte)
Byte 6–10	Dedicated device diagnosis information

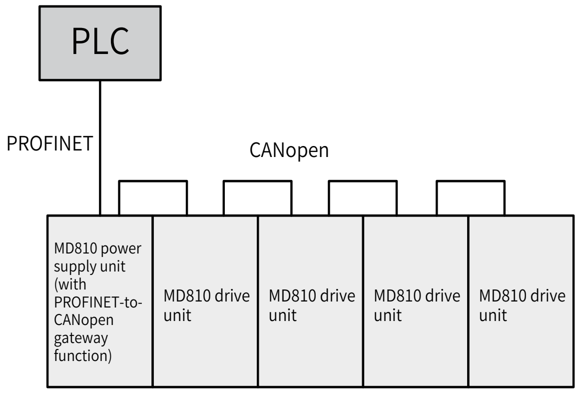
Dedicated device diagnosis provides customized network bridge fault diagnosis information, as described in the following table.

Byte 6	Byte 7	Byte 8	Byte 9	Byte 10
Dedicated device diagnosis length	Type	CANopen slave No.	Fault code	
4	Parameter error (1)	1–30	Parameter PDO length not matched with that on the drive (35)	Reserved
4	Parameter error (1)	1–30	Node offline during configuration (34)	Reserved
4	CANopen network fault (3)	1–30	CANopen slave offline during running (32)	Reserved
5	AC drive fault (4)	1–30	Drive fault (high bits)	Drive fault (low bits)

B.7 PROFINET-to-CANopen Gateway

B.7.1 PROFINET Overview

The PROFINET-to-CANopen gateway function is implemented in the MD810 power supply unit to convert PROFINET to the CANopen protocol. The following figure shows the basic structure of the network bridge.



The gateway function implements data exchange for a total of 30 nodes (including the power supply unit). Detailed data is as follows.

1) For the power supply unit: The gateway function supports three RPDOs and three TPDOs each with a maximum of 24 bytes.

2) For the MD810 or IS810 drive unit: The gateway function supports a maximum of 29 nodes, each of which can be configured with up to four RPDOs and four TPDOs each with a maximum of 32 bytes. The total number of RPDOs and that of TPDOs configured for the 29 nodes cannot exceed 63. The maximum input or output data length exported by the 29 nodes is 504 bytes, which is obtained by multiplying 63 with 8.

This section describes PROFINET-to-CANopen conversion with the CANopen node of the MD810 drive unit, Siemens' S300 PLC, and Siemens' STEP 7 are used as examples.

B.7.2 Configuration Preparation

Complete the following configuration before using the PROFINET-to-CANopen network bridge function:

1) Power supply unit: Set Fd-10 (Communication protocol selection) to 5 and Fd-12 (CAN baud rate) to the desired CANopen baud rate to support PROFINET-to-CANopen conversion.

2) Drive unit: Set Fd-10 (Communication protocol selection) to 1 (CANopen), set Fd-12 (CAN baud rate) to the desired baud rate, and set Fd-13 (CAN station number) to the CAN station number (the value 1 is not allowed). Ensure that the CAN station numbers increase gradually. You can set Fd-13 (CAN station number) to 1 if the node does not have process data.

NOTE

◆ The power supply unit that supports PROFINET-to-CANopen conversion provides four Ethernet ports, which are divided into two groups. Ensure that PROFINET and CANopen are wired properly.

B.7.3 Process Data Configuration on the AC Drive

This section describes process data configuration, which is the same for the power supply unit and drive unit. The process data required for communication of the local device is configured using the parameters in group AF.

Every CANopen slave supports sending and receiving up to 32-byte process data. Each PDO supports up to eight bytes. Parameters can be selected as required.

Set the received/sent parameters as follows. In the configuration, define IN as AC drive -> PLC and OUT as PLC -> AC drive in a unified manner.

You can select received/sent parameters by modifying parameters in group AF of the power supply unit. Take the following table as an example. The method of configuring F0-01 (Product SN) in OUT1 is as follows:

1) Enter the parameter group No. of received/sent parameters plus 0x2000 in the first parameter in group AF of corresponding INPUT or OUTPUT. For example, F0 corresponds to 0x20F0. Enter it in AF-00.

2) After the group No. of received/sent parameters plus 1 is finished, convert the result into a hexadecimal number and enter the high bits of the second parameter in group AF of corresponding INPUT or OUTPUT; convert the parameter data length into a hexadecimal number and enter the low bits of the second parameter in group AF of corresponding INPUT or OUTPUT. For example, if the parameter data length of F0-01 is 16 bits, enter 0x0210.

Target Parameter No.	Group AF Address	Setting Value	Remarks
F0-01	AF-00	0x20F0	Group No. F0 + 0x2000
	AF-01	0x0210	Upper byte 02: Parameter number in the group + 1 (offset) Lower byte 10: Parameter length For example, this value is 10, 20, and 08 for a 16-bit, 32-bit, and 8-bit parameters, respectively. Note: The parameter No. must be converted into a hexadecimal number.

You can also map the CANopen object dictionary to group AF. Except that object dictionary sub-index must be set without adding 1, other steps are similar, as shown in the following table:

Target Object Dictionary	Group AF Address	Setting Value	Remarks
0x2073-12.	AF-00	0x2073	Object dictionary index
	AF-01	0x1210	Upper byte 12: Object dictionary sub-index; Lower byte 10: 16-bit object length.

1 MD810 mapping configuration

The MD810 drive unit is used as an example. The following table shows the relation between the parameters in group AF and INPUT/OUTPUT.

		Group AF Address		AF Param. Value	Process Data Address			Group AF Address		AF Param. Value	Process Data Address
OUT	RPDO1	OUT1	AF-00	0x2073	0x7311	INPUT	TPDO1	INPUT1	AF-32	0x2070	0x7044
			AF-01	0x1210					AF-33	0x4510	
		OUT2	AF-02	0x2073	0x7310			INPUT2	AF-34	0x2070	0x7045
			AF-03	0x1110					AF-35	0x4610	
		OUT3	AF-04					INPUT3	AF-36		
			AF-05						AF-37		
		OUT4	AF-06					INPUT4	AF-38		
			AF-07						AF-39		
	RPDO2	OUT5	AF-08				TPDO2	INPUT5	AF-40		
			AF-09						AF-41		
		OUT6	AF-10					INPUT6	AF-42		
			AF-11						AF-43		
		OUT7	AF-12					INPUT7	AF-44		
			AF-13						AF-45		
		OUT8	AF-14					INPUT8	AF-46		
			AF-15						AF-47		
	RPDO3	OUT9	AF-16				TPDO3	INPUT9	AF-48		
			AF-17						AF-49		
		OUT10	AF-18					INPUT10	AF-50		
			AF-19						AF-51		
		OUT11	AF-20					INPUT11	AF-52		
			AF-21						AF-53		
		OUT12	AF-22					INPUT12	AF-54		
			AF-23						AF-55		
	RPDO4	OUT13	AF-24				TPDO4	INPUT13	AF-56		
			AF-25						AF-57		
		OUT14	AF-26					INPUT14	AF-58		
			AF-27						AF-59		
		OUT15	AF-28					INPUT15	AF-60		
			AF-29						AF-61		
		OUT16	AF-30					INPUT16	AF-62		
			AF-31						AF-63		

NOTE

- For 32-bit data, ensure that each configured PDO contains not more than 8 bytes.
- The power supply unit supports input and output of up to 24 bytes, respectively. Power on the power supply unit again after modifying its process data.
- If received or sent data needs to be reserved, use Fd-93 in the power supply unit and drive units. If the first received data reserved by the power supply unit corresponds to AF-00 and AF-01, set AF-00 to 0x20Fd and AF-01 to 0x5E10.
- AF-00 = 0x2000 + FD = 0x20FD;
- 8 high-order bits of AF-01 = 93+1 = 0x5E;
- 8 lower-order bits of AF-01 = 0x10.

2 IS810 mapping configuration method

IS810 is updated from IS620P. For its application details, see the IS620P user guide.

Configure the IS810 PROFINET gateway as follows: Set the CANopen slave number in 0C-00 and select 0C– 45 = 1 gateway mode for the CANopen mode.

Differently from the PROFIBUS-DP-to-CANopen gateway, the PROFINET-to-CANopen gateway supports four RPDOs/TPDOs for IS810 and the 8-, 16-, and 32-bit data structures. The corresponding parameters are as follows.

		Group 2D Address		2D Param. Value	Process Data Address			Group 2E Address		2E Param. Value	Process Data Address
OUT	RPDO1	Number of mapping objects	2D-32			INPUT	TPDO1	Number of mapping objects	2E-20		
		OUT1	2D-33					INPUT1	2E-21		
			2D-34						2E-22		
		OUT2	2D-35					INPUT2	2E-23		
			2D-36						2E-24	0x4610	
		OUT3	2D-37					INPUT3	2E-25		
			2D-38						2E-26		
		OUT4	2D-39					INPUT4	2E-27		
			2D-40						2E-28		
	RPDO2	Number of mapping objects	2D-49				TPDO2	Number of mapping objects	2E-37		
		OUT5	2D-50					INPUT5	2E-38		
			2D-51						2E-39		
		OUT6	2D-52					INPUT6	2E-40		
			2D-53						2E-41		
		OUT7	2D-54					INPUT7	2E-42		
			2D-55						2E-43		
		OUT8	2D-56					INPUT8	2E-44		
			2D-57						2E-45		
	RPDO3	Number of mapping objects	2D-66				TPDO3	Number of mapping objects	2E-54		
		OUT9	2D-67					INPUT9	2E-55		
			2D-68						2E-56		
		OUT10	2D-69					INPUT10	2E-57		
			2D-70						2E-58		
		OUT11	2D-71					INPUT11	2E-59		
			2D-72						2E-60		
		OUT12	2D-73					INPUT12	2E-61		
			2D-74						2E-62		
OUT	RPDO4	Number of mapping objects	2D-83			INPUT	TPDO4	Number of mapping objects	2E-71		
		OUT13	2D-84					INPUT13	2E-72		
			2D-85						2E-73		
		OUT14	2D-86					INPUT14	2E-74		
			2D-87						2E-75		
		OUT15	AF-88					INPUT15	2E-76		
			AF-89						2E-77		
		OUT16	AF-90					INPUT16	2E-78		
			AF-91						2E-79		

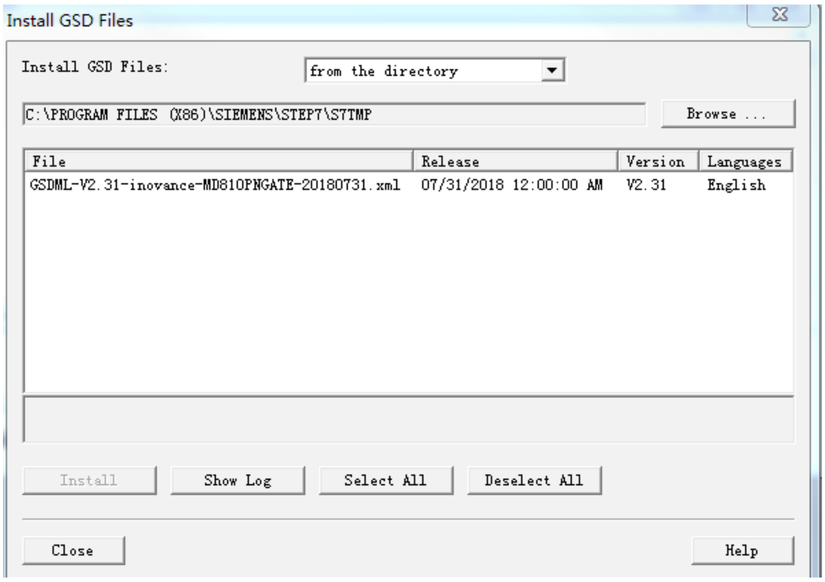
NOTE

- ◆ Pay attention to the configured mapping length. Ensure that each configured PDO contains not more than eight bytes.
- ◆ If PDO for communication is not required, clear the parameter value; otherwise, the configuration may fail.
- ◆ The configured number of mapping objects must comply with the actual value.

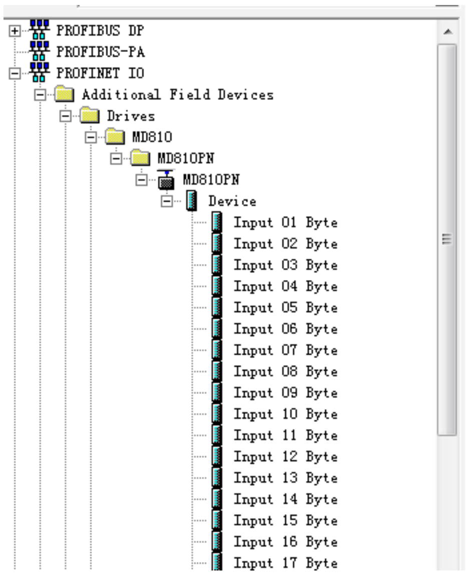
B.7.4 Configuration on STEP 7

1 Import the GSDML file.

Import the GSDML file to STEP 7, as shown in the following figure.

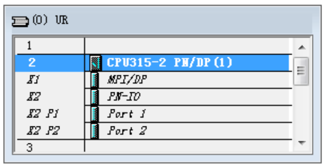


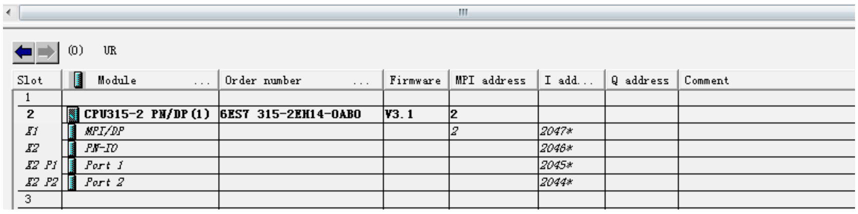
If the import is successful, the device is displayed, as shown in the following figure.



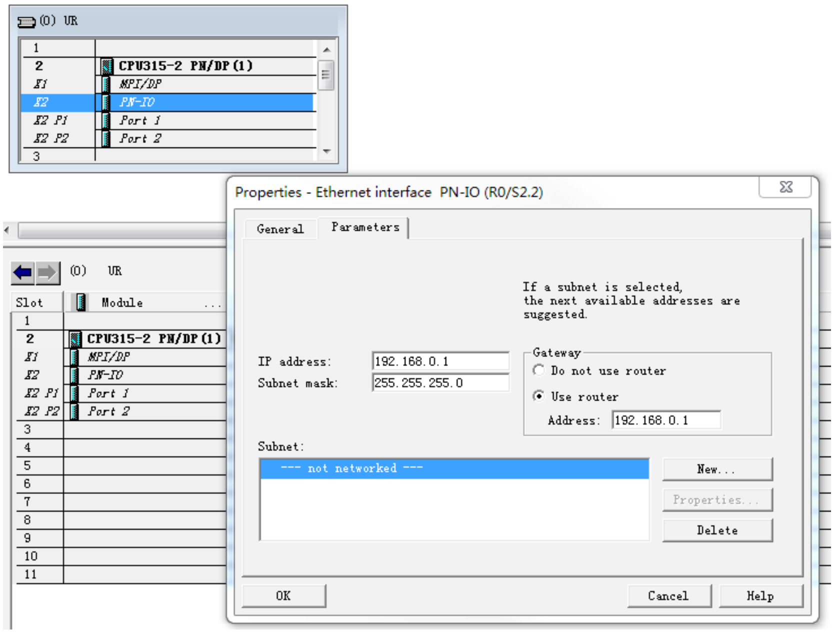
2 Build a PROFINET network.

Assume that a PLC exists in configuration, as shown in the following figure. Add a PROFINET network.

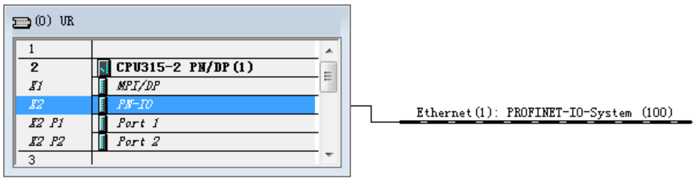


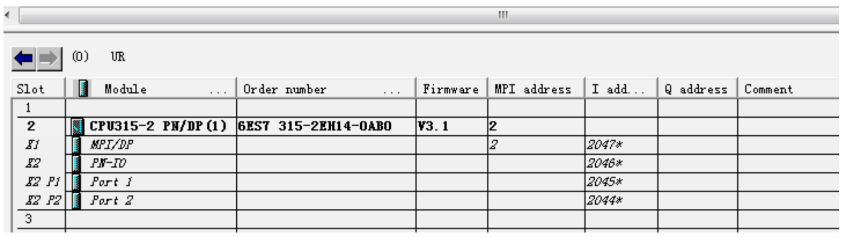


Right-click **PN-IO** and choose **Insert PROFINET IO System** from the shortcut menu. In the displayed window, select **Properties**, as shown in the following figure.

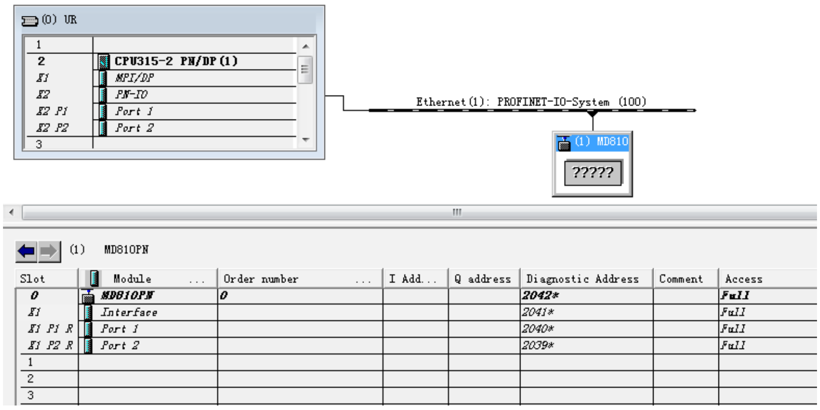


Click **New**. Keep the default settings unless otherwise specified. Then, click **OK**. The following figure shows the new PROFINET network.





Drag the previously added MD810PN device and drop it onto the bus, as shown in the following figure.

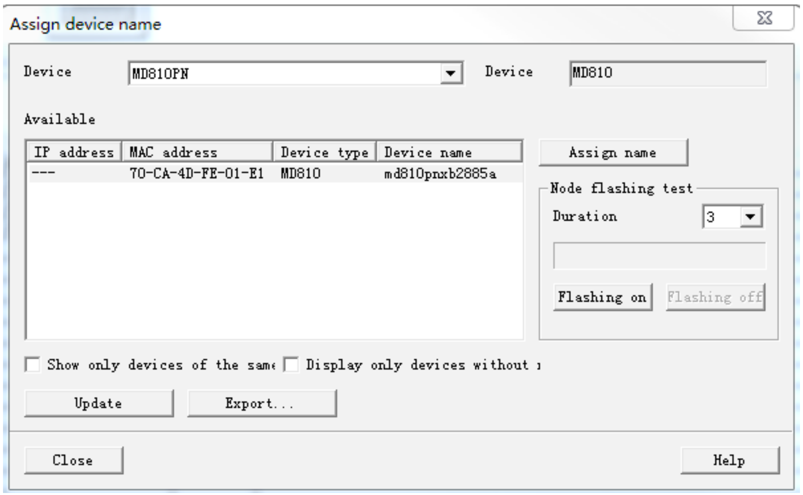


3 Allocate device names.

PROFINET communication requires each device to be allocated with a name. You can name each device as needed and allocate the name to the device. The allocated device name must be consistent with that in configuration. Otherwise, PROFINET communication will fail.

Double-click the module dragged to the configuration and modify the device name as needed. You can also keep the default name.

Then, allocate the name to the PROFINET-to-CANopen device. In the preceding menu, select **Internet** for **PLC** and select **Assign device names**. The following window is displayed.



Select the node to be allocated with a name and click Assign name. Then, close the window.

4 Configure process data.

Before configuring process data, ensure that the AC drive parameters have been set and the process data described above has been configured.

The configuration rules of the PROFINET-to-CANopen gateway function are as follows.

1) Add a node by double-clicking or dragging and dropping it in the list.

2) The power supply unit gateway is named Device 1, which must be added regardless of whether process data of the power supply unit exists.

3) Device 2 corresponds to CANopen node 2, and so on.

4) Each device contains two sub-slots. The first one only receives input data, and the second one only receives output data.

5) The length of data in each sub-slot must be the same as the total input or output length of the

corresponding AC drive. The length is measured in bytes.

6) If a site does not have input or output data, insert "Input No Data" or "Output No Data" into the corresponding sub-slot.

7) Power on the power supply unit again after you modify the process data configuration during PROFINET-to-CANopen communication.

See the following example:

(1) MD810PN

Slot	Module	Order number	I Add...	Q address	Diagnostic Address	Comment	Access
0	***MD810PN***	*0*			***2042****		***Full***
X1	*Interface*				*2041**		*Full*
X1 P1 R	*Port 1*				*2040**		*Full*
X1 P2 R	*Port 2*				*2039**		*Full*
1	**Device**				**256***		
1.1	Input 02 Byte		256...257				Full
1.2	Output No Data				2037*		Full
2	**Device**				**258***		
2.1	Input 12 Byte		258...269				Full
2.2	Output 12 Byte			256...267			Full
3	**Device**				**2038***		
3.1	Input No Data				2038*		Full
3.2	Output No Data				2036*		Full
4	**Device**				**270***		
4.1	Input 04 Byte		270...273				Full
4.2	Output 04 Byte			268...271			Full
5	**Device**				**274***		
5.1	Input 04 Byte		274...277				Full
5.2	Output 04 Byte			272...275			Full
6	**Device**				**278***		
6.1	Input 04 Byte		278...281				Full
6.2	Output 04 Byte			276...279			Full
7	**Device**				**282***		
7.1	Input 32 Byte		282...313				Full
7.2	Output 32 Byte			280...311			Full
8	**Device**				**314***		
8.1	Input 04 Byte		314...317				Full
8.2	Output 04 Byte			312...315			Full
9							
10							

As shown in the preceding figure, Device 1 is the power supply unit and has only one input data record of two bytes in group AF. Therefore, insert "Input 02 Byte" into the first slot, and insert "Output No Data" because no output data exists.

Device 2 corresponds to CANopen node 2 and has six input data records and six output data records, each of which is two bytes in length. Therefore, there are a total of 12 bytes of input data and 12 bytes of output data.

Device 3 corresponds to CANopen node 3 and has no process data. In principle, this site can be set to site 1 (which is not involved in the gateway function), but the configuration in the preceding figure also ensures normal operation.

The configuration for the following nodes is similar.

Process data address mapping:

Device 5 is used as an example. The input data is four bytes in length. Assume that the two process data records 0x7044 and 0x7045 are configured in the corresponding AF group. In the PLC, I addresses 270 to 273 correspond to the two data records. I270 to I271 correspond to 0x7044. I270 is the upper byte of 0x7044, and I271 is the lower byte. Other mappings are similar.

NOTE

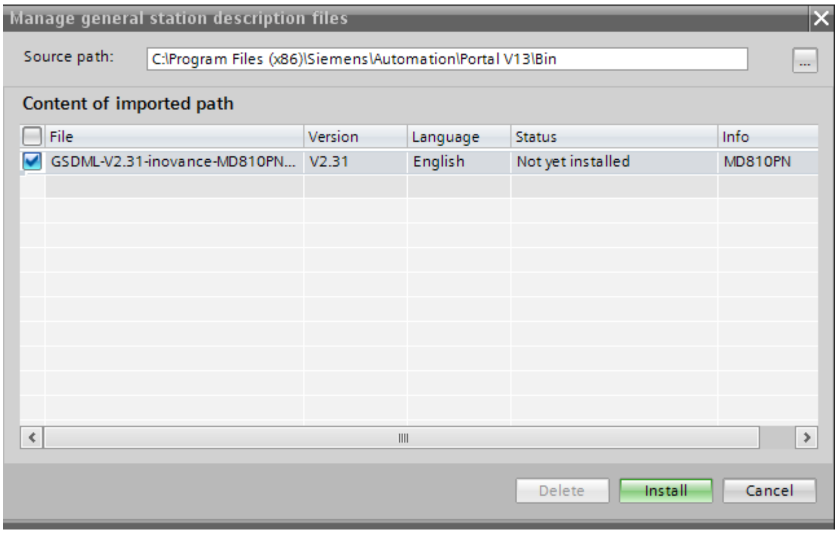
◆ Ensure that the AC drive configuration has a one-to-one correspondence with each device configured on STEP 7; otherwise, an error may be reported.

Then, download the configuration to the PLC and start communication.

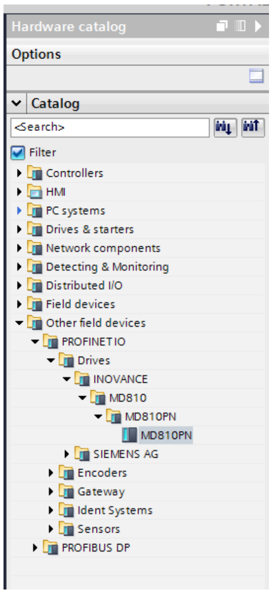
B.7.5 Configuration on TIA Portal

■ Import the GSDML file.

Open **Manage general station description files** under **Options**, as shown in the following figure.

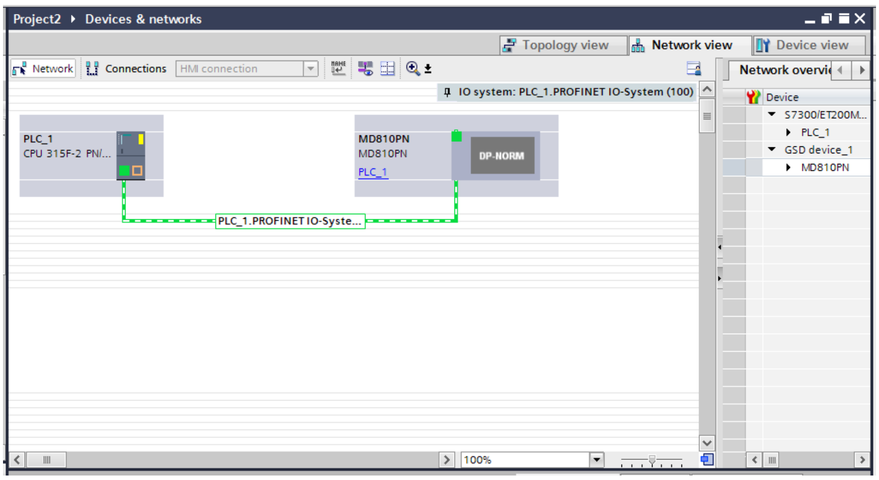


If the import is successful, the device is displayed, as shown in the following figure.



■ Build a PROFINET network.

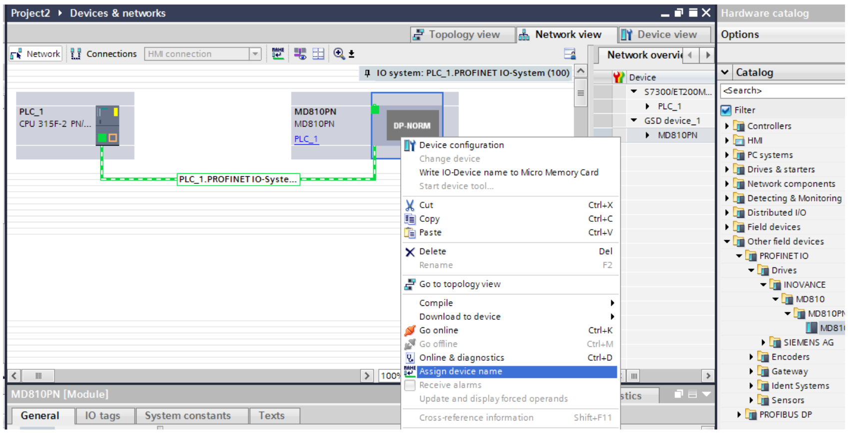
After a PLC is added, drag and drop the MD810PN device onto the page, and connect it to the PLC, as shown in the following figure.



■ Allocate device names.

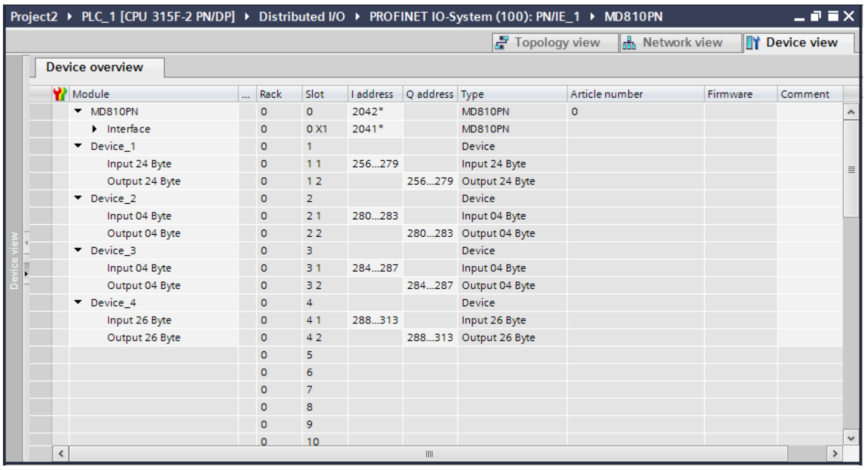
Right-click the device and choose **Assign device name** from the shortcut menu, as shown in the following figure.

The method of allocating device names is the same as that for STEP 7. For details, see the "Allocate device names" description in "B.6.4 Configuration on STEP 7".



■ Configure process data.

The method of configuring process data is the same as that for STEP 7. For details, see the "Configure process data" description in "B.6.4 Configuration on STEP 7". The following figure shows the page with complete configuration.



Module	Rack	Slot	I address	Q address	Type	Article number	Firmware	Comment
MD810PN	0	0	2042*		MD810PN	0		
Interface	0	0 X1	2041*		MD810PN			
Device_1	0	1			Device			
Input 24 Byte	0	1 1	256...279		Input 24 Byte			
Output 24 Byte	0	1 2		256...279	Output 24 Byte			
Device_2	0	2			Device			
Input 04 Byte	0	2 1	280...283		Input 04 Byte			
Output 04 Byte	0	2 2		280...283	Output 04 Byte			
Device_3	0	3			Device			
Input 04 Byte	0	3 1	284...287		Input 04 Byte			
Output 04 Byte	0	3 2		284...287	Output 04 Byte			
Device_4	0	4			Device			
Input 26 Byte	0	4 1	288...313		Input 26 Byte			
Output 26 Byte	0	4 2		288...313	Output 26 Byte			
	0	5						
	0	6						
	0	7						
	0	8						
	0	9						
	0	10						

Then, download the configuration to the PLC and start communication.

B.7.6 Auxiliary Functions

■ Startup with a missing site

This function is applicable in the scenario where you want to start the network without modifying the PLC configuration and program when a CANopen slave fails to go online. In this case, set Fd-50 to 1. The setting takes effect after power-on again.

NOTE

◆ It is an auxiliary function not intended to solve problems similar to error 16.74. Be sure to enable this function after commissioning is complete, and do not perform network commissioning when this function is enabled.

◆ Use this function only when a node fails to go online, rather than it is slow to go online.

■ PROFINET timeout period setting

You can set the maximum timeout period of PROFINET through Fd-55 (unit: ms; default: 350) based on the onsite situation. After the setting is successful, the CANopen network stops running when the time-out period has elapsed. The setting takes effect after power-on again.

B.7.7 Error Reporting and Diagnosis

When the gateway function is incorrectly configured, the PLC and power supply unit report errors. The power supply unit may report the following errors:

Error Code	Error Message
16.71	PROFINET is disconnected.
16.72	A CANopen slave is disconnected. Identify the disconnected slave and check the wiring.
None	A slave generates an application alarm. Identify the slave. (This error is only reported by the PLC.)
16.74	The configured CANopen slave is missing. Check whether the CANopen station number is correct.
16.75	The process data configuration of some CANopen slaves is inconsistent with the PLC configuration.
16.76	The process data of the power supply unit is inconsistent with the PLC configuration.
16.77	The PROFINET function of the power supply unit is faulty. Set Fd-10 to 5 and power on the power supply unit again. (The PLC generates an alarm when PROFINET is disconnected.)
16.78	The PROFINET function of the power supply unit is faulty. Set Fd-10 to 5 and power on the power supply unit again. (The PLC generates an alarm when PROFINET is disconnected.)

You can query the error description using the diagnosis function in the PLC commissioning software. For example, when a slave is disconnected, the power supply panel reports error 16.72, and the same error is reported by the slot of the corresponding node of the PLC.

B.7.8 Monitoring

The power supply unit provides parameters used to monitor the online status and other information about slaves, as shown in the following table.

Parameter	Description
Fd-51	CANopen slave communication disabled time
Fd-52	Number of online CANopen slaves
Fd-53	Online status of sites 1 to 15. Bit 1 indicates site 1, and so on.
Fd-54	Online status of sites 16 to 31. Bit 0 indicates site 16, and so on.
Fd-59	PROFINET software version
Fd-61	Two high-order bytes of a MAC address
Fd-62	Two middle bytes of a MAC address
Fd-63	Two low-order bytes of a MAC address

B.7.9 Configuration of PROFINET Gateway Used with Siemens PLC S1500

The hardware configuration described in this section is based on the following models:

Inovance's MD810 power supply unit with the gateway, model: MD81020M4T22G120

Inovance's IS810P-CO CANopen bus servo, model: IS810P50M4T005CO

Inovance's standard servo motor, model: ISMH2-15C30CD-U231Y

Siemens' PROFINET bus PLC, model: S7-1500

1 Servo configuration

■ Preparations

1) Check whether the MD810 power supply unit is equipped with the PROFINET gateway (PROFINET interface), and ensure that the drive unit in use supports the CANopen bus.

2) Ensure that the main circuit is correctly connected, including three-phase input, inter-unit bridging, and output motor connection.

NOTE

◆ MD810 must be connected to a three-phase 380 VAC power supply. Do not connect it to a single-phase power supply.

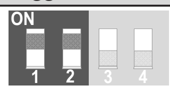
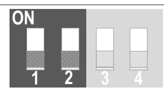
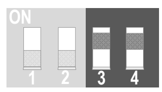
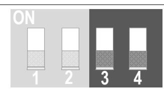
3) Connect the network cable correctly.

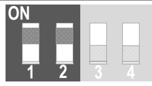
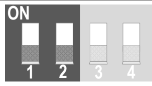
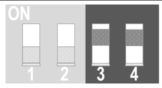
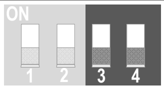
Connect the PROFINET interface of the MD810 power supply unit to the PLC communication interface through a network cable.

Connect the RJ45 network interface of the MD810 power supply unit to the RJ45 network interface of the drive units.

Adjust the DIP switch for the MD810 power supply unit. Turn on switches 3 and 4 for CAN1. (The following table lists the definitions of the DIP switch.)

Connect the last drive unit to a termination resistor; otherwise, CANopen communication may be abnormal and alarm A16.13 may be generated.

Terminal ID	Terminal Name	Function	Toggle Position
S1	Selection of RS485 termination resistor	The termination resistor is connected when switches 1 and 2 are turned on.	
		The termination resistor is disconnected when switches 1 and 2 are turned off.	
	Selection of CAN1 termination resistor	The termination resistor is connected when switches 3 and 4 are turned on.	
		The termination resistor is disconnected when switches 3 and 4 are turned off.	

Terminal ID	Terminal Name	Function	Toggle Position
S2	Selection of C485 termination resistor	The termination resistor is connected when switches 1 and 2 are turned on.	
		The termination resistor is disconnected when switches 1 and 2 are turned off.	
	Selection of CAN2 termination resistor	The termination resistor is connected when switches 3 and 4 are turned on.	
		The termination resistor is disconnected when switches 3 and 4 are turned off.	

■ Communication parameter setting

1) Power supply unit (master):

Set Fd-10 (Communication protocol selection) to 5, indicating the PROFINET-to-CANopen gateway mode.

Set Fd-12 (CAN baud rate) to 5. (In this example, Fd-12 is set to 5, so the baud rate is 500 Kbit/s.)

Set Fd-13 (CAN station number) to 1 to set node 1 as the master.

2) Drive unit (slave):

MD810 drive unit:

Set Fd-10 (Communication protocol selection) to 1, indicating the CANopen mode.

Set Fd-12 (CAN baud rate) to 5. (In this example, Fd-12 is set to 5, so the baud rate is 500 Kbit/s. The setting must be consistent between the slave and master.)

Set Fd-13 (CAN station number) to any other value than 1.

3) IS810 drive unit:

Set H0C-45 (Communication protocol selection) to 1, indicating the CANopen mode.

Set H0C-00 (CAN station number) to any value other than 1.

Set H0C-02 (CAN baud rate) to 5. (In this example, H0C-02 is set to 5, so the baud rate is 500 Kbit/s. The setting must be consistent between the slave and master.)

■ Process data transmission configuration

The CANopen transmission parameters related to the IS810 servo drive unit belong to groups 2D and 2E. The following table lists the mappings.

		Group 2D Address		2D Param. Value	Process Data Address			Group 2E Address		2E Param. Value	Process Data Address
OUT	RPDO1	Number of mapping objects	2D-32			INPUT	TPDO1	Number of mapping objects	2E-20		
		OUT1	2D-33					INPUT1	2E-21		
			2D-34						2E-22		
		OUT2	2D-35					INPUT2	2E-23		
			2D-36						2E-24		
		OUT3	2D-37					INPUT3	2E-25		
			2D-38						2E-26		
		OUT4	2D-39					INPUT4	2E-27		
			2D-40						2E-28		
	RPDO2	Number of mapping objects	2D-49				TPDO2	Number of mapping objects	2E-37		
		OUT5	2D-50					INPUT5	2E-38		
			2D-51						2E-39		
		OUT6	2D-52					INPUT6	2E-40		
			2D-53						2E-41		
		OUT7	2D-54					INPUT7	2E-42		
			2D-55						2E-43		
		OUT8	2D-56					INPUT8	2E-44		
			2D-57						2E-45		
OUT	RPDO3	Number of mapping objects	2D-66			INPUT	TPDO3	Number of mapping objects	2E-54		
		OUT9	2D-67					INPUT9	2E-55		
			2D-68						2E-56		
		OUT10	2D-69					INPUT10	2E-57		
			2D-70						2E-58		
		OUT11	2D-71					INPUT11	2E-59		
			2D-72						2E-60		
		OUT12	2D-73					INPUT12	2E-61		
			2D-74						2E-62		
	RPDO4	Number of mapping objects	2D-83				TPDO4	Number of mapping objects	2E-71		
		OUT13	2D-84					INPUT13	2E-72		
			2D-85						2E-73		
		OUT14	2D-86					INPUT14	2E-74		
			2D-87						2E-75		
		OUT15	AF-88					INPUT15	2E-76		
			AF-89						2E-77		
		OUT16	AF-90					INPUT16	2E-78		
			AF-91						2E-79		

1) You can configure up to 32-byte RPDO and 32-byte TPDO process data. Each PDO can be configured with process data not exceeding 8 bytes in length.

2) PDOs can be configured with servo parameters and CANopen object dictionaries. The tables in Configuration method 1 and Configuration method 2 below list the mappings.

Parameters (the servo parameters are used as an example, and the same principle applies to the AC drive):

Assume that you want to assign values to servo parameters H11-12 and H11-14 through the PLC. The value of H11-12 consists of 32 bits, and that of H11-14 also consists of 16 bits.

You can plan a configuration method based on the actual number of PDOs to be configured and the data type. Two configuration methods are described as follows.

Configuration method 1:

Method 1	2D Address			Value	Remarks
RPDO1	Mapping quantity	2D32		2	
	OUT1	2D33	H1112	2011	First-segment displacement
		2D34		0D20	32 bits
	OUT2	2D35	H1114	2011	First-segment speed
		2D36		0F10	16 bits
	OUT3	2D37			
		2D38			
	OUT4	2D39			
		2D40			

Configuration method 2:

	2D Address			Value	Remarks
RPDO1	Mapping quantity	2D32		1	
	OUT1	2D33	H1112	2011	First-segment displacement
		2D34		0D20	32 bits
	OUT2	2D35			
		2D36			
	OUT3	2D37			
		2D38			
	OUT4	2D39			
		2D40			
RPDO2	Mapping quantity	2D49		1	
	OUT5	2D50	H1114	2011	First-segment speed
		2D51		0F10	16 bits
	OUT6	2D52			
		2D53			
	OUT7	2D54			
		2D55			
	OUT8	2D56			
		2D57			

Configuration principle:

The setting corresponding to H11-12 is 20110D20.

(a) 20110D20: H11 value + 0x2000 = 0x2011. Enter 2011 in the upper bytes of OUT1.

(b) 20110D20: The parameter number 12 is in decimal format, which is 0C in the hexadecimal format. An offset of 1 is required, becoming 0D.

(c) 20110D20: 32-bit parameters correspond to 20, 16-bit parameters correspond to 10, and 8-bit parameters correspond to 08. For details about the parameter length, see the IS620P Series Servo Drive Application Manual – CANopen Communication (document code: 19010699).

Object dictionary:

You can configure the CANopen object dictionary to the servo.

Assume that you want to read 0x6077-12 from the servo through the PLC. The data type is 16-bit. An offset is not required by object dictionaries. The following table lists the formats.

	2E Address			
TPDO1	Mapping quantity	2E 20	1	
	IPUT1	2E 21	6077	
		2E 22	1210	16 bits
	IPUT2	2E 23		
		2E 24		
	IPUT3	2E 25		
		2E 26		
	IPUT4	2E 27		
		2E 28		

3) You can set no more than four parameters (total length not exceeding 32 bytes) for RPDO1/TPDO1 (RPDO/TPDO2, 3, 4, and so on) as needed. The mapping quantity must be consistent.

The CANopen transmission parameters related to the MD810 drive unit belong to group AF.

Parameters AF-00 to AF-31 belong to RPDO and are transferred from the host controller to the drive.

Parameters AF-32 to AF-63 belong to TPDO and are transferred from the drive to the host controller.

		Group AF Address		AF Param. Value	Process Data Address			Group AF Address		AF Param. Value	Process Data Address
OUT	RPDO1	OUT1	AF-00			INPUT	TPDO1	INPUT1	AF-32		
			AF-01						AF-33		
		OUT2	AF-02					INPUT2	AF-34		
			AF-03						AF-35		
		OUT3	AF-04					INPUT3	AF-36		
			AF-05						AF-37		
		OUT4	AF-06					INPUT4	AF-38		
			AF-07						AF-39		
	RPDO2	OUT5	AF-08				TPDO2	INPUT5	AF-40		
			AF-09						AF-41		
		OUT6	AF-10					INPUT6	AF-42		
			AF-11						AF-43		
		OUT7	AF-12					INPUT7	AF-44		
			AF-13						AF-45		
		OUT8	AF-14					INPUT8	AF-46		
			AF-15						AF-47		
	RPDO3	OUT9	AF-16				TPDO3	INPUT9	AF-48		
			AF-17						AF-49		
		OUT10	AF-18					INPUT10	AF-50		
			AF-19						AF-51		
		OUT11	AF-20					INPUT11	AF-52		
			AF-21						AF-53		
		OUT12	AF-22					INPUT12	AF-54		
			AF-23						AF-55		
	RPDO4	OUT13	AF-24				TPDO4	INPUT13	AF-56		
			AF-25						AF-57		
		OUT14	AF-26					INPUT14	AF-58		
			AF-27						AF-59		
		OUT15	AF-28					INPUT15	AF-60		
			AF-29						AF-61		
		OUT16	AF-30					INPUT16	AF-62		
			AF-31						AF-63		

4) You can configure up to 32-byte RPDO and 32-byte TPDO process data. Each PDO can be configured with process data not exceeding 8 bytes in length.

5) PDOs can be configured with AC drive parameters and CANopen object dictionaries.

Parameters (AC drive parameters are used as an example):

Assume that you want to assign values to AC drive parameters F0-01 and F0-10 through the PLC. The value of F0-01 consists of 16 bits, and that of F0-10 also consists of 16 bits.

You can plan a configuration method based on the actual number of PDOs to be configured and the data type. The configuration method is described as follows.

Method 1	Group AF Address			Value	
RPDO1	OUT1	AF-00	F0-01	20F0	First-segment displacement
		AF-01		0210	16 bits
	OUT2	AF-02	F0-10	20F0	First-segment speed
		AF-03		0B10	16 bits
	OUT3	AF-04			
		AF-05			
	OUT4	AF-06			
		AF-07			

Configuration principle (F0-10 is used as an example):

The setting corresponding to F0-10 is 20F00B10.

(a) 20F00B10: F0 value + 0x2000 = 0x20F0. Enter 20F0 in the AF-00 (upper bytes of OUT1).

(b) 20F00B10: The parameter number 10 is in the decimal format, which is 0A in the hexadecimal format. An offset of 1 is required, becoming 0B.

(c) 20F00B10: 32-bit parameters correspond to 20, 16-bit parameters correspond to 10, and 8-bit parameters correspond to 08. The AC drive parameter values are 16 bits in length, corresponding to 10.

Object dictionary:

You can configure the CANopen object dictionary to the AC drive.

Assume that you want to write 0x2073-12 to the AC drive through the PLC. The data type is 16-bit. An offset is not required by object dictionaries. The following table lists the formats.

	Group AF Address		Value	Data Length
RPDO1	OUT1	AF-00	2073	
		AF-01	1210	16 bits
	OUT2	AF-02		
		AF-03		
	OUT3	AF-04		
		AF-05		
	OUT4	AF-06		
		AF-07		

6) You can set no more than four parameters (total length not exceeding 32 bytes) for RPDO1/TPDO1 (RPDO/TPDO2, 3, 4, and so on) as needed. The mapping quantity must be consistent.

7) After servo configuration is complete, perform PLC configuration by following "2 PLC configuration". The servo configuration and PLC configuration must be consistent; otherwise, the drive may generate the E16.75 alarm.

The following table lists common alarms.

Fault Code	Fault Description and Solution
E16.71	PROFINET is disconnected. Reconnect the network.
E16.72	A CANopen slave is disconnected. Identify the disconnected slave, check the wiring, and reconnect to the network.
E16.74	The configured CANopen slave is missing. Check whether the CANopen node number matches and whether the device configuration of the PLC is correct.
E16.75	The process data configuration of some CANopen slaves is inconsistent with that of the PLC. Check the configuration of the PLC and that of the servo or AC drive and ensure that the data length is consistent between the PLC and the servo or AC drive.
E16.76	The process data configuration of the power supply unit is inconsistent with that of the PLC. Check the configuration of the PLC and that of the servo or AC drive and ensure that the data length is consistent between the PLC and the servo or AC drive.

Fault Code	Fault Description and Solution
E16.77	The PROFINET function of the power supply unit is faulty. Set Fd-10 to 5 and power on the power supply unit again.
E16.78	The PROFINET function of the power supply unit is faulty. Set Fd-10 to 5 and power on the power supply unit again.
A16.13	The master-slave communication is abnormal. Check whether the wiring is correct, whether the DIP switch of the MD810 power supply unit is set correctly, and whether the end drive unit is connected to a termination resistor. (You can rectify the fault temporarily by reducing the baud rate, but you still need to add a termination resistor.)

2 PLC configuration

On the PLC, install the GSD file and complete project configuration, network configuration, hardware configuration, and monitoring configuration.

■ Basic configuration

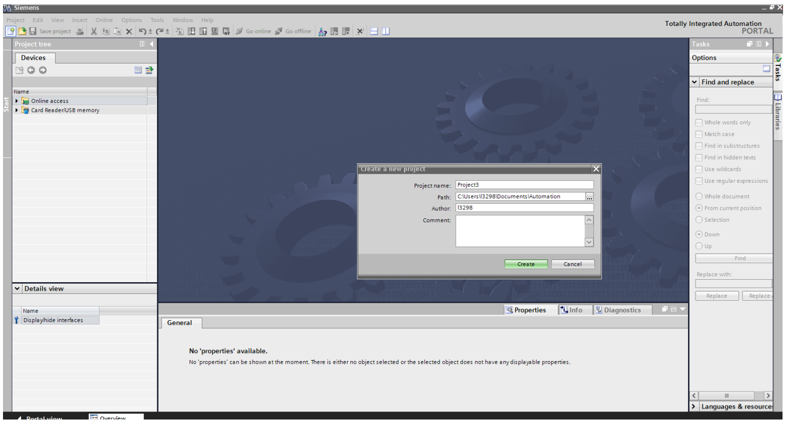
1) Hardware configuration: Inovance's MD810 power supply unit with the gateway (MD81020M4T22G120), Inovance's IS810P-CO (IS810P50M4T005CO), and Siemens' PROFINET bus PLC

2) Software: Siemens TIA Portal V14 and Inovance's servo commissioning software (manual input is supported)

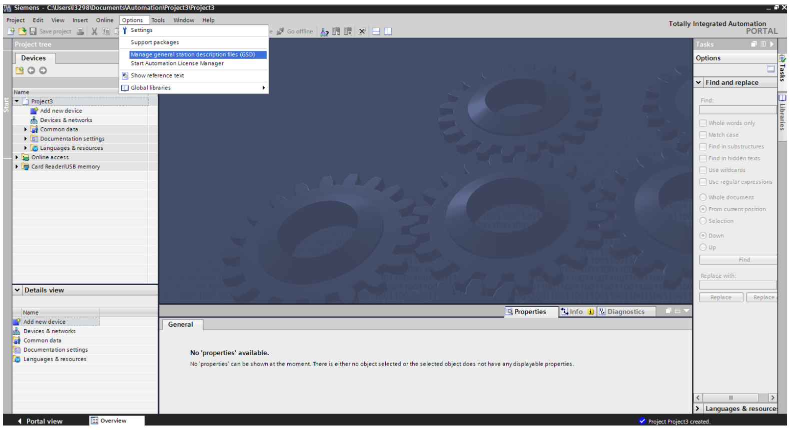
■ GSD file configuration

1) Start TIA Portal. TIA Portal V14 is used as an example. You can select a version as needed.

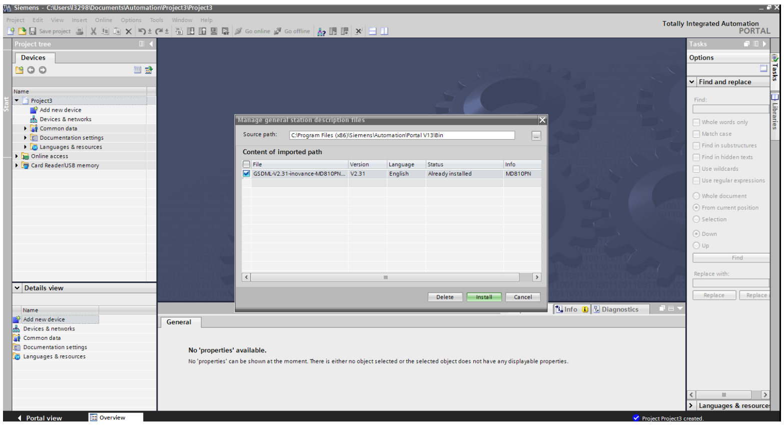
2) Create a project.



3) Install the GSD file.

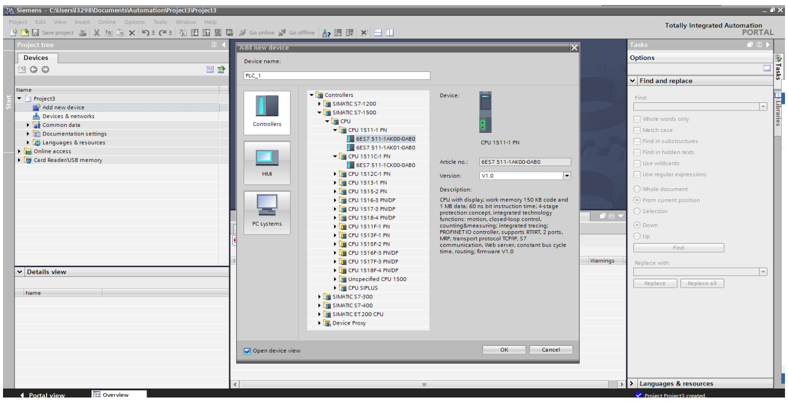


4) Select and install the matched GSD file. A prompt is displayed if the GSD file is not installed.

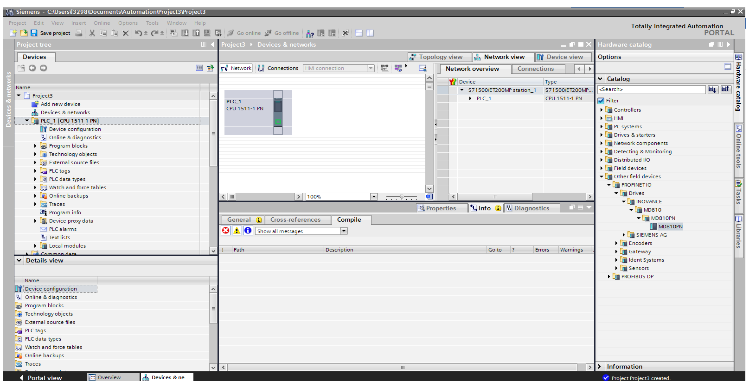


■ Project configuration

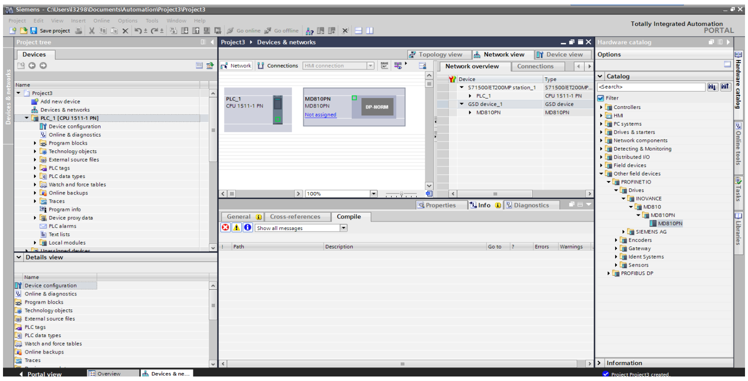
1) Add a new device. Add a PLC based on the actual situation.



2) Configure a slave. The following figure shows the master after a slave is added. Add the slave MD810PN on the right.

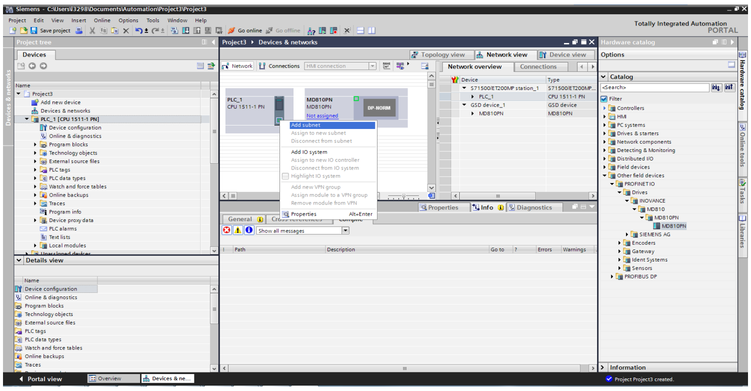


3) Configure the slave, as shown in the following figure.

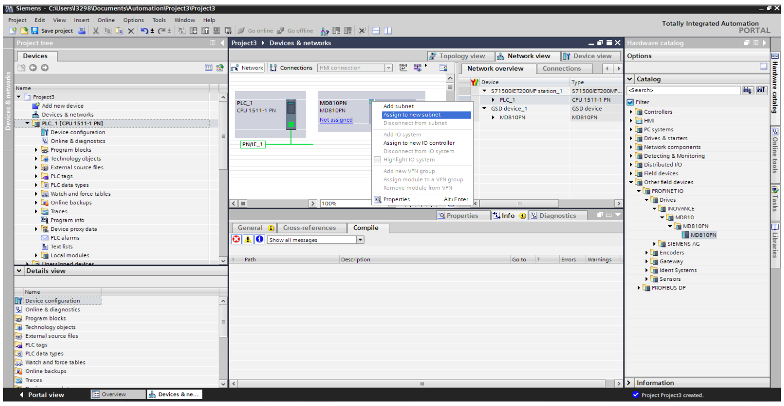


■ Network configuration

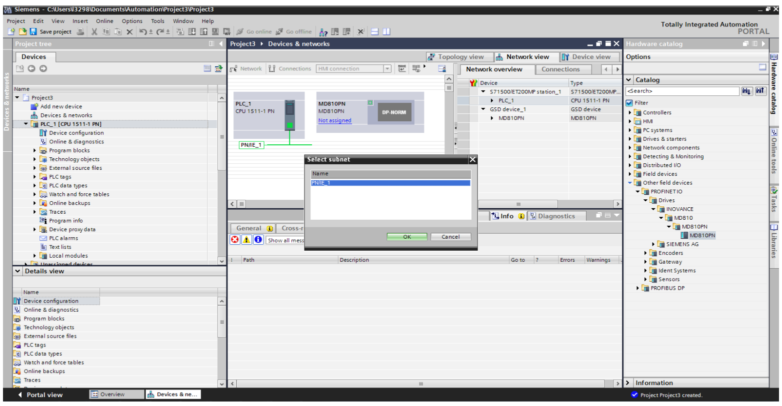
1) Add a subnet to the master.



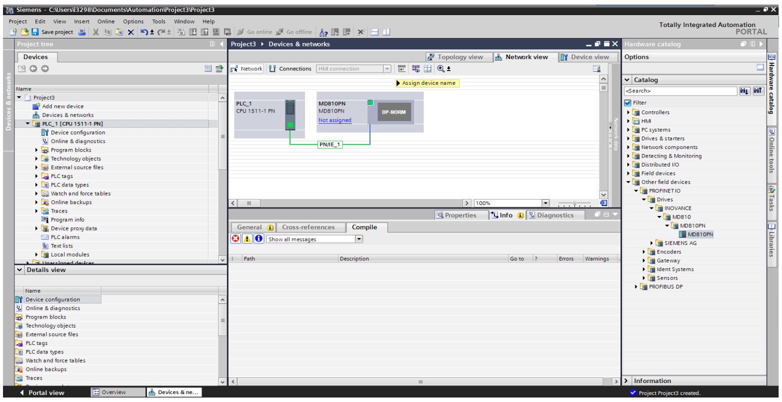
2) Allocate the slave to the subnet.



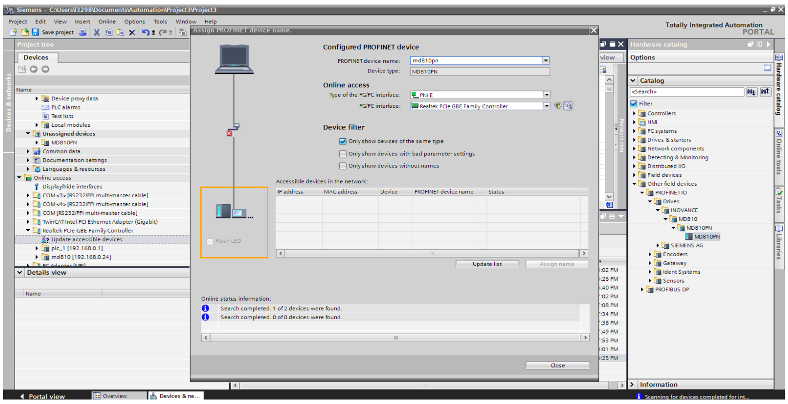
3) Select the subnet.



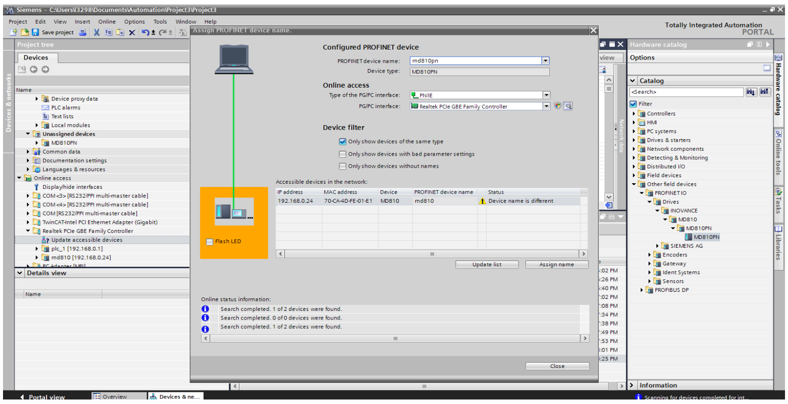
4) The following figure shows the added network. Click PN/IE_1, select Assign device name, and allocate a name to the slave.



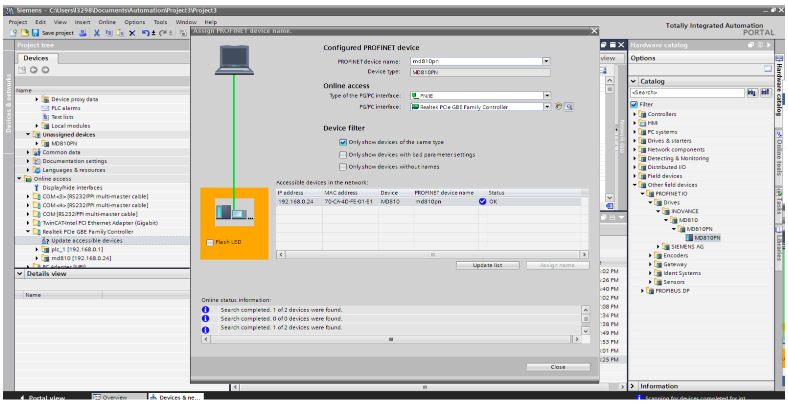
5) Connect the device correctly, allocate a device interface, and click Update list.



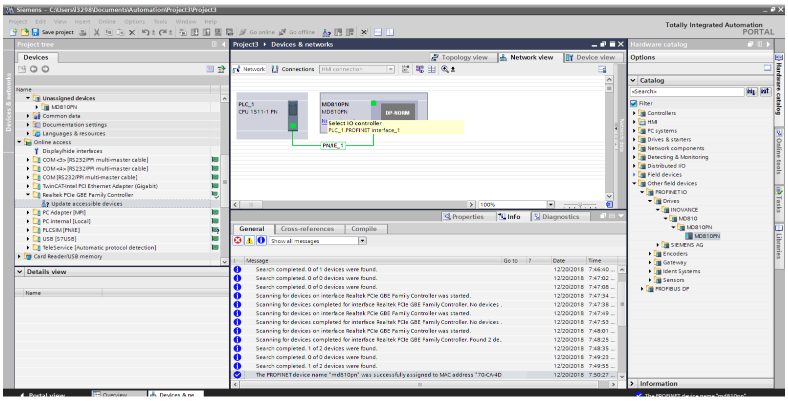
6) Allocate a name to the slave.



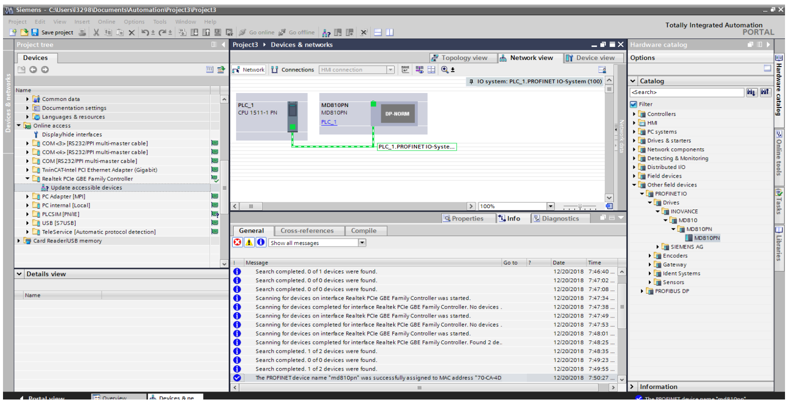
7) See the following figure.



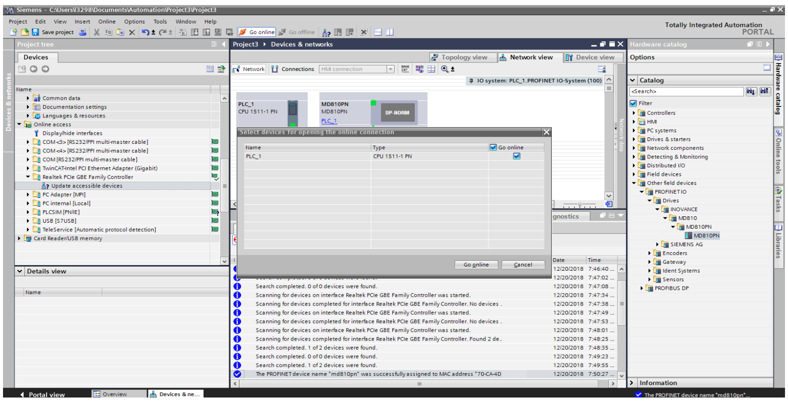
8) Select an interface.



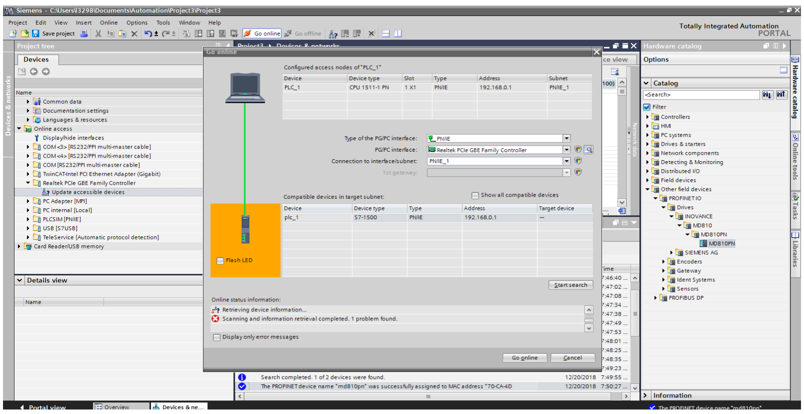
9) The following figure shows the correct connection.



10) Switch to online mode.



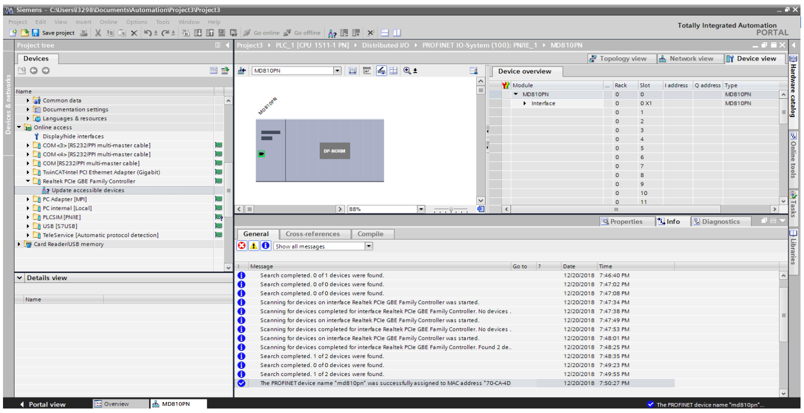
11) Select the device during initial connection.



■ Hardware configuration

1) Double-click the added MD810 device configuration to perform hardware configuration on the MD810 power supply unit and the attached drive unit. Edit the configuration in the Device overview

tab.

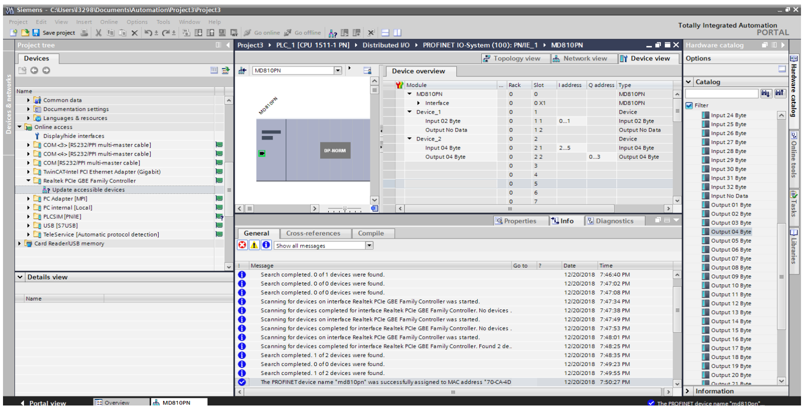


2) Perform configuration based on the PDO settings of the MD810 power supply unit and the attached drive unit. You can only set the number of bytes on the PLC and ensure that the set number is consistent with the number of bytes occupied by the PDOs of the drive; otherwise, an alarm indicating hardware mismatch is generated and the drive generates the E16.75 alarm. For example, if the drive TPDO is configured with a 32-bit PDO and a 16-bit PDO, add 6-byte input to the PLC and add output of the same number of bytes to RPDO.

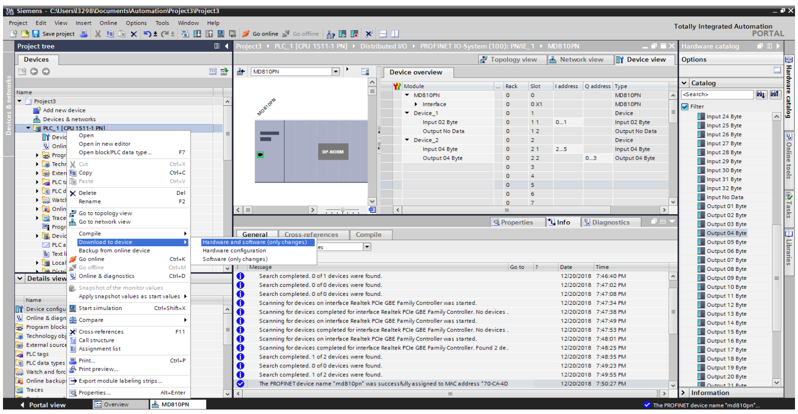
Brief description:

In the following figure, Device_1 is the power supply unit configured with a 2-byte input data.

Device_2 is the drive unit configured with a 12-byte input data and an 18-byte output data.

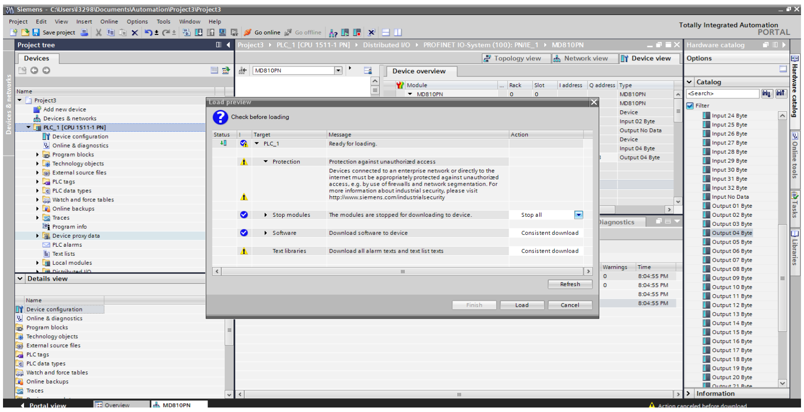


3) Download the configuration to the PLC. After the hardware configuration in step 2 is modified, download the configuration to the PLC again. If only the hardware configuration is modified, you can download only the hardware configuration.



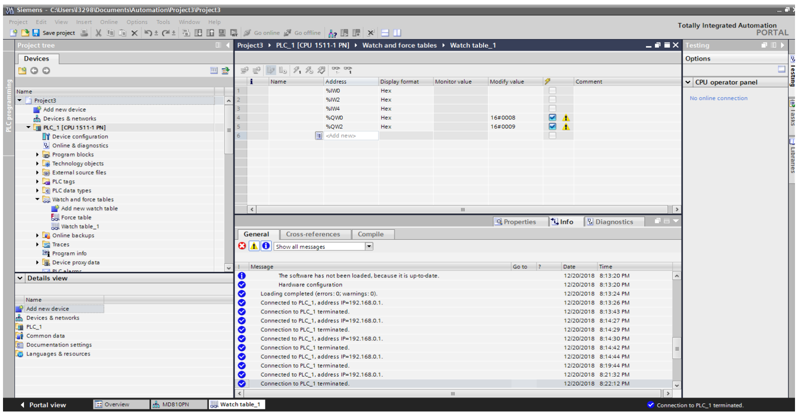
4) Download step 1: Click Load to download the configuration to the PLC. Then, the PLC stops running.

5) Download step 2: Click Finish after the download is complete. The PLC restarts.

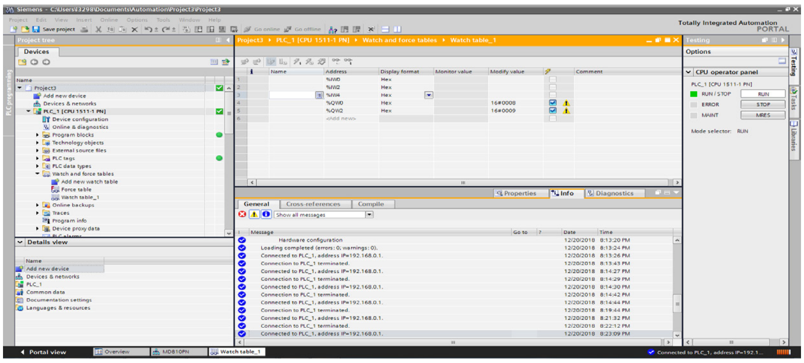


■ Adding the online monitoring list

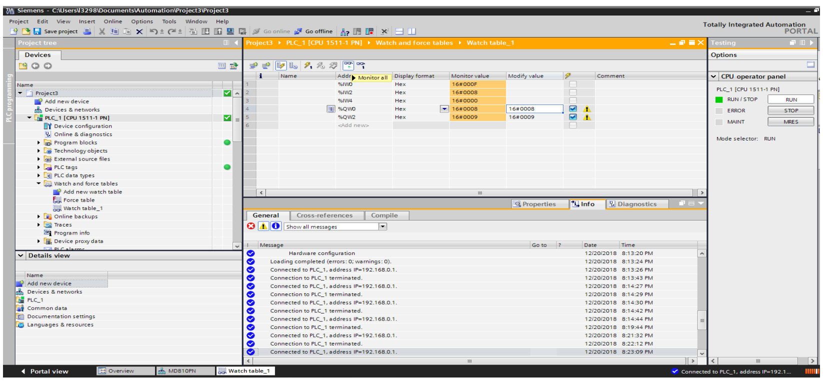
1) Add the monitoring list and add motoring items based on the variables to be monitored.



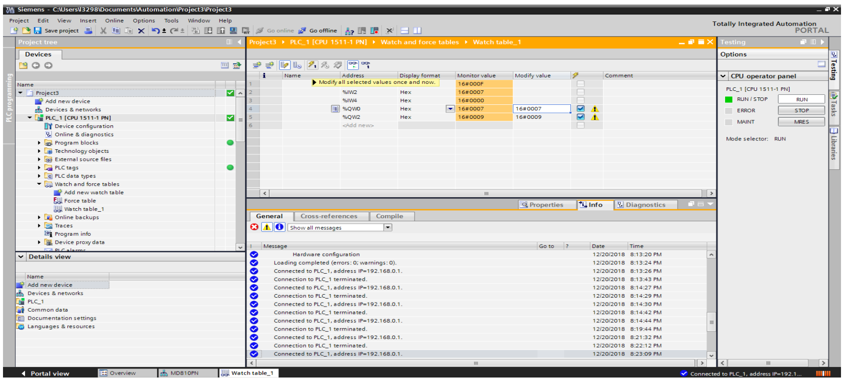
2) Switch to online mode.



3) Click Monitor all.



4) Modify values.



The configuration of the drive must be consistent with that of the PLC; otherwise, an alarm will be generated.

The following table lists common alarms.

Fault Code	Fault Description and Solution
E16.71	PROFINET is disconnected. Reconnect the network.
E16.72	A CANopen slave is disconnected. Identify the disconnected slave, check the wiring, and reconnect to the network.
E16.74	The configured CANopen slave is missing. Check whether the CANopen node number matches and whether the device configuration of the PLC is correct.
E16.75	The process data configuration of some CANopen slaves is inconsistent with that of the PLC. Check the configuration of the PLC and that of the servo or AC drive and ensure that the data length is consistent between the PLC and the servo or AC drive.
E16.76	The process data configuration of the power supply unit is inconsistent with that of the PLC. Check the configuration of the PLC and that of the servo or AC drive and ensure that the data length is consistent between the PLC and the servo or AC drive.
E16.77	The PROFINET function of the power supply unit is faulty. Set Fd-10 to 5 and power on the power supply unit again.
E16.78	The PROFINET function of the power supply unit is faulty. Set Fd-10 to 5 and power on the power supply unit again.
A16.13	The master-slave communication is abnormal. Check whether the wiring is correct, whether the DIP switch of the MD810 power supply unit is set correctly, and whether the end drive unit is connected to a termination resistor. (You can rectify the fault temporarily by reducing the baud rate, but you still need to add a termination resistor.)

B.8 Positioning Commanded Through Communication

B.8.1 Communication Control

Set F0-02 (Command source selection) to 2 (Communication control) to enable communication control. The communication address is as follows.

1) Control word

The control word address 0x7311 is as follows.

Command	Definition
0	Stop
1	Start positioning
3	Forward jog
4	Reverse jog
5	Coast to stop
7	Fault reset

2) Control word for position control

The control word address 0x731E is as follows.

Command	Definition
0	Position control disabled
1	Position control enabled
3	Position control pause enabled (B4-57 = 1)
5	Re-positioning enabled (B4-59 = 1)

3) Communication parameter address

When B4-50 is set to 4 and B5-12 is set to 3, the communication position and speed command addresses are as follows.

Speed Command Address	Definition
0x7320	Postioning speed upper limit (r/min)
0x7321	High 16 bits of position command
0x7322	Low 16 bits of position command
0x0800 (eeprom written for 0xF800)	Jog frequency (0.01 Hz)

4) Addresses of status reading parameters in group U2

To enable the forward jog and reverse jog at the same time, cancel the jog command and insert a stop command (0 written for 0x7311) between the forward jog and reverse jog commands.

B.8.2 Other Parameter Addresses

Parameter Name	Parameter Address (Hexadecimal)	Parameter Address (Decimal)	Parameter Description
Frequency reference	0x7310	29456	Two decimal places. For example, if a decimal value 1000 is written, the frequency reference is 10.00 Hz. Note: The frequency reference and speed reference (0x7317) cannot be used at the same time.
Running state 1	0x703D	28733	1: Forward 2: Reverse 3: Stopped 4: Motor auto-tuning 5: Faulty
Running state 2	0x7044	28740	
Output frequency	0x7000	28672	Two decimal places. For example, if a decimal value 1000 is read, the output frequency is 10.00 Hz.
Encoder feedback frequency	0x701d	28701	Two decimal places. For example, if a decimal value 1000 is read, the encoder feedback frequency is 10.00 Hz. This parameter is a signed value.
Speed reference	0x7317	29463	The unit is 1 rpm. Note that the speed reference and frequency reference (0x7310) cannot be used at the same time.
Output current	0x7004	28676	One decimal place. For example, if a decimal value 100 is read, the output current is 10.0 A.
Output voltage	0x7003	28675	0 decimal places. For example, if a decimal value 100 is read, the output voltage is 100 V.
Bus voltage	0x7002	28674	One decimal plage. For example, if a decimal value 5680 is read, the bus voltage is 568.0 V.
DI state	0x7007	28679	See the description below.

Parameter Name	Parameter Address (Hexadecimal)	Parameter Address (Decimal)	Parameter Description
DO control	0x7312	29458	See the description below.
AO1	0x7313	29459	0 to 7FFF indicates 0% to 100% .
Pulse output	0x7315	29461	0 to 7FFF indicates 0% to 100% . The maximum fequency must be set by F5-09 (Maximum FMP output frequency).

DI State (0X7007)															
Bit15	Bit14	Bit13	Bit12	Bit10	Bit09	Bit09	Bit08	Bit07	Bit06	Bit05	Bit04	Bit03	Bit02	Bit01	Bit00
0	0	0	0	0	0	0	0	0	0	0	DIO2	DIO1	DI3	DI2	DI1

For example, a hexadecimal value 0x0008 is read for the DI state, which is converted to a binary value 0000_0000_0000_1001, that is, DIO1. In this case, the DI1 input is valid.

DO Settings (0X7312)															
Bit15	Bit14	Bit13	Bit12	Bit10	Bit09	Bit09	Bit08	Bit07	Bit06	Bit05	Bit04	Bit03	Bit02	Bit01	Bit00
0	0	0	0	0	0	0	0	0	0	0	FMR control	Reserved	RELAY1 control	DIO2 output control	DIO1 output control

Running State 2 (0x7044)															
Bit15	Bit14	Bit13	Bit12	Bit10	Bit09	Bit09	Bit08	Bit07	Bit06	Bit05	Bit04	Bit03	Bit02	Bit01	Bit00
Fault codec								Reserved	Reserved	Reserved	Reserved	Frequency reached	Faulty	Forward/ Reverse running	Running state

Bit00: 1 → Run; 0 → Stop

Bit01: 1 → Reverse running; 0 → Forward running

Bit02: 1 → Faulty; 0 → Normal

Bit03: 1 → Output frequency reaching the set frequency; 0 → Output freuqnecy not reaching the set frequency

Bit04: Reserved bit, the value of which is read as 1

Appendix C Parameter Table of the Drive Unit

Set a non-zero value for FP-00 (User password) to enable password protection for viewing and modifying parameters. To disable password protection, set FP-00 to zero.

The password protection only applies to the operation using the operating panel. Enter the password to view and modify the parameters. Viewing or modifying the parameters (groups FP and FF exclusive) through communication is not protected by the password.

The user-defined parameters are not protected by the password.

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

The parameter description tables in this chapter use the following symbols.

The symbols in the parameter table are described as follows:

Symbol	Meaning
☆	It is possible to modify the parameter with the AC drive in the Stop and in the Run status.
★	It is not possible to modify the parameter with the AC drive in the Run status.
●	The parameter is the actual measured value and cannot be modified.
*	The parameter is a factory parameter and can be set only by the manufacturer.

C.1 Basic Function Parameters

Para. No.	Para. Name	Setting Range	Default	Property
Group F0: Basic Functions				
F0-00	G/P type display	1: G type (constant-torque load)	Model dependent	●
F0-01	1st motor control mode	0: Sensorless vector control (SVC) 1: Feedback vector control (FVC) 2: Voltage/Frequency control (V/F control)	0	★
F0-02	Command source selection	0: External LCD panel/Commissioning software 1: Terminal I/O control 2: Communication control	0	★
F0-03	Main frequency source X selection	0: Digital setting (initial value F0-08 can be modified by terminal UP/DOWN, non-retentive at power failure) 1: Digital setting (initial value F0-08 can be modified by terminal UP/DOWN, retentive at power failure) 2: AI1 3: AI2 4: (Reserved) 5: Pulse reference (DIO1) 6: Multi-reference 7: Simple PLC 8: PID 9: Communication setting 10: Synchronization control	0	★
F0-04	Auxiliary frequency source Y selection	Same as F0-03 (Main frequency source X selection)	0	★
F0-05	Base value of range of auxiliary frequency source Y for main and auxiliary calculation	0: Maximum frequency 1: Main frequency reference X	0	☆
F0-06	Range of auxiliary frequency source Y for main and auxiliary calculation	0% to 150%	100%	☆

Para. No.	Para. Name	Setting Range	Default	Property
F0-07	Final frequency reference setting selection	Ones position: Frequency source selection 0: Main frequency reference X 1: Main and auxiliary calculation result (based on tens position) 2: Switchover between main frequency reference X and auxiliary frequency reference Y 3: Switchover between main frequency reference X and main and auxiliary calculation result 4: Switchover between auxiliary frequency reference Y and main and auxiliary calculation result Tens position: Main and auxiliary calculation relationship 0: Main + auxiliary 1: Main - auxiliary 2: Max. (main, auxiliary) 3: Min. (main, auxiliary) 4: Main x Auxiliary	0	☆
F0-08	Preset frequency	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	☆
F0-09	Running direction	0: Run in the same direction 1: Run in the reverse direction	0	☆
F0-10	Maximum frequency	5.00 to 600.00 Hz	50.00 Hz	★
F0-11	Setting channel of frequency reference upper limit	0: Set by F0-12 (Frequency reference upper limit) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting 6: Multi-reference	0	★
F0-12	Frequency reference upper limit	F0-14 (Frequency reference lower limit) to F0-10 (Maximum frequency)	50.00 Hz	☆
F0-13	Frequency reference upper limit offset	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F0-14	Frequency reference lower limit	0.00 Hz to F0-12 (Frequency reference upper limit)	0.00 Hz	☆
F0-15	Carrier frequency	0.8 to 6.0 kHz	Model dependent	☆
F0-16	Carrier frequency adjusted with temperature	0: Disabled 1: Enabled	1	☆
F0-17	Acceleration time 1	0.00s to 65000s	20.0s	☆
F0-18	Deceleration time 1	0.00s to 65000s	20.0s	☆
F0-19	Acceleration/Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s		★
F0-21	Frequency offset of auxiliary frequency setting channel for main and auxiliary calculation	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F0-22	Frequency reference resolution	1: 0.1 Hz 2: 0.01 Hz	2	★
F0-23	Retentive of digital setting frequency upon stop	0: Disabled 1: Enabled	0	☆
F0-25	Acceleration/Deceleration time base frequency	0: F0-10 (Maximum frequency) 1: Frequency reference 2: 100 Hz	0	★
F0-26	Base frequency for UP/DOWN modification during running	0: Running frequency 1: Frequency reference	0	★
F0-27	Main frequency reference coefficient	0.00% to 100.00%	10.00%	☆
F0-28	Auxiliary frequency coefficient	0.00% to 100.00%	10.00%	☆

Para. No.	Para. Name	Setting Range	Default	Property
Group F1: 1st Motor Parameters				
F1-00	Motor type selection	0: Common asynchronous motor 1: Variable frequency asynchronous motor 2: Synchronous motor	0	★
F1-01	Rated motor power	0.1 to 1000.0 kW	Model dependent	★
F1-02	Rated motor voltage	1 to 2000 V	Model dependent	★
F1-03	Rated motor current	0.01 A to 655.35 A (drive power ⩽ 55 kW) 0.1 A to 6553.5 A (drive power > 55 kW)	Model dependent	★
F1-04	Rated motor frequency	0.01 Hz to maximum frequency (F0-10)	Model dependent	★
F1-05	Rated motor rotation speed	1 RPM to 65535 RPM	Model dependent	★
F1-06	Asynchronous/Synchronous motor stator resistance	0.001 Ω to 65.535 Ω (drive power ⩽ 55 kW) 0.0001 Ω to 6.5535 Ω (drive power > 55 kW)	Auto-tuned	★
F1-07	Asynchronous motor rotor resistance	0.001 Ω to 65.535 Ω (drive power ⩽ 55 kW) 0.0001 Ω to 6.5535 Ω (drive power > 55 kW)	Auto-tuned	★
F1-08	Asynchronous motor leakage inductive reactance	0.01 mH to 655.35 mH (drive power ⩽ 55 kW) 0.001 mH to 65.535 mH (drive power > 55 kW)	Auto-tuned	★
F1-09	Asynchronous motor mutual inductive reactance	0.1 mH to 6553.5 mH (drive power ⩽ 55 kW) 0.01 mH to 655.35 mH (drive power > 55 kW)	Auto-tuned	★
F1-10	Asynchronous motor no-load current	0.01 A to F1-03 (Rated motor current) (drive power ⩽ 55 kW) 0.1 A to F1-03 (Rated motor current) (drive power > 55 kW)	Auto-tuned	★
F1-11	Asynchronous motor iron-core saturation coefficient 1	50.0% to 100.0%	86.0%	☆
F1-12	Asynchronous motor iron-core saturation coefficient 2	100.0% to 150.0%	130.0%	☆
F1-13	Asynchronous motor iron-core saturation coefficient 3	100.0% to 170.0%	140.0%	☆
F1-14	Asynchronous motor iron-core saturation coefficient 4	100.0% to 180.0%	150.0%	☆
F1-15	PG2 encoder mode	0: Pulse input 1: Encoder speed feedback Note: This parameter is valid only for the G5xx series models.	1	★
F1-17	Synchronous motor axis D inductance	0.01 mH to 655.35 mH (drive power ⩽ 55 kW) 0.001 mH to 65.535 mH (drive power > 55 kW)	Auto-tuned	★
F1-18	Synchronous motor axis Q inductance	0.01 mH to 655.35 mH (drive power ⩽ 55 kW) 0.001 mH to 65.535 mH (drive power > 55 kW)	Auto-tuned	★
F1-19	Synchronous motor back EMF	0.1 V to 6553.5 V	Auto-tuned	★
F1-20	Frequency-division signal source (Note: This parameter is valid only for the G5xx series models.)	0: ABZ1 1: ABZ2 2: 23-bit encoder 3:Sin-cos encoder 4:SSI encoder Note: This parameter is valid only for the G5xx series models.	0	★
F1-21	Sin-cos encoder wave quantity per resolution	1 to 65535 Note: This parameter is valid only for the G5xx series models.	100	★
F1-22	PG2 encoder pulses per revolution	1 to 20000 Note: This parameter is valid only for the G5xx series models.	1024	★
F1-23	PG2 encoder type	0: ABZ incremental encoder 1: 23-bit encoder 2: Sin-cos encoder 3: SSI encoder 4–5: Reserved Note: This parameter is valid only for the G5xx series models.	0.00%	★

Para. No.	Para. Name	Setting Range	Default	Property
F1-24	Encoder feedback speed (U0-29) display filtering	0 to 65535 ms	0	☆
F1-25	Encoder power supply selection	0: 15 V power supply 1: 5 V power supply Note: Applied for dual-axis models only.	1	★
F1-26	Auto-tuning direction (inertia and synchronous motor auto-tuning)	0 to 1	1	★
F1-27	Encoder pulses per revolution	1 to 20000	1024	★
F1-28	Encoder type	0: ABZ incremental encoder 1: 23-bit encoder 2: Resolver	0	★
F1-29	PG signal filter	0: Non-adaptive filter 1: Adaptive filter 2: Fixed interlock 3: Automatic interlock	1	★
F1-30	Encoder wiring flag	Ones position: AB signal direction or rotation direction Tens position: Reserved	0	★
F1-31	Encoder zero position angle	0.0 to 359.9°	0.0°	★
F1-32	Motor gear ratio (numerator)	1 to 65535	1	★
F1-33	Motor gear ratio (denominator)	1 to 65535	1	★
F1-34	Number of pole pairs of resolver	1 to 32	1	★
F1-35	Resolver frequency-division coefficient/ABZ encoder frequency-division coefficient (G5xx series)	0 to 63	1	☆
F1-36	PG card wire-breaking detection	0: Disabled 1: Enabled	0	★
F1-37	Auto-tuning selection	0: No operation 1: Asynchronous motor static auto-tuning 2: Asynchronous motor complete auto-tuning 3: Asynchronous motor static complete auto-tuning 4: Asynchronous motor inertia auto-tuning (only FVC) 11: Synchronous motor no-load partial auto-tuning (back EMF exclusive) 12: Synchronous motor dynamic no-load auto-tuning 13: Synchronous motor static complete auto-tuning 14: Synchronous motor inertia auto-tuning (only FVC)	0	★
F1-38	SSI encoder baud rate	0: 2 Mbps 1: 1 Mbps 2: 500 Kbps 3: 250 Kbps Note: This parameter is valid only for the G5xx series models.	1	★
F1-39	SSI encoder single-turn bits	1 to 255 Note: This parameter is valid only for the G5xx series models.	12	★
F1-40	SSI encoder multi-turn bits	1 to 255 Note: This parameter is valid only for the G5xx series models.	12	★
F1-41	SSI encoder data format	0: Binary 1: Gray code Note: This parameter is valid only for the G5xx series models.	0	★
F1-42	PG1 singal filter	0: Non-adaptive filter 1: Self-adaptive filter 2: Fixed interlock 3: Automatic interlock Note: This parameter is valid only for the G5xx series models.	1	★

Para. No.	Para. Name	Setting Range	Default	Property
F1-43	PG2 singal filter	0: Non-adaptive filter 1: Self-adaptive filter 2: Fixed interlock 3: Automatic interlock Note: This parameter is valid only for the G5xx series models.	1	★
F1-44	SSI encoder error bits	0 to 255 Note: This parameter is valid only for the G5xx series models.	3	★
F1-45	SSI encoder fully closed loop	0: Single closed loop 1: Fully closed loop Note: This parameter is valid only for the G5xx series models.	0	★
F1-46	Absolute encoder frequency-division coefficient	0 to 65536 Note: This parameter is valid only for the G5xx series models.	1024	★
F1-47	SSI encoder type	0: Common SSI 1: Laser ranging SSI Note: This parameter is valid only for the G5xx series models.	0	★
Group F2: 1st Motor Vector Control Parameters				
F2-00	Speed loop proportional gain Kp at low speed	1 to 200	Asynchronous motor: 30 Synchronous motor: 20	☆
F2-01	Speed loop integral time Ti at low speed	0.001s to 10.000s	0.500s	☆
F2-02	Switchover frequency 1	0.00 to F2-05 (Switchover frequency 2)	5.00 Hz	☆
F2-03	Speed loop proportional gain Kp at high speed	1 to 200	20	☆
F2-04	Speed loop integral time Ti at high speed	0.001s to 10.000s	1.000s	☆
F2-05	Switchover frequency 2	F2-02 (Switchover frequency 1) to F0-10 (Maximum frequency)	10.00 Hz	☆
F2-06	SVC/FVC slip compensation gain	50% to 200%	100%	☆
F2-07	Speed feedback filter time	0.000s to 0.100s	0.004s	☆
F2-08	SVC/FVC deceleration over-excitation gain	0 to 200	64	☆
F2-09	Torque limit source in speed control (motoring)	0: Digital setting (F2-10) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 100% of the values 1 to 7 corresponding to F2-10	0	☆
F2-10	Digital setting of torque limit in speed control (motoring)	0.0% to 200.0%	150.0%	☆
F2-11	Torque limit source in speed control (generating)	0: Digital setting (F2-10) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 8: Digital setting (F2-12)	0	☆
F2-12	Digital setting of torque limit in speed control (generating)	0.0% to 200.0%	150.0%	☆
F2-13	Current loop proportional gain Kp at low speed	0.1 to 10.0	1.0	☆

Para. No.	Para. Name	Setting Range	Default	Property
F2-14	Current loop integral gain Ki at low speed	0.1 to 10.0	1.0	☆
F2-15	Current loop proportional gain Kp at high speed	0.1 to 10.0	1.0	☆
F2-16	Current loop integral gain Ki at high speed	0.1 to 10.0	1.0	☆
F2-17	Speed loop proportional gain Kp at zero speed lock	1 to 100	30	☆
F2-18	Speed loop integral time Ti at zero speed lock	0.001s to 10.000s	0.500s	☆
F2-20	Speed loop switchover frequency at zero speed lock	0.00 to F2-02 (Switchover frequency 1)	0.05Hz	☆
F2-21	Maximum output voltage coefficient	100 to 110	100	☆
F2-22	Output voltage filter time	0.000 to 0.010s	0.000s	☆
F2-23	Zero speed lock	0: Disabled 1: Enabled	0	★
F2-24	SVC/FVC overvoltage suppression coefficient KP	0 to 1000	40	☆
F2-25	Acceleration rate compensation gain	0 to 200	0	☆
F2-26	Acceleration rate compensation filtering time	0 to 500	10	☆
F2-27	SVC/FVC overvoltage suppression function	0: Disabled 1: Enabled	1	☆
F2-28	Cut-off frequency of torque filter	50 Hz to 1000 Hz	500 Hz	☆
F2-29	Synchronous motor initial position angle detection current	50% to 180%	80%	☆
F2-30	Speed loop parameter auto-calculation	0: Disabled 1: Enabled	0	★
F2-31	Expected speed loop bandwidth at high speed	1.0 to 200.0 Hz	10.0 Hz	☆
F2-32	Expected speed loop bandwidth at low speed	1.0 Hz to 200.0 Hz	10.0 Hz	☆
F2-33	Expected speed loop bandwidth at zero speed	1.0 Hz to 200.0 Hz	10.0 Hz	☆
F2-34	Expected speed loop damping ratio (unchanged generally)	0.100 to 65.000	1.000	☆
F2-35	System inertia (equivalent to startup time, unit: s)	0.001 to 50.000s	Model dependent	★
F2-36	Single motor inertia (kg*m^2)	0.001 to 50.000	Model dependent	★
F2-43	Inertia auto-tuning and dynamic speed reference	0% to 100%	30%	★
F2-47	Inertia auto-tuning	0: Disabled 1: Enabled	0	★
F2-48	Speed loop bandwidth setting value in inertia auto-tuning	0.1 Hz to 100.0 Hz	10.0 Hz	★
F2-50	Inertia auto-tuning mode	0: Acceleration/Deceleration mode 1: Triangular wave mode	0	★
F2-51	Inertia auto-tuning acceleration/ deceleration coefficient (unit: 0.1)	0.1 to 10.0	1.0	★
F2-52	Decoupling control	0 to 1	0	★
F2-53	Generating power limit function	0: Disabled 1: Enabled	0	★
F2-54	Generating power limit value	0.0 to 200.0%	Model dependent	★

Para. No.	Para. Name	Setting Range	Default	Property
Group F3: V/F Control Parameters				
F3-00	V/F curve setting	0: Linear V/F 1: Multi-point V/F 2: Square V/F 3: 1.2-power V/F 4: 1.4-power V/F 6: 1.6-power V/F 8: 1.8-power V/F 9: Reserved 10: V/F complete separation 11: V/F half separation	0	★
F3-01	Torque boost	0.0%: (automatic torque boost) 0.1% to 30.0%	Model dependent	☆
F3-02	Cut-off frequency of torque boost	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	★
F3-03	Multi-point V/F frequency 1	0.00 Hz to F3-05 (Multi-point V/F frequency 2)	0.00 Hz	★
F3-04	Multi-point V/F voltage 1	0.0% to 100.0%	0.0%	★
F3-05	Multi-point V/F frequency 2	F3-03 (Multi-point V/F frequency 1) to F3-07 (Multi-point V/F frequency 3)	0.00 Hz	★
F3-06	Multi-point V/F voltage 2	0.0% to 100.0%	0.0%	★
F3-07	Multi-point V/F frequency 3	F3-05 (Multi-point V/F frequency 2) to F1-04 (Rated motor frequency)	0.00 Hz	★
F3-08	Multi-point V/F voltage 3	0.0% to 100.0%	0.0%	★
F3-09	V/F slip compensation gain	0.0% to 200.0%	0.0%	☆
F3-10	V/F over-excitation gain	0 to 200	64	☆
F3-11	V/F oscillation suppression gain	0 to 100	Model dependent	☆
F3-12	Oscillation suppression gain function	0: Disabled 3: Enabled	3	★
F3-13	Voltage source for V/F separation	0: Digital setting (F3-14, Digital setting of voltage for V/F separation) 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Multi-reference	0	☆
F3-14	Digital setting of voltage for V/F separation	0 V to the rated motor voltage	0 V	☆
F3-15	Voltage rise time of V/F separation	0.0s to 1000.0s Note: It sets the time for the output voltage to rise from 0 to the rated motor voltage.	0.0s	☆
F3-16	Voltage decline time of V/F separation	0.0s to 1000.0s Note: It sets the time for the output voltage to rise from 0 to the rated motor voltage.	0.0s	☆
F3-17	Stop mode selection for V/F separation	0: Frequency and voltage declining to 0 independently 1: Frequency declining after voltage declines to 0	0	★
F3-18	Current limit level	50% to 200%	150%	★
F3-19	Current limit selection	0: Disabled 1: Enabled	1	★
F3-20	Current limit gain	0 to 100	20	☆
F3-21	Compensation factor of speed multiplying current limit level	50 to 200	50	★
F3-22	Voltage limit	650.0 V to 800.0 V	770.0 V	★
F3-23	Voltage limit selection	0: Disabled 1: Enabled	1	★
F3-24	Frequency gain for voltage limit	0 to 100	30	☆
F3-25	Voltage gain for voltage limit	0 to 100	30	☆

<table>
<tr><th>Para. No.</th><th>Para. Name</th><th>Setting Range</th><th>Default</th><th>Property</th></tr>
<tr><td>F3-26</td><td>Frequency rise threshold during voltage limit</td><td>0 to 50</td><td>5</td><td>★</td></tr>
<tr><td>F3-27</td><td>Slip compensation time constant</td><td>0.1 to 10.0</td><td>0.5</td><td>☆</td></tr>
<tr><td>F3-28</td><td>Automatic frequency rise function</td><td>0: Disabled
1: Enabled</td><td>0</td><td>★</td></tr>
<tr><td>F3-29</td><td>Minimum motoring torque current</td><td>10 to 100</td><td>50</td><td>★</td></tr>
<tr><td>F3-30</td><td>Maximum generating torque current</td><td>10 to 100</td><td>20</td><td>★</td></tr>
<tr><td>F3-31</td><td>Automatic frequency rise KP</td><td>0 to 100</td><td>50</td><td>☆</td></tr>
<tr><td>F3-32</td><td>Automatic frequency rise KI</td><td>0 to 100</td><td>50</td><td>☆</td></tr>
<tr><td>F3-33</td><td>Online torque compensation gain</td><td>80 to 150</td><td>100</td><td>★</td></tr>
<tr><td colspan="5">Group F4: Input Terminals</td></tr>
<tr><td>F4-00</td><td>DI1 function selection</td><td rowspan="5">0: No function
1: Forward run (FWD)
2: Reverse run (REV)
3: Three-wire control
4: Forward jog (FJOG)
5: Reverse jog (RJOG)
6: Terminal UP
7: Terminal DOWN
8: Coast to stop
9: Fault reset (RESET)
10: Running pause
11: External fault normally open (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: UP and DOWN setting clear (terminal, operating panel)
20: Running command switchover terminal
21: Acceleration/Deceleration inhibited
22: PID pause
23: PLC status reset
24: Wobble pause
25: Counter input (DIO1)
26: Counter reset
27: Length count input (DIO1)
28: Length reset
29: Torque control inhibited
30: Reserved
31: Reserved
32: Immediate DC injection braking
33: External fault normally closed (NC) input
34: Frequency modification enabled
35: Reverse PID operation direction
36: External stop terminal 1
37: Control command switchover terminal 2
38: PID integral disabled
39: Switchover between main frequency reference X and preset frequency reference
40: Switchover between auxiliary frequency reference Y and preset frequency
41: Reserved
42: Position lock enabled
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: Deceleration DC injection braking
50: Clear the current running time
51: Two-wire/Three-wire control switchover
52-53: Reserved
54: Winding diameter reset
55–56: Initial winding diameter
57: Pre-drive
58: Winding/Unwinding switchover
59: Winding diameter calculation disabled
60: Exiting tension mode
61: Speed limit direction
62: Rovolution calculation reset</td><td>1</td><td>★</td></tr>
<tr><td>F4-01</td><td>DI2 function selection</td><td>4</td><td>★</td></tr>
<tr><td>F4-02</td><td>Reserved</td><td>-</td><td>-</td></tr>
<tr><td>F4-03</td><td>DIO1 function selection</td><td>12</td><td>★</td></tr>
<tr><td>F4-04</td><td>DIO2 function selection</td><td>13</td><td>★</td></tr>
<tr><td>F4-10</td><td>DI filter time</td><td>0.000s to 1.000s</td><td>0.010s</td><td>☆</td></tr>
</table>

Para. No.	Para. Name	Setting Range	Default	Property
F4-11	Terminal I/O control mode	0: Two-wire mode 1 1: Two-wire mode 2 2: Three-wire mode 1 3: Three-wire mode 2	0	★
F4-12	Terminal UP/DOWN change rate	0.001 Hz/s to 65.535 Hz/s	1.000 Hz/s	☆
F4-13	AI curve 1 minimum input	-10.00 V to F4-15 (AI curve 1 maximum input)	-10.00 V	☆
F4-14	Corresponding percentage of AI curve 1 minimum input	-100.0% to +100.0%	-100.0%	☆
F4-15	AI curve 1 maximum input	F4-13 (AI curve 1 minimum input) to +10.00 V	10.00 V	☆
F4-16	Corresponding percentage of AI curve 1 maximum input	-100.0% to +100.0%	100.0%	☆
F4-17	AI1 filter time	0.00s to 10.00s	0.10s	☆
F4-18	AI curve 2 minimum input	0.00 V to F4-20 (AI curve 2 maximum input)	0.00 V	☆
F4-19	Corresponding percentage of AI curve 2 minimum input	-100.0% to +100.0%	0.0%	☆
F4-20	AI curve 2 maximum input	F4-18 (AI curve 2 minimum input) to +10.00 V	10.00 V	☆
F4-21	Corresponding percentage of AI curve 2 maximum input	-100.0% to +100.0%	100.0%	☆
F4-22	AI2 filter time	0.00s to 10.00s	0.10s	☆
F4-23	AI curve 3 minimum input	0.00 V to F4-25 (AI curve 3 maximum input)	0.00 V	☆
F4-24	Corresponding percentage of AI curve 3 minimum input	-100.0% to +100.0%	0.0%	☆
F4-25	AI curve 3 maximum input	F4-23 (AI curve 3 minimum input) to +10.00 V	10.00 V	☆
F4-26	Corresponding percentage of AI curve 3 maximum input	-100.0% to +100.0%	100.0%	☆
F4-28	Pulse minimum input	0.00 kHz to F4-30 (Pulse max. input)	0.00 kHz	☆
F4-29	Corresponding percentage of pulse minimum input	-100.0% to +100.0%	0.0%	☆
F4-30	Pulse max. input	F4-28 (Pulse minimum input) to 100.00 kHz	50.00 kHz	☆
F4-31	Corresponding percentage of pulse maximum input	-100.0% to +100.0%	100.0%	☆
F4-32	Pulse filter time	0.00s to 10.00s	0.10s	☆
F4-33	AI curve selection	Ones position: 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 position: AI2 curve selection, same as above Hundreds position: Reserved	321	☆
F4-34	Setting for AI less than minimum input	Ones position: Setting selection when AI1 less than min. input 0: Corresponding percentage of min. input 1: 0.0% Tens position: Setting selection when AI2 less than min. input, same as above Hundreds position: Reserved	0	☆
F4-35	DI1 delay	0.0s to 3600.0s	0.0s	☆
F4-36	DI2 delay	0.0s to 3600.0s	0.0s	☆
F4-37	Reserved	-	-	-

<table>
<tr><th>Para. No.</th><th>Para. Name</th><th>Setting Range</th><th>Default</th><th>Property</th></tr>
<tr><td>F4-38</td><td>DI active mode selection 1</td><td>0: High level active
1: Low level active
Ones position: DI1
Tens position: DI2
Hundreds position: Reserved
Thousands position: DIO1
Ten thousands position: DIO2</td><td>0</td><td>★</td></tr>
<tr><td>F4-40</td><td>AI2 input type</td><td>0: Voltage input
1: Current input (input impedance 500 Ω)</td><td>0</td><td>★</td></tr>
<tr><td>F4-41</td><td>DIO terminal type</td><td>Ones position: DIO1 type
0: DI/PulseIn
1: DO
Tens position: DIO2 type
0: DI
1: DO/FMP</td><td>00</td><td>★</td></tr>
<tr><td colspan="5">Group F5: Output Terminals</td></tr>
<tr><td>F5-00</td><td>DIO2 terminal output mode</td><td>0: Pulse output (FMP)
1: Digital output (FMR)</td><td>0</td><td>☆</td></tr>
<tr><td>F5-01</td><td>FMR output function selection</td><td rowspan="3">0: No function
1: Drive running
2: Fault output 1 (output at coast to stop/decelerate to stop)
3: Frequency-level detection 1 output
4: Frequency reached
5: Zero-speed running (no output at stop)
6: Motor overload pre-warning
7: Drive overload pre-warning
8: Set count value reached
9: Designated count value reached
10: Length reached
11: PLC cycle completed
12: Accumulative running time reached
13: Frequency limited
14: Torque limited
15: Ready for run
16: AI1 > AI2
17: Frequency upper limit reached
18: Frequency lower limit reached (related to running)
19: Undervoltage state output
20: Communication setting
23: Zero-speed running 2 (at stop)
24: Accumulative power-on time reached
25: Frequency-level detection 2 output
26: Frequency 1 reached output
27: Frequency 2 reached output
28: Current 1 reached output
29: Current 2 reached output
30: Timing reached output
31: AI1 input limit exceeded
32: Drive output load loss
33: Reverse running
34: Zero current state
35: IGBT temperature reached
36: Output current limit exceeded
37: Frequency lower limit reached (having output at stop)
38: Abnormality output (direct output at fault or warning)
39: Current overheat pre-warning
40: Current running time reached
41: Fault output 2 (ouput at coast to stop/decelerate to stop, no output at undervoltage)
43: Position lock enabled [deviation pulses < F6-25 (-Position lock end amplitude)]</td><td>0</td><td>☆</td></tr>
<tr><td>F5-02</td><td>Relay function selection</td><td>2</td><td>☆</td></tr>
<tr><td>F5-04</td><td>DO1 function selection</td><td>0</td><td>☆</td></tr>
</table>

Para. No.	Para. Name	Setting Range	Default	Property
F5-06	FMP output function selection	0: Running frequency 1: Set frequency 2: Output current 3: Output torque (100.0% corresponds to 2 times of rated motor torque) 4: Output power 5: Output voltage (100.0% corresponds to 1.2 times of rated drive voltage) 6: Pulse input (100.0% corresponds to 50.0 kHz) 7: AI1 8: AI2 10: Length 11: Count value 12: Communication setting 13: Motor speed 14: Output current (100.0% corresponds to 1000.0 A) 15: Output voltage (100.0% corresponds to 1000.0 V) 16: Output torque (directional, 100.0% corresponds to 2 times of rated motor torque) 19: Taper output	0	☆
F5-07	AO function selection		0	☆
F5-09	Maximum FMP output frequency	0.01 kHz to 100.00 kHz	50.00 kHz	☆
F5-10	AO1 zero offset coefficient	-100.0% to +100.0%	0.0%	☆
F5-11	AO1 gain	-10.00 to +10.00	1.00	☆
F5-17	FMR output delay	0.0s to 3600.0s	0.0s	☆
F5-18	Relay output delay	0.0s to 3600.0s	0.0s	☆
F5-20	DIO1 output delay	0.0s to 3600.0s	0.0s	☆
F5-21	DIO2 output delay	0.0s to 3600.0s	0.0s	☆
F5-22	DO active mode selection	0: Positive logic active 1: Negative logic active Ones position: FMR (DIO2) Tens position: RELAY1 Hundreds position: Reserved Thousands position: DIO1 Ten thousands position: Reserved	0	☆
F5-23	AO mode selection	0: Voltage output 1: Current output	0	★
Group F6: Start/Stop Control				
F6-00	Start mode	0: Direct startup 1: Flying start (asynchronous motor) 2: Vector pre-excitation startup (asynchronous motor)	0	☆
F6-01	Flying start mode	0: From stop frequency 1: From 50 Hz 2: From F0-10 (Maximum frequency)	0	★
F6-02	Flying start speed	1 to 100	20	☆
F6-03	Startup frequency	0.00 Hz to 10.00 Hz	0.00 Hz	☆
F6-04	Startup frequency active time	0.0s to 100.0s	0.0s	★
F6-05	Startup DC injection braking current/ pre-excited current	0% to 100%	0%	★
F6-06	Startup DC injection braking active time/pre-excitation active time	0.0s to 100.0s	0.0s	★
F6-07	Acceleration/Deceleration mode	0: Linear acceleration/deceleration 1: S-curve acceleration/deceleration	0	★
F6-08	Time proportion of S-curve start segment	0.0% to (100.0% to F6-09, Time proportion of S-curve end segment)	30.0%	★

Para. No.	Para. Name	Setting Range	Default	Property
F6-09	Time proportion of S-curve end segment	0.0% to (100.0% to F6-09, Time proportion of S-curve end segment)	30.0%	★
F6-10	Stop mode	0: Decelerate to stop 1: Coast to stop	0	☆
F6-11	Shutdown DC injection braking/ Position lock start frequency	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F6-12	Shutdown DC injection braking delay time	0.0s to 100.0s	0.0s	☆
F6-13	Shutdown DC injection braking current	0% to 100%	0%	☆
F6-14	Shutdown DC injection braking active time	0.0s to 100.0s	0.0s	☆
F6-15	Braking use ratio	0% to 100%	100%	★
F6-16	Closed-loop current KP of flying start	0 to 1000	500	☆
F6-17	Closed-loop current KI of flying start	0 to 1000	800	☆
F6-18	Flying start current	30 to 200	100	☆
F6-20	Voltage rise time at flying start	0.5s to 3.0s	1.0s	☆
F6-21	Demagnetization time	00.00s to 10.00s	1.00s	☆
F6-22	Startup pre-torque setting	000.0% to 200.0%	0.0%	☆
F6-23	Operation at command from power supply unit	0: Stop according to F6-10 (Stop mode) 1: Ignore stop command	0	★
F6-24	Position lock KP	0.0 to 100.0	10.0	☆
F6-25	Position lock end amplitude	0 to 16383	10	☆
Group F7: Operating Panel and Display				
F7-03	LED display running parameter 1	0000 to FFFF Bit00: Running frequency (Hz) Bit01: Frequency reference (Hz) Bit02: Bus voltage (V) Bit03: Output voltage (V) Bit04: Output current (A) Bit05: Output power (kW) Bit06: Output torque (%) Bit07: DI state Bit08: DO state Bit09: AI1 voltage (V) Bit10: AI2 voltage (V) Bit11: Reserved Bit12: Count value Bit13: Length value Bit14: Load speed display Bit15: PID reference	1F	☆

Para. No.	Para. Name	Setting Range	Default	Property
F7-04	LED display running parameter 2	0000 to FFFF Bit00: PID feedback Bit01: PLC stage Bit02: Pulse input frequency (kHz) Bit03: Running frequency 2 (Hz) Bit04: Remaining running time Bit05: AI1 voltage before correction (V) Bit06: AI2 voltage before correction (V) Bit07: Reserved Bit08: Linear speed Bit09: Current power-on time (h) Bit10: Current running time (min) Bit11: Pulse input frequency (Hz) Bit12: Communication setting value Bit13: Encoder feedback speed Bit14: Main frequency X display Bit15: Auxiliary frequency Y display	0	☆
F7-05	LED display stop parameters	0000 to FFFF Bit00: Frequency reference (Hz) Bit01: Bus voltage (V) Bit02: DI state Bit03: DO state Bit04: AI1 voltage (V) Bit05: AI2 voltage (V) Bit06: Reserved Bit07: Count value Bit08: Length value Bit09: PLC stage Bit10: Load speed display Bit11: PID reference Bit12: Pulse input frequency (kHz)	33	☆
F7-06	Load speed display coefficient	0.0001 to 6.5000	1	☆
F7-07	Heatsink temperature of IGBT	0.0°C to 100.0°C	-	●
F7-08	Product series	810	-	●
F7-09	Accumulative running time	0h to 65535h	-	●
F7-10	Performance software version	-	-	●
F7-11	Function software version	-	-	●
F7-12	Number of decimal places for load speed display	0: 0 decimal place 1: 1 decimal place 2: 2 decimal places 3: 3 decimal places	1	☆
F7-13	Accumulative power-on time	0 to 65535 h	-	●
F7-14	Accumulative power consumption	0° to 65535°	-	●
Group F8: Auxiliary Functions				
F8-00	Jog running frequency	0.00 Hz to F0-10 (Maximum frequency)	2.00 Hz	☆
F8-01	Jog acceleration time	0.0s to 6500.0s	20.0s	☆
F8-02	Jog deceleration time	0.0s to 6500.0s	20.0s	☆
F8-03	Acceleration time 2	0.0s to 6500.0s	Model dependent	☆
F8-04	Deceleration time 2	0.0s to 6500.0s	Model dependent	☆
F8-05	Acceleration time 3	0.0s to 6500.0s	Model dependent	☆
F8-06	Deceleration time 3	0.0s to 6500.0s	Model dependent	☆

Para. No.	Para. Name	Setting Range	Default	Property
F8-07	Acceleration time 4	0.0s to 6500.0s	Model dependent	☆
F8-08	Deceleration time 4	0.0s to 6500.0s	Model dependent	☆
F8-09	Jump frequency 1	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F8-10	Jump frequency 2	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F8-11	Jump frequency band	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F8-12	Forward/Reverse run switchover dead-zone time	0.0s to 3000.0s	0.0s	☆
F8-13	Reverse run control	0: Enabled 1: Disabled	0	☆
F8-14	Running mode when frequency reference lower than frequency lower limit	0: Run at frequency lower limit 1: Stop 2: Run at zero speed	0	☆
F8-16	Accumulative power-on time threshold	0 to 65000 h	0	☆
F8-17	Accumulative running time threshold	0 to 65000 h	0	☆
F8-18	Startup protection	0: Disabled 1: Enabled	0	☆
F8-19	Frequency detection value (FDT1)	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	☆
F8-20	Frequency detection hysteresis (FDT1)	0.0% to 100.0% (FDT1 level)	5.0%	☆
F8-21	Detection width of target frequency reached	0.0% to 100.0% (maximum frequency)	0.0%	☆
F8-22	Jump frequency during acceleration/ deceleration	0: Disabled 1: Enabled	0	☆
F8-25	Switchover frequency of acceleration time 1 and acceleration time 2	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F8-26	Switchover frequency of deceleration time 1 and deceleration time 2	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
F8-27	Set highest priority to JOG function	0: Disabled 1: Enabled	0	☆
F8-28	Frequency detection value 2	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	☆
F8-29	Frequency detection hysteresis (FDT2)	0.0% to 100.0% (FdT2 level)	5.0%	☆
F8-30	Detection value 1 of any frequency reached	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	☆
F8-31	Detection width 1 of any frequency reached	0.0% to 100.0% (maximum frequency)	0.0%	☆
F8-32	Detection value 2 of any frequency reached	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	☆
F8-33	Detection width 2 of any frequency reached	0.0% to 100.0% (maximum frequency)	0.0%	☆
F8-34	Zero current detection level	0.0% to 300.0% The value 100.0% corresponds to the rated motor current.	5.0%	☆
F8-35	Zero current detection delay	0.01s to 600.00s	0.10s	☆
F8-36	Output overcurrent threshold	0.0% (no detection) 0.1% to 300.0% (rated motor current)	200.0%	☆
F8-37	Output overcurrent detection delay	0.00s to 600.00s	0.00s	☆
F8-38	Detection value 1 of any current reached	0.0% to 300.0% (rated motor current)	100.0%	☆
F8-39	Detection width 1 of any current reached	0.0% to 300.0% (rated motor current)	0.0%	☆
F8-40	Detection value 2 of any current reached	0.0% to 300.0% (rated motor current)	100.0%	☆
F8-41	Detection width 2 of any current reached	0.0% to 300.0% (rated motor current)	0.0%	☆

Para. No.	Para. Name	Setting Range	Default	Property
F8-42	Timing function	0: Disabled 1: Enabled	0	★
F8-43	Timing duration source	0: Set by F8-44 (Timing duration) 1: AI1 2: AI2 AI range dependent on F8-44 (Timing duration)	0	★
F8-44	Timing duration	0.0 min to 6500.0 min	0.0 min	★
F8-45	AI1 input voltage lower limit	0.00 V to F8-46 (AI1 input voltage upper limit)	3.10 V	☆
F8-46	AI1 input voltage upper limit	F8-45 (AI1 input voltage lower limit) to 11.00 V	6.80 V	☆
F8-47	IGBT temperature threshold	0°C to 100°C	75°C	☆
F8-48	Cooling fan working mode	0: Working during drive running 1: Working continuously	0	☆
F8-49	Wakeup frequency	F8-51 (Hibernating frequency) to F0-10 (Maximum frequency)	0.00 Hz	☆
F8-50	Wakeup delay	0.0s to 6500.0s	0.0s	☆
F8-51	Hibernating frequency	0.00 Hz to F8-49 (Wakeup frequency)	0.00 Hz	☆
F8-52	Hibernating delay	0.0s to 6500.0s	0.0s	☆
F8-53	Current running time threshold	0.0 min to 6500.0 min	0.0 min	☆
F8-54	STO alarm on operating panel	0: STO alarm invalid 1: STO alarm valid	0	☆
F8-55	Emergency stop deceleration time	0.0s to 6500.0s	0.0	☆
F8-56	Jog by LED panel	0	0	☆
Group F9: Fault and Protection				
F9-00	Drive overload protection	0 to 1	0	☆
F9-01	Motor overload protection gain	0.20 to 10.00	1.00	☆
F9-02	Motor overload pre-warning coefficient	50% to 100%	80%	☆
F9-06	Output phase loss detection before startup	0: Disabled 1: Enabled	0	☆
F9-07	Detection of short-circuit to ground	0: No detection 1: Detection before power-on 2: Detection during running 3: Detection before power-on and during running	1	★
F9-09	Fault auto reset times	0 to 20	0	☆
F9-10	DO action during auto fault reset	0: Not act 1: Act	0	☆
F9-11	Auto fault reset interval	0.1s to 100.0s	1.0s	☆

Para. No.	Para. Name	Setting Range		Default	Property
F9-14	1st fault type	0: No fault 1: Hardware fault 2: Overcurrent during acceleration 3: Overcurrent during deceleration 4: Overcurrent at constant speed 5: Overvoltage during acceleration 6: Overvoltage during deceleration 7: Overvoltage at constant speed 9: Undervoltage 10: Drive overload 11: Motor overload 12: Reserved 13: Output phase loss 14: IGBT overheat 15: External device fault 16: Communication fault 17: Reserved 18: Reserved 19: Motor auto-tuning abnormal	20: Encoder/PG card abnormal 21: EEPROM read/write error 22: Motor auto-tuning abnormal 23: Motor short circuit to ground 24: Inter-phase short-circuit 25: Power supply unit fault 26: Accumulative running time reached 27: User-defined fault 1 28: User-defined fault 2 29: Accumulative power-on time reached 30: Load loss 31: PID feedback loss during running 42: Speed deviation excessive 43: Motor overspeed 45: Motor overtemperature 80: Fan fault		●
F9-15	2nd fault type				●
F9-16	3rd (latest) fault type				●
F9-17	Frequency upon 3rd fault	0.00 to 655.35 Hz		0.00 Hz	●
F9-18	Current upon 3rd fault	0.00 to 655.35 A		0.00 A	●
F9-19	Bus voltage upon 3rd fault	0.0 to 6553.5 V		0.0 V	●
F9-20	DI status upon 3rd fault	0 to 9999		0	●
F9-21	Output terminal status upon 3rd fault	0 to 9999		0	●
F9-22	Drive status upon 3rd fault	0 to 65535		0	●
F9-23	Power-on time upon 3rd fault	0 to 65535s		0s	●
F9-24	Running time upon 3rd fault	0.0 to 6553.5s		0.0s	●
F9-25	IGBT temperature upon 3rd fault				●
F9-26	3rd fault subcode				●
F9-27	Frequency upon 2nd fault	0.00 to 655.35 Hz		0.00 Hz	●
F9-28	Current upon 2nd fault	0.00 to 655.35 A		0.00 A	●
F9-29	Bus voltage upon 2nd fault	0.0 to 6553.5 V		0.0 V	●
F9-30	DI status upon 2nd fault	0 to 9999		0	●
F9-31	Output terminal status upon 2nd fault	0 to 9999		0	●
F9-32	Drive status upon 2nd fault	0 to 65535		0	●
F9-33	Power-on time upon 2nd fault	0 to 65535s		0s	●
F9-34	Running time upon 2nd fault	0.0 to 6553.5s		0.0s	●
F9-35	IGBT temperature upon 2nd fault				●
F9-36	2nd fault subcode				●
F9-37	Frequency upon 1st fault	0.00 to 655.35 Hz		0.00 Hz	●
F9-38	Current upon 1st fault	0.00 to 655.35 A		0.00 A	●
F9-39	Bus voltage upon 1st fault	0.0 to 6553.5 V		0.0 V	●
F9-40	Input terminal status upon 1st fault	0 to 9999		0	●
F9-41	Output terminal status upon 1st fault	0 to 9999		0	●
F9-42	Drive status upon 1st fault	0 to 65535		0	●
F9-43	Power-on time upon 1st fault	0 to 65535s		0s	●
F9-44	Running time upon 1st fault	0.0 to 6553.5s		0.0s	●
F9-45	IGBT temperature upon 1st fault				●

Para. No.	Para. Name	Setting Range	Default	Property
F9-46	1st fault subcode			●
F9-48	Fault protection action selection 1	Ones position: Motor overload (E11) Tens position: Reserved Hundreds position: Output phase loss (E13) Thousands position: Heatsink overheat (E14) Ten thousands position: External fault (E15) Note: If 0 (Coast to stop) or 4 (Warning) is selected, output phase loss is valid only for V/F control.	10050 0: Coast to stop 1: Decelerate to stop 2: Reserved 3: Reserved 4: Warning 5: Canceled	★
F9-49	Fault protection action selection 2	Ones position: Communication timeout (E16) Tens position: External DC soft charge unit fault (E17) (only for 90 kW and above models) Hundreds position: Reserved Thousands position: Motor auto-tuning abnormal (E19) Ten thousands position: Encoder abnormal (E20)	00050 0: Coast to stop 1: Decelerate to stop 2: Reserved 3: Reserved 4: Warning 5: Canceled	★
F9-50	Fault protection action selection 3	Ones position: EEPROM read/write error Tens position: Motor auto-tuning abnormal (E22) Hundreds position: Motor short circuit to ground (E23) Thousands position: Inter-phase short-circuit (E24) Ten thousands position: Reserved	25000 0: Coast to stop 1: Decelerate to stop 2: Reserved 3: Reserved 4: Warning 5: Canceled	★
F9-51	Fault protection action selection 4	Ones position: Accumulative running time reached (E26) Tens position: User-defined fault 1 (E27) Hundreds position: User-defined fault 2 (E28) Thousands position: Accumulative power-on time reached (E29) Ten thousands position: Load loss (E30)	51111 0: Coast to stop 1: Decelerate to stop 2: Reserved 3: Reserved 4: Warning 5: Canceled	★
F9-52	Fault protection action selection 5	Ones position: PID feedback loss during running (E31) Tens position: Reserved Hundreds position: Reserved Thousands position: Speed deviation excessive (E42) Ten thousands position: Motor overspeed (E43)	00101 0: Coast to stop 1: Decelerate to stop 2: Reserved 3: Reserved 4: Warning 5: Canceled	★
F9-53	Fault protection action selection 6	Ones position: Motor overtemperature (E45) Tens position: Reserved Hundreds position: Reserved Thousands position: Reserved Ten thousands position: Fan fault (E80)	05500 0: Coast to stop 1: Decelerate to stop 2: Reserved 3: Reserved 4: Warning 5: Canceled	★
F9-54	Frequency selection for continuing to run upon fault	0: Current running frequency 1: Frequency reference 2: Frequency upper limit 3: Frequency lower limit 4: Backup frequency upon abnormality	1	☆
F9-55	Backup frequency upon abnormality	0.0% to 100.0% (F0-10, Maximum frequency)	100.0%	☆

Para. No.	Para. Name	Setting Range	Default	Property
F9-56	Type of motor temperature sensor	0: No sensor (AI1 input) 1: PT100 2: PT1000	0	☆
F9-57	Motor overheat protection threshold	0°C to 200°C	110°C	☆
F9-58	Motor overheat pre-warning threshold	0°C to 200°C	90°C	☆
F9-59	Power dip ride-through function selection	0: Disabled 1: Decelerate 2: Decelerate to stop	0	★
F9-60	Threshold of power dip ride-through function disabled	80 to 100%	85%	☆
F9-61	Judging time of bus voltage recovering from power dip	0.0s to 100.0s	0.5s	☆
F9-62	Threshold of power dip ride-through function enabled	60% to 100% (Standard bus voltage)	80%	☆
F9-64	Load loss detection level	0.0 to 100.0%	10.0%	☆
F9-65	Load loss detection time	0.1s to 60.0s	1.0s	☆
F9-67	Overspeed detection level	0.0% to 50.0% (maximum frequency) 0.0%: No detection	5.0%	☆
F9-68	Overspeed detection time	0.0s to 60.0s	1.0s	☆
F9-69	Detection level of speed deviation excessive	0.0% to 50.0% (maximum frequency) 0.0%: No detection	20.0%	☆
F9-70	Detection time of speed deviation excessive	0.0s to 60.0s	5.0s	☆
F9-71	Power dip ride-through gain	0 to 100	40	☆
F9-72	Power dip ride-through integral coefficient	0 to 100	30	☆
F9-73	Deceleration time of power dip ride-through	0.0 to 300.0s	20.0s	☆
Group FA: Process Control PID Function				
FA-00	PID reference setting channel	0: FA-01 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: Communication setting (1000H) 6: Multi-reference	0	☆
FA-01	PID digital setting	0.0% to 100.0%	50.0%	☆
FA-02	PID feedback setting channel	0: AI1 1: AI2 3: AI1 - AI2 4: Pulse reference (DIO1) 5: Communication setting (1000H) 6: AI1 + AI2 7: Max. (|AI1|, |AI2|) 8: Min. (|AI1|, |AI2|)	0	☆
FA-03	PID operation direction	0: Forward 1: Reverse	0	☆
FA-04	PID reference and feedback range	0 to 65535	1000	☆
FA-05	Proportional gain Kp1	0.0 to 1000.0	20.0	☆
FA-06	Integral time Ti1	0.01s to 100.00s	2.00s	☆
FA-07	Differential time Td1	0.000s to 10.000s	0.000s	☆
FA-08	PID output limit in reverse direction	0.00 to F0-10 (Maximum frequency)	2.00 Hz	☆
FA-09	PID deviation limit	0.0% to 100.0%	0.0%	☆
FA-10	PID differential limit	0.00% to 100.00%	0.10%	☆
FA-11	PID reference change time	0.00 to 650.00s	0.00s	☆

Para. No.	Para. Name	Setting Range	Default	Property
FA-12	PID feedback filter time	0.00 to 60.00s	0.00s	☆
FA-13	PID deviation gain	0.0% to 100.0%	100.0%	☆
FA-15	Proportional gain Kp2	0.0 to 1000.0	20.0	☆
FA-16	Integral time Ti2	0.01s to 100.00s	2.00s	☆
FA-17	Differential time Td2	0.000s to 10.000s	0.000s	☆
FA-18	PID parameter switchover condition	0: No switchover 1: Switchover via DI 2: Auto switchover based on deviation 3: Auto switchover based on running frequency 6: Auto adjustment based on winding diameter 7: Auto adjustment based on percentage of maximum winding diameter	0	☆
FA-19	PID deviation 1 for auto switchover	0.0% to FA-20 (PID deviation 2 for auto switchover)	20.0%	☆
FA-20	PID deviation 2 for auto switchover	FA-19 (PID deviation 1 for auto switchover) to 100.0%	80.0%	☆
FA-21	PID initial value	0.0% to 100.0%	0.0%	☆
FA-22	PID initial value active time	0.00 to 650.00s	0.00s	☆
FA-23	Maximum deviation between two PID outputs in forward direction	0.00% to 100.00%	1.00%	☆
FA-24	Maximum deviation between two PID outputs in reverse direction	0.00% to 100.00%	1.00%	☆
FA-25	PID integral property	Integral pausing 0: Disabled 1: Enabled	0	☆
FA-26	Detection level of PID feedback loss	0.0%: No detection 0.1% to 100.0%	0.0%	☆
FA-27	Detection time of PID feedback loss	0.0s to 20.0s	0.0s	☆
Group Fb: Wobble function, Fixed Length, and Count				
Fb-00	Wobble setting mode	0: Relative to the central frequency 1: Relative to maximum frequency	0	☆
Fb-01	Wobble amplitude	0.0% to 100.0%	0.0%	☆
Fb-02	Wobble step	0.0% to 50.0%	0.0%	☆
Fb-03	Wobble cycle	0.1s to 3000.0s	10.0s	☆
Fb-04	Triangular wave rising time coefficient	0.1% to 100.0%	50.0%	☆
Fb-05	Set length	0 m to 65535 m	1000 m	☆
Fb-06	Actual length	0 m to 65535 m	0 m	☆
Fb-07	Number of pulses per meter	0.1 to 6553.5	100.0	☆
Fb-08	Set count value	1 to 65535	1000	☆
Fb-09	Designated count value	1 to 65535	1000	☆
Fb-10	Loop caculation reset method	0: Edge triggering 1: Electrical level trigger	0	☆
Fb-11	Loop caculation reset signal	0: Not reset 1: Reset	0	☆
Fb-12	Power fail save caculation	0: Disabled 1: Enabled	0	☆
Fb-13	Orignal value of loop caculation	0 to 65535 (FB-18 = 0) 0.0 to 6553.5 (FB-18 = 1)	0	☆
Fb-14	Multi-drive ratio (numerator)	1 to 65535	1	☆
Fb-15	Multi-drive ratio (denominator)	1 to 65535	1	☆
Fb-16	Actual running loop (FB-13)	0 to 65535 (FB-18 = 0) 0 to 6553.5 (FB-18 = 1)	0	●
Fb-17	Running loop	0 to 65535 (FB-18 = 0) 0 to 6553.5 (FB-18 = 1)	0	●
Fb-18	Loop caculation precision	0: 1 loop 1: 0.1 loop	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
Fb-19	Loop caculation direction	0: Consistent direct 1: Reverse direction	0	☆
Group FC: Multi-Reference and Simple PLC Function				
FC-00	Reference 0	-100.0% to +100.0%	0.0%	☆
FC-01	Reference 1	-100.0% to +100.0%	0.0%	☆
FC-02	Reference 2	-100.0% to +100.0%	0.0%	☆
FC-03	Reference 3	-100.0% to +100.0%	0.0%	☆
FC-04	Reference 4	-100.0% to +100.0%	0.0%	☆
FC-05	Reference 5	-100.0% to +100.0%	0.0%	☆
FC-06	Reference 6	-100.0% to +100.0%	0.0%	☆
FC-07	Reference 7	-100.0% to +100.0%	0.0%	☆
FC-08	Reference 8	-100.0% to +100.0%	0.0%	☆
FC-09	Reference 9	-100.0% to +100.0%	0.0%	☆
FC-10	Reference 10	-100.0% to +100.0%	0.0%	☆
FC-11	Reference 11	-100.0% to +100.0%	0.0%	☆
FC-12	Reference 12	-100.0% to +100.0%	0.0%	☆
FC-13	Reference 13	-100.0% to +100.0%	0.0%	☆
FC-14	Reference 14	-100.0% to +100.0%	0.0%	☆
FC-15	Reference 15	-100.0% to +100.0%	0.0%	☆
FC-16	Simple PLC running mode	0: Stop after running for one cycle 1: Keep final values after running for one cycle 2: Repeat after running for one cycle	0	☆
FC-17	Simple PLC retentive selection	Ones position: 0: Non-retentive upon power failure 1: Retentive upon power failure Tens position: 0: Non-retentive upon stop 1: Retentive upon stop	00	☆
FC-18	Running time of simple PLC reference 0	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-19	Acceleration/Deceleration time of simple PLC reference 0	0 to 3	0	☆
FC-20	Running time of simple PLC reference 1	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-21	Acceleration/Deceleration time of simple PLC reference 1	0 to 3	0	☆
FC-22	Running time of simple PLC reference 2	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-23	Acceleration/Deceleration time of simple PLC reference 2	0 to 3	0	☆
FC-24	Running time of simple PLC reference 3	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-25	Acceleration/Deceleration time of simple PLC reference 3	0 to 3	0	☆
FC-26	Running time of simple PLC reference 4	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-27	Acceleration/Deceleration time of simple PLC reference 4	0 to 3	0	☆
FC-28	Running time of simple PLC reference 5	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-29	Acceleration/Deceleration time of simple PLC reference 5	0 to 3	0	☆
FC-30	Running time of simple PLC reference 6	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-31	Acceleration/Deceleration time of simple PLC reference 6	0 to 3	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
FC-32	Running time of simple PLC reference 7	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-33	Acceleration/Deceleration time of simple PLC reference 7	0 to 3	0	☆
FC-34	Running time of simple PLC reference 8	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-35	Acceleration/Deceleration time of simple PLC reference 8	0 to 3	0	☆
FC-36	Running time of simple PLC reference 9	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-37	Acceleration/Deceleration time of simple PLC reference 9	0 to 3	0	☆
FC-38	Running time of simple PLC reference 10	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-39	Acceleration/Deceleration time of simple PLC reference 10	0 to 3	0	☆
FC-40	Running time of simple PLC reference 11	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-41	Acceleration/Deceleration time of simple PLC reference 11	0 to 3	0	☆
FC-42	Running time of simple PLC reference 12	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-43	Acceleration/Deceleration time of simple PLC reference 12	0 to 3	0	☆
FC-44	Running time of simple PLC reference 13	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-45	Acceleration/Deceleration time of simple PLC reference 13	0 to 3	0	☆
FC-46	Running time of simple PLC reference 14	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-47	Acceleration/Deceleration time of simple PLC reference 14	0 to 3	0	☆
FC-48	Running time of simple PLC reference 15	0.0s (h) to 6553.5s (h)	0.0s (h)	☆
FC-49	Acceleration/Deceleration time of simple PLC reference 15	0 to 3	0	☆
FC-50	Time unit of simple PLC running	0: s (second) 1: h (hour)	0	☆
FC-51	Reference 0 source	0: FC-00 1: AI1 2: AI2 4: Pulse reference (DIO1) 5: PID 6: Set by preset frequency (F0-08), modified by terminal UP/DOWN	0	☆
Group Fd: Communication Parameters				
Fd-00	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	5	☆

Para. No.	Para. Name	Setting Range	Default	Property
Fd-01	Modbus data format	0: No check (8-N-2) 1: Even parity check (8-E-1) 2: Odd parity check (8-O-1) 3: 8-N-1	0	☆
Fd-02	Modbus local address	1 to 247 (0: broadcast address)	1	☆
Fd-03	Modbus response delay	0 to 20 ms	2	☆
Fd-04	Modbus communication timeout	0.0 (invalid), 0.1s to 60.0s	0	☆
Fd-06	Auto reset of communication fault	0: Disabled 1: Enabled	1	☆
Fd-09	Communication status	Ones position: CANopen 0: Disabled 1: Initialization 2: Pre-operational 8: Operational Tens position: CANlink 0: Disabled 1: Initialization 2: Pre-operational 8: Operational Hundreds position: PROFIBUS-DP 0: Disabled 1: Initialization 8: Operational	0	●
Fd-10	CANopen/CANlink switchover	1: CANopen 2: CANlink	1	★
Fd-11	CANopen402 protocol	0: Disabled 1: Enabled	1	★
Fd-12	CAN baud rate	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps	5	★
Fd-13	CAN station No.	1 to 127 (for both CANlink and CANopen)	1	★
Fd-14	Number of CAN frames received in a period			●
Fd-15	Maximum value of node receiving error counter			●
Fd-16	Maximum value of node sending error counter			●
Fd-17	Bus disconnection times within a period			●
Fd-18	Power supply unit No.	1 to 99	1	★
Fd-20	PROFIBUS-DP communication address	0 to 125 (0: broadcast address)	0	★
Fd-21	PROFIBUS-DP communication dropping coefficient	0 to 65535	350	☆
Fd-22	DP-CANopen conversion network bridge	0: Reporting communiation error reported if the number of slaves in PLC is inconsistent with the actual 1: Not reporting communiation error reported if the number of slaves in PLC is inconsistent with the actual	0	☆
Fd-23	Number of online slates	0 to 65535	0	●
Fd-24	PROFIBUS-DP to CANopen conversion power-on delay	0s to 65535s	8s	☆

Para. No.	Para. Name	Setting Range	Default	Property
Fd-25	Status of stations 1 to 15 at PROFIBUS-DP to CANopen conversion	0: Offline 1: Online Bit1: Station 1 Bit2 : Station 2 … Bit15: Station 15	0	●
Fd-26	Status of stations 16 to 30 at PROFIBUS-DP to CANopen conversion	0: Offline 1: Online Bit0 : Station 16 Bit1 : Station 17 … Bit14: Station 30	0	●
Fd-32	AF group mapping mode switchover	0: Communication not saved 1: Communication saved	0	★
Fd-33	CANopen communication period	-	-	●
Fd-34	CANopen mode	0: Common mode 1: Expert mode	0	★
Fd-35	CANopen disabling time	0 to 65535 (Unit: 100 us)	0	★
Fd-36	CANopen event time	0 ms to 65535 ms	0	★
Fd-94	Modbus software version	0.00 to 655.35	0.00	●
Fd-95	CANlink software version	0.00 to 655.35	0.00	●
Fd-96	CANopen software version	0.00 to 655.35	0.00	●
Fd-97	PROFIBUS-DP software version	0.00 to 655.35	0.00	●
Fd-98	DP2CANOPEN software version	-	-	●
Fd-99	MODBUS2CANOPEN software version	-	-	●
Group FE: Use-Defined Parameters				
FE-00	User-defined parameter 0	F0-00 (G/P type display) to FP-xx A0-00 (Speed/Torque control selection) to Ax-xx U0-xx to U0-xx	F0-01	☆
FE-01	User-defined parameter 1		F0-02	☆
FE-02	User-defined parameter 2		F0-03	☆
FE-03	User-defined parameter 3		F0-07	☆
FE-04	User-defined parameter 4		F0-08	☆
FE-05	User-defined parameter 5		F0-17	☆
FE-06	User-defined parameter 6		F0-18	☆
FE-07	User-defined parameter 7		F3-00	☆
FE-08	User-defined parameter 8		F3-01	☆
FE-09	User-defined parameter 9		F4-00	☆
FE-10	User-defined parameter 10		F4-01	☆
FE-11	User-defined parameter 11		F4-02	☆
FE-12	User-defined parameter 12		F5-04	☆
FE-13	User-defined parameter 13		F5-07	☆
FE-14	User-defined parameter 14		F6-00	☆
FE-15	User-defined parameter 15		F6-10	☆
FE-16	User-defined parameter 16		F0-00	☆
FE-17	User-defined parameter 17		F0-00	☆
FE-18	User-defined parameter 18		F0-00	☆
FE-19	User-defined parameter 19		F0-00	☆
FE-20	User-defined parameter 20		F0-00	☆
FE-21	User-defined parameter 21		F0-00	☆
FE-22	User-defined parameter 22		F0-00	☆
FE-23	User-defined parameter 23		F0-00	☆
FE-24	User-defined parameter 24		F0-00	☆
FE-25	User-defined parameter 25		F0-00	☆
FE-26	User-defined parameter 26		F0-00	☆

Para. No.	Para. Name	Setting Range	Default	Property
FE-27	User-defined parameter 27	F0-00 (G/P type display) to FP-xx A0-00 (Speed/Torque control selection) to Ax-xx U0-xx to U0-xx	F0-00	☆
FE-28	User-defined parameter 28		F0-00	☆
FE-29	User-defined parameter 29		F0-00	☆
FE-30	User-defined parameter 30		F0-00	☆
FE-31	User-defined parameter 31		F0-00	☆
Group FP: User-defined Parameters				
FP-00	User password	0 to 65535	0	☆
FP-01	Parameter initialization	0: No operation 01: Restore factory parameters except motor parameters, encoder parameters, and F0-10 (Maximum frequency) 02: Clear records 04: Back up current user parameters 501: Restore backup user parameters 502: Restore to factory setting (except FD group and AF group parameters)	0	★
FP-02	Parameter display property	Ones position: (Selection of display of group U) 0: Hidden 1: Displayed Tens position: (Selection of display of group A) 0: Hidden 1: Displayed	111	☆
FP-03	Selection of individualized parameter display	Ones position: Selection of display of user-defined parameters 0: Not displayed 1: Displayed Tens position: Selection of display of user-modified parameters 0: Not displayed 1: Displayed	11	☆
FP-04	Parameter modification property	0: Modification allowed 1: Modification prohibited	0	☆
Group A0: Torque Control and Restricting Parameters				
A0-00	Speed/Torque control selection	0: Speed control 1: Torque control	0	★
A0-01	Torque reference source in torque control	0: Digital setting(A0-03) 1: AI1 2: AI2 4: Pulse reference 5: Communication setting 6: Min. (AI1, AI2) 7: Max. (AI1, AI2) 100% of the values 1 to 7 corresponding to A0-03	0	★
A0-03	Torque digital setting	-200.0% to +200.0%	100.0%	☆
A0-04	Torque filter time	0s to 5.000s	0.000s	☆
A0-05	Speed limit digital setting	-120.0% to 120.0%	0.00%	☆
A0-07	Acceleration time (torque)	0.0s to 650.00s	1.00s	☆
A0-08	Deceleration time (torque)	0.0s to 650.00s	1.00s	☆
A0-09	Setting channel of speed limit	0: Set by A0-05 (Speed limit digital setting) 1: Frequency source	0	☆
A0-10	Speed limit offset	0 to F0-10 (Maximum frequency)	5.00 Hz	☆
A0-11	Effective mode of speed limit offset	0: Bidirectional offset effective 1: Unidirectional offset effective	1	★
A0-12	Frequency acceleration time	0.0s to 6500.0s	1.0s	☆
A0-13	Frequency deceleration time	0.0s to 6500.0s	1.0s	☆

Para. No.	Para. Name	Setting Range	Default	Property
A0-14	Torque mode switchover	0: No switchover 1: Switchover to speed control at stop 2: Target torque at stop being 0	1	★
Group A1: Virtual DI/DO				
A1-00	VDI1 function selection	Refer to F4-00 (DI1 function selection).	0	★
A1-01	VDI2 function selection	Refer to F4-00 (DI1 function selection).	0	★
A1-02	VDI3 function selection	Refer to F4-00 (DI1 function selection).	0	★
A1-03	VDI4 function selection	Refer to F4-00 (DI1 function selection).	0	★
A1-04	VDI5 function selection	Refer to F4-00 (DI1 function selection).	0	★
A1-05	VDI active state setting mode	0: Set by A1-06 (Selection of VDI active state) 1: DO state 2: DI state Ones position: VDI1 Tens position: VDI2 Hundreds position: VDI3 Thousands position: VDI4 Ten thousands position: VDI5	00000	★
A1-06	Selection of VDI active state	0: Inactive 1: Active Ones position: VDI1 Tens position: VDI2 Hundreds position: VDI3 Thousands position: VDI4 Ten thousands position: VDI5	00000	☆
A1-07	Function selection for AI1 used as DI	Refer to F4-00 (DI1 function selection).	0	★
A1-08	Function selection for AI2 used as DI	Refer to F4-00 (DI1 function selection).	0	★
A1-10	Active mode selection for AI used as DI	Ones position: AI1 0: High level active 1: Low level active Tens position: AI2 0: High level active 1: Low level active	00	★
Group A5: Control Optimization Parameters				
A5-00	DPWM switchover frequency upper limit	0.00 Hz to F0-10 (Maximum frequency)	12.00 Hz	☆
A5-01	PWM modulation mode	0: Asynchronous modulation 1: Synchronous modulation	0	☆
A5-02	Dead zone compensation	0: Disabled 1: Enabled	1	★
A5-03	Random PWM depth	0: Random PWM invalid 1 to 10:	0	☆
A5-04	Fast current limit	0: Disabled 1: Enabled	1 0 (Asynchronous motor SVC)	☆
A5-05	Sampling delay	1 to 13	5	☆
A5-06	Undervoltage threshold	60% to 140%	100.0%	☆
Group A6: AI Curve Setting				
A6-00	AI curve 4 minimum input	-10.00 V to A6-02 (AI curve 4 inflexion 1 input)	0.00 V	☆
A6-01	Corresponding percentage of AI curve 4 minimum input	-100.0% to +100.0%	0.0%	☆
A6-02	AI curve 4 inflexion 1 input	A6-00 (AI curve 4 minimum input) to A6-04 (AI curve 4 inflexion 2 input)	3.00 V	☆
A6-03	Corresponding percentage of AI curve 4 inflexion 1 input	-100.0% to +100.0%	30.0%	☆

Para. No.	Para. Name	Setting Range	Default	Property
A6-04	AI curve 4 inflexion 2 input	A6-02 (AI curve 4 inflexion 1 input) to A6-06 (AI curve 4 maximum input)	6.00 V	☆
A6-05	Corresponding percentage of AI curve 4 inflexion 2 input	-100.0% to +100.0%	60.0%	☆
A6-06	AI curve 4 maximum input	A6-04 (AI curve 4 inflexion 2 input) to +10.00 V	10.00 V	☆
A6-07	Corresponding percentage of AI curve 4 maximum input	-100.0% to +100.0%	100.0%	☆
A6-08	AI curve 5 minimum input	-10.00 V to A6-10 (AI curve 5 inflexion 1 input)	-10.00 V	☆
A6-09	Corresponding percentage of AI curve 5 minimum input	-100.0% to +100.0%	-100.0%	☆
A6-10	AI curve 5 inflexion 1 input	A6-08 (AI curve 5 minimum input) to A6-12 (AI curve 5 inflexion 2 input)	-3.00 V	☆
A6-11	Corresponding percentage of AI curve 5 inflexion 1 input	-100.0% to +100.0%	-30.0%	☆
A6-12	AI curve 5 inflexion 2 input	A6-10 (AI curve 5 inflexion 1 input) to A6-14 (AI curve 5 maximum input)	3.00 V	☆
A6-13	Corresponding percentage of AI curve 5 inflexion 2 input	-100.0% to +100.0%	30.0%	☆
A6-14	AI curve 5 maximum input	A6-12 (AI curve 5 inflexion 2 input) to +10.00 V	10.00 V	☆
A6-15	Corresponding percentage of AI curve 5 maximum input	-100.0% to +100.0%	100.0%	☆
A6-16	AI1 gain	-10.00 to +10.00	1.00	☆
A6-17	AI1 zero offset coefficient	-100.0% to +100.0%	0.0%	☆
A6-18	AI2 gain	-10.00 to +10.00	1.00	☆
A6-19	AI2 zero offset coefficient	-100.0% to +100.0%	0.0%	☆
A6-24	Jump point of AI1 input corresponding percentage	-100.0% to +100.0%	0.0%	☆
A6-25	Jump amplitude of AI1 input corresponding percentage	0.0% to 100.0%	0.5%	☆
A6-26	Jump point of AI2 input corresponding percentage	-100.0% to +100.0%	0.0%	☆
A6-27	Jump amplitude of AI2 input corresponding percentage	0.0% to 100.0%	0.5%	☆
Group A8: Synchronization Control				
A8-00	Local address	1-124 (0: broadcast address)	1	★
A8-01	Baud rate	6: 1 Mbps	6	★
A8-02	Communication timeout	0.0s to 10.0s	1.0s	☆
A8-10	Master/Slave selection in speed and position control	0: Disabled 1: Master 2: Slave 3: Middle node	0	★
A8-11	Synchronization mode selection	0: Speed synchronization 1: Position synchronization	0	★
A8-12	Following master station number (set for slave)	1 to 124	1	★
A8-14	Slave configuration parameter	0: Not following master start/stop command 1: Following master start/stop command	1	★
A8-15	Acceleration time (position)	0.0s to 100.0s	0.0s	☆
A8-16	Deceleration time (position)	0.0s to 100.0s	0.0s	☆
A8-17	Electronic gear ratio (numerator)	1 to 65535	1	☆
A8-18	Electronic gear ratio (denominator)	1 to 65535	1	☆
A8-19	Speed feedforward gain	0.000 to 20.000	1.000	☆
A8-20	Position loop proportional gain switchover mode	0: No switchover (A8-21, Speed loop proportional gain 1) 1: Switchover based on deviation 2: Switchover based on frequency	0	☆
A8-21	Speed loop proportional gain 1	0.00 to 100.00	5.00	☆

Para. No.	Para. Name	Setting Range	Default	Property
A8-22	Deviation 1 for position loop proportional gain switchover	0 to A8-24 (Deviation 2 for position loop proportional gain switchover)	5	☆
A8-23	Speed loop proportional gain 2	0.00 to 100.00	15	☆
A8-24	Deviation 2 for position loop proportional gain switchover	A8-22 (Deviation 1 for position loop proportional gain switchover) to 60000	20	☆
A8-25	Speed proportional coefficient (slave) (reserved)	0.000 to 60.000	1.000	★
A8-26	Speed filter coefficient	0.000s to 10.000s	0.000s	☆
A8-27	Acceleration rate compensation coefficient	0.00 to 100.00	5.00	☆
A8-28	Acceleration rate moving average filter coefficient	0 to 50	10	☆
A8-29	Minimum pulse deviation	0 to 500	0	☆
A8-30	Maximum pulse deviation	0 to 60000	500	☆
A8-31	Position loop output limit	0.00 Hz to 600.00 Hz	2.00 Hz	☆
A8-32	Detection threshold of excessive deviation	0 to 60000	600	☆
A8-33	Detection time of excessive deviation	0.00 ms to 50.00 ms	1.00 ms	☆
A8-34	Speed/Position synchronization switchover mode	0: No switchover 1: Switchover based on frequency	0	★
A8-35	Speed/Position synchronization switchover frequency	0.00 Hz to F0-10 (Maximum frequency)	50.00 Hz	★
A8-36	Communication delay compensation mode	0: Automatic compensation 1: Calculated based on baud rate 2: Parameter setting (A8-37, Communication delay digital setting)	0	★
A8-37	Communication delay digital setting	0 us to 2000 µs	156 us	★
A8-39	Frequency 1 for position loop proportional gain switchover	0.00 Hz to A8-40 (Frequency 2 for position loop proportional gain switchover)	5.00 Hz	☆
A8-40	Frequency 2 for position loop proportional gain switchover	A8-39 (Frequency 1 for position loop proportional gain switchover) to 600.00 Hz	10.00 Hz	☆
A8-42	Master sending frequency setting channel selection (set for master)	0: Feedback frequency 1: Running frequency	0	★
A8-43	Master sending frequency switchover threshold	0.00 Hz to 600.00 Hz	5.00 Hz	★
A8-50	Master/Slave selection in load allocation	0: Disabled 1: Master 2: Slave	0	★
A8-52	Following master station number (set for slave)	1 to 124	1	★
A8-54	Slave configuration parameter (load allocation)	0: Not following master start/stop command 1: Following master start/stop command	1	★
A8-55	Torque acceleration time	0.000s to 60.000s	0.000s	☆
A8-56	Torque deceleration time	0.000s to 60.000s	0.000s	☆
A8-57	Frequency gain	-10.00 to +10.00	1.00	★
A8-58	Frequency offset	-100.00% to +100.00%	0.00%	★
A8-59	Torque gain	-10.00 to +10.00	1.00	★
A8-60	Torque offset	-100.00% to +100.00%	0.00%	★
A8-61	Master sending frequency setting channel selection (set for master)	0: Feedback frequency 1: Running frequency 2: Running frequency if < A8-62 (Master sending frequency switchover threshold), feedback frequency if > A8-62 (Master sending frequency switchover threshold)	0	☆
A8-62	Master sending frequency switchover threshold	0.00 Hz to 600.00 Hz	5.00 Hz	☆

Para. No.	Para. Name	Setting Range	Default	Property
A8-70	Master/Slave selection in droop control	0: Disabled 1: Master 2: Slave 3: Self-droop	0	★
A8-71	Droop control mode selection	2: Master and slave droop	2	★
A8-72	Following master station number (set for slave)	1 to 124	1	★
A8-74	Slave configuration parameter (droop control)	Ones position 0: Not following master start/stop command 1: Following master start/stop command	1	★
A8-77	Droop ratio	0.00% to 15.00%	5.00%	☆
Group A9: Vector Control Parameters				
A9-00	Online auto-tuning of asynchronous motor rotor time constant	0: Disabled 1: Enabled	0	☆
A9-01	Rotor resistance gain by asynchronous motor auto-tuning in FVC mode	0 to 100	5	☆
A9-02	Start frequency for auto-tuning of asynchronous motor rotor resistance in FVC mode	2 to 100 Hz	7Hz	☆
A9-03	Magnetic field coefficient by auto-tuning of asynchronous motor in FVC mode	30 to 150	40	☆
A9-04	Maximum torque limit coefficient of weaken flux field in SVC/FVC mode	30 to 150	80	☆
A9-05	Speed filter of asynchronous motor in SVC mode	5 to 32 ms	15ms	☆
A9-06	Speed feedback operation of asynchronous motor speed control in SVC mode	0: No operation 1: Minimum synchronization frequency limited based on load change 2, 3: Fixed current output at low-speed running	0	☆
A9-07	Magnetic field adjusting band of asynchronous motor in SVC mode	0 to 8.0 Hz	2.0 Hz	☆
A9-08	Current at low-speed running of asynchronous motor in SVC mode	30 to 170	100	☆
A9-09	Switchover frequency of fixed current output of asynchronous motor in SVC mode	2.0 Hz to 100.0 Hz	3.0 Hz	☆
A9-10	Speed fluctuation suppression coefficient of asynchronous motor in SVC mode	0 to 6	3	☆
A9-11	Acceleration/Deceleration time of asynchronous motor in SVC mode	0.1s to 3000.0s	20.0s	☆
A9-12	Quick auto-tuning of stator resistance before asynchronous motor startup	0: Disabled 1: Enabled	0	☆
A9-13	Stator resistance coefficient 1 by asynchronous motor quick auto-tuning	-		★
A9-14	Stator resistance coefficient 2 by asynchronous motor quick auto-tuning	-		★
A9-15	Stator resistance coefficient 3 by asynchronous motor quick auto-tuning	-		★
A9-17	Real-time angle of synchronous motor	-		☆
A9-18	Initial position angle detection of synchronous motor	0: Detection always 1: No detection 2: Detection at first-time running	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
A9-20	Weaken flux mode	0: Automatic 1: PMSM adjust voltage angle weaken flux 2: PMSM adjust axis D current (Id) weaken flux 3: Disabled	1	★
A9-21	Weaken flux gain of synchronous motor	0 to 50	5	☆
A9-22	Output voltage limit margin of synchronous motor	0% to 50%	5%	☆
A9-23	Maximum force gain of synchronous motor	20% to 300%	100%	☆
A9-24	Excitation current gain of synchronous motor	40% to 200%	100%	☆
A9-25	Speed evaluation integral gain of synchronous motor in SVC mode	5 to 1000	30	☆
A9-26	Speed evaluation proportional gain of synchronous motor in SVC mode	5 to 300	20	☆
A9-27	Speed filter of synchronous motor in SVC mode	10 to 2000	100	☆
A9-28	Minimum carrier frequency of synchronous motor in SVC mode	0.8 kHz to F0-15 (Carrier frequency)	2.0 kHz	☆
A9-29	Synchronous motor low-speed excitation current	0% to 80%	30%	☆
Group AC: AI/AO Correction				
AC-00	AI1 measured voltage 1	-10.000 V to 10.000 V	Factory-corrected	☆
AC-01	AI1 displayed voltage 1	-10.000 V to 10.000 V	Factory-corrected	☆
AC-02	AI1 measured voltage 2	-10.000 V to 10.000 V	Factory-corrected	☆
AC-03	AI1 displayed voltage 2	-10.000 V to 10.000 V	Factory-corrected	☆
AC-04	AI2 measured voltage 1	-10.000 V to 10.000 V	Factory-corrected	☆
AC-05	AI2 displayed voltage 1	-10.000 V to 10.000 V	Factory-corrected	☆
AC-06	AI2 measured voltage 2	-10.000 V to 10.000 V	Factory-corrected	☆
AC-07	AI2 displayed voltage 2	-10.000 V to 10.000 V	Factory-corrected	☆
AC-12	AO target voltage 1	-10.000 V to 10.000 V	Factory-corrected	☆
AC-13	AO measured voltage 1	-10.000 V to 10.000 V	Factory-corrected	☆
AC-14	AO target voltage 2	-10.000 V to 10.000 V	Factory-corrected	☆
AC-15	AO measured voltage 2	-10.000 V to 10.000 V	Factory-corrected	☆
AC-20	PT100 target voltage 1	-3.300 V to 3.300 V	Factory-corrected	☆
AC-21	PT100 measured voltage 1	-3.300 V to 3.300 V	Factory-corrected	☆
AC-22	PT100 target voltage 2	-3.300 V to 3.300 V	Factory-corrected	☆
AC-23	PT100 measured voltage 2	-3.300 V to 3.300 V	Factory-corrected	☆
AC-24	PT1000 target voltage 1	-3.300 V to 3.300 V	Factory-corrected	☆
AC-25	PT1000 measured voltage 1	-3.300 V to 3.300 V	Factory-corrected	☆

Para. No.	Para. Name	Setting Range	Default	Property
AC-26	PT1000 target voltage 2	-3.300 V to 3.300 V	Factory-corrected	☆
AC-27	PT1000 measured voltage 1	-3.300 V to 3.300 V	Factory-corrected	☆
AC-28	AO target current 1	0 mA to 20 mA	Factory-corrected	☆
AC-29	AO measured current 1	0 mA to 20 mA	Factory-corrected	☆
AC-30	AO target current 2	0 mA to 20 mA	Factory-corrected	☆
AC-31	AO measured current 2	0 mA to 20 mA	Factory-corrected	☆
Group AF: Process Data Address Mapping				
AF-00	RPDO1-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-01	RPDO1-SubIndex0-L	0x0000 to 0xFFFF	0x0000	☆
AF-02	RPDO1-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-03	RPDO1-SubIndex1- L	0x0000 to 0xFFFF	0x0000	☆
AF-04	RPDO1-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-05	RPDO1-SubIndex2- L	0x0000 to 0xFFFF	0x0000	☆
AF-06	RPDO1-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-07	RPDO1-SubIndex3- L	0x0000 to 0xFFFF	0x0000	☆
AF-08	RPDO2-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-09	RPDO2-SubIndex0- L	0x0000 to 0xFFFF	0x0000	☆
AF-10	RPDO2-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-11	RPDO2-SubIndex1- L	0x0000 to 0xFFFF	0x0000	☆
AF-12	RPDO2-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-13	RPDO2-SubIndex2- L	0x0000 to 0xFFFF	0x0000	☆
AF-14	RPDO2-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-15	RPDO2-SubIndex3- L	0x0000 to 0xFFFF	0x0000	☆
AF-16	RPDO3-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-17	RPDO3-SubIndex0- L	0x0000 to 0xFFFF	0x0000	☆
AF-18	RPDO3-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-19	RPDO3-SubIndex1- L	0x0000 to 0xFFFF	0x0000	☆
AF-20	RPDO3-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-21	RPDO3-SubIndex2- L	0x0000 to 0xFFFF	0x0000	☆
AF-22	RPDO3-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-23	RPDO3-SubIndex3- L	0x0000 to 0xFFFF	0x0000	☆
AF-24	RPDO4-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-25	RPDO4-SubIndex0- L	0x0000 to 0xFFFF	0x0000	☆
AF-26	RPDO4-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-27	RPDO4-SubIndex1- L	0x0000 to 0xFFFF	0x0000	☆
AF-28	RPDO4-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-29	RPDO4-SubIndex2- L	0x0000 to 0xFFFF	0x0000	☆
AF-30	RPDO4-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-31	RPDO4-SubIndex3- L	0x0000 to 0xFFFF	0x0000	☆
AF-32	TPDO1-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-33	TPDO1-SubIndex0-L	0x0000 to 0xFFFF	0x0000	☆
AF-34	TPDO1-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-35	TPDO1-SubIndex1-L	0x0000 to 0xFFFF	0x0000	☆
AF-36	TPDO1-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-37	TPDO1-SubIndex2-L	0x0000 to 0xFFFF	0x0000	☆
AF-38	TPDO1-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-39	TPDO1-SubIndex3-L	0x0000 to 0xFFFF	0x0000	☆
AF-40	TPDO2-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆

Para. No.	Para. Name	Setting Range	Default	Property
AF-41	TPDO2-SubIndex0-L	0x0000 to 0xFFFF	0x0000	☆
AF-42	TPDO2-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-43	TPDO2-SubIndex1-L	0x0000 to 0xFFFF	0x0000	☆
AF-44	TPDO2-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-45	TPDO2-SubIndex2-L	0x0000 to 0xFFFF	0x0000	☆
AF-46	TPDO2-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-47	TPDO2-SubIndex3-L	0x0000 to 0xFFFF	0x0000	☆
AF-48	TPDO3-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-49	TPDO3-SubIndex0-L	0x0000 to 0xFFFF	0x0000	☆
AF-50	TPDO3-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-51	TPDO3-SubIndex1-L	0x0000 to 0xFFFF	0x0000	☆
AF-52	TPDO3-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-53	TPDO3-SubIndex2-L	0x0000 to 0xFFFF	0x0000	☆
AF-54	TPDO3-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-55	TPDO3-SubIndex3-L	0x0000 to 0xFFFF	0x0000	☆
AF-56	TPDO4-SubIndex0-H	0x0000 to 0xFFFF	0x0000	☆
AF-57	TPDO4-SubIndex0-L	0x0000 to 0xFFFF	0x0000	☆
AF-58	TPDO4-SubIndex1-H	0x0000 to 0xFFFF	0x0000	☆
AF-59	TPDO4-SubIndex1-L	0x0000 to 0xFFFF	0x0000	☆
AF-60	TPDO4-SubIndex2-H	0x0000 to 0xFFFF	0x0000	☆
AF-61	TPDO4-SubIndex2-L	0x0000 to 0xFFFF	0x0000	☆
AF-62	TPDO4-SubIndex3-H	0x0000 to 0xFFFF	0x0000	☆
AF-63	TPDO4-SubIndex3-L	0x0000 to 0xFFFF	0x0000	☆
AF-66	Number of valid RPDOs	0x0000 to 0xFFFF	0x0000	●
AF-67	Number of valid TPDOs	0x0000 to 0xFFFF	0x0000	●
Group B0: Control Mode, Linear Speed, and Winding Diameter				
B0-00	Tension control mode	0: Disabled 1: Open-loop tension torque control 2: Closed-loop tension speed control 3: Closed-loop tension torque control 4: Constant linear peed control	0	★
B0-01	Winding mode	0: Winding 1: Unwinding	0	☆
B0-02	Unwinding reverse tightening selection	0: Enabled 0.01 to 50.00m/min: linear speed of reverse tightening	0	☆
B0-03	Mechanical transmission ratio	0.01 to 300.00	1.00	☆
B0-04	Line speed setting channel	0: No input 1: AI1 2: AI2 4: Pulse input 5: Communication setting (1000H) 6: Communication setting (731AH)	0	★
B0-05	Maximum linear speed	0.1 to 6500.0m/min	1000.0 m/min	☆
B0-06	Minimum linear speed for winding diameter calculation	0.1 to 6500.0m/min	20.0 m/min	☆
B0-07	Winding diameter calculation method	0: Calculated based on linear speed 1: Calculated based on accumulative thickness 2: AI1 3: AI2 5: Pulse input (DIO1)	0	★
B0-08	Maximum winding diameter	1 to 6000.0mm	500.0 mm	☆
B0-09	Reel diameter	1 to 6000.0mm	100.0 mm	☆

Para. No.	Para. Name	Setting Range	Default	Property
B0-10	Setting channel of initial winding diameter	0: B0-11 to B0-13 1: AI1 2: AI2	0	★
B0-11	Initial winding diameter 1	1 mm to 6000.0 mm	100.0 mm	☆
B0-12	Initial winding diameter 2	1 mm to 6000.0 mm	100.0 mm	☆
B0-13	Initial winding diameter 3	1 mm to 6000.0 mm	100.0 mm	☆
B0-14	Current winding diameter	1 mm to 6000.0 mm	100.0 mm	☆
B0-15	Winding diameter filter time	0.00s to 10.00s	5.00s	☆
B0-16	Winding diameter change rate	0: Disabled 0.1 mm to 10.0 mm	1.0	☆
B0-17	Winding diameter change direction limit	0: Disabled 1: Decrease inhibited during winding, and increase inhibited during unwinding	0	☆
B0-18	Winding diameter reset during running	0: Disabled 1: Enabled	0	☆
B0-19	Pre-drive speed gain	-100.0% to +100.0%	0.0%	☆
B0-20	Pre-drive torque limit source	0: F2-09 [Torque limit source in speed control (motoring)] 1: Based on tension	1	★
B0-21	Pre-drive torque correction	-100.0% to +100.0%	0.0%	☆
B0-22	Pre-drive winding diameter calculation delay	0.1s to 6500.0s	10.0s	☆
B0-23	Pre-drive acceleration time (reserved)	0.0s to 6000.0s	0.0s	☆
B0-24	Pre-drive deceleration time (reserved)	0.0s to 6000.0s	0.0s	☆
B0-25	Pre-drive winding diameter calculation function	0: Disabled 1: Enabled	0	☆
B0-26	Closed-loop speed PID control limit (B0-00 = 2) Speed limit (B0-00 ≠ 2)	0.0% to 100.0%	50.0%	☆
B0-27	Closed-loop speed PID control limit offset (B0-00 = 2)	B0-00 = 2: 0.00 Hz to 100.00 Hz	5.00 Hz/%	☆
	Speed limit offset (B0-00 ≠ 2)	B0-00 ≠ 2: 0.00% to 100.00%		
B0-28	Closed-loop speed PID control limit selection (B0-00 = 2)	0: Limit by B0-26 and B0-27 (only limited by F0-10, Maximum frequency) 1: Limit by B0-27	0	☆
	Speed limit selection (B0-00 ≠ 2)	0: Disabled (only limited by F0-10, Maximum frequency) 1: Limit by B0-26 and B0-27		
B0-29	Number of pulses per revolution	1 to 60000	1	☆
B0-30	Revolutions per layer	1 to 10000	100	☆
B0-31	Setting channel of material thickness (reserved)	0: Digital setting 1: AI1 2: AI2	0	☆
B0-32	Material thickness 0	0.01 mm to 100.00 mm	0.01 mm	☆
B0-33	Material thickness 1	0.01 mm to 100.00 mm	0.01 mm	☆
B0-34	Material thickness 2	0.01 mm to 100.00 mm	0.01 mm	☆
B0-35	Material thickness 3	0.01 mm to 100.00 mm	0.01 mm	☆
B0-36	Maximum thickness	0.01 mm to 100.00 mm	1.00 mm	☆
B0-38	Closed-loop tension torque mode main + auxiliary torque	0: Disabled 1: Enabled	1	☆
B0-40	Unwinding motoring allowed	0: Not allowed 1: Allowed	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B0-41	Constant linear speed input source	0: AI1 1: AI2 3: Pulse input 4: Communication settings (1000H) 5: Communication settings (731AH)	0	★
Group B1: Tension Setting				
B1-00	Tension setting channel	0: Set by B0-01 (Winding mode) 1: AI1 2: AI2 4: Pulse reference 5: Communication setting (1000H)	0	★
B1-01	Tension digital setting	0 N to 65000 N	50 N	☆
B1-02	Maximum tension	0 N to 65000 N	200 N	☆
B1-03	Zero-speed threshold	0.0% to 20.0% (F0-10, Maximum frequency)	0.0%	☆
B1-04	Zero-speed tension rise	0.0 to 1000.0%	0.0%	☆
B1-05	Frequency acceleration time in torque control mode (reserved)	0s to 6500.0s	0.0s	☆
B1-06	Frequency deceleration time in torque mode (reserved)	0s to 6500.0s	0.0s	☆
B1-07	Friction force compensation	0.0% to 50.0%	0.0%	☆
B1-08	Mechanical inertia compensation coefficient	$0\ N \cdot m^2$ to $65535\ N \cdot m^2$	$0\ N \cdot m^2$	☆
B1-09	Correction coefficient of acceleration inertia compensation	0.0% to 200.0%	100.0%	☆
B1-10	Correction coefficient of deceleration inertia compensation	0.0% to 200.0%	100.0%	☆
B1-11	Material density	$0\ kg/m^3$ to $60000\ kg/m^3$	0Kg/m^3	☆
B1-12	Material width	0 mm to 60000 mm	0 mm	☆
B1-13	Inertia compensation exit delay	0 ms to 1000 ms	0 ms	☆
B1-16	Closed-loop torque PID control limit	0.0% to 100.0%	50.0%	☆
B1-17	Friction force compensation correction coefficient	-50.0 to +50.0%	0.0%	☆
B1-18	Friction force compensation curve	0: Frequency 1: Linear speed 2: Multi-friction force compensation curve 1 3: Multi-friction force compensation curve 2	0	★
B1-19	Multi-friction force compensation torque 1	0.0 to 50.0%	0.0%	☆
B1-20	Multi-friction force compensation torque 2	0.0 to 50.0%	0.0%	☆
B1-21	Multi-friction force compensation torque 3	0.0 to 50.0%	0.0%	☆
B1-22	Multi-friction force compensation torque 4	0.0 to 50.0%	0.0%	☆
B1-23	Multi-friction force compensation torque 5	0.0 to 50.0%	0.0%	☆
B1-24	Multi-friction force compensation torque 6	0.0 to 50.0%	0.0%	☆
B1-25	Multi-friction force compensation inflexion 1	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
B1-26	Multi-friction force compensation inflexion 2	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
B1-27	Multi-friction force compensation inflexion 3	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
B1-28	Multi-friction force compensation inflexion 4	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆

Para. No.	Para. Name	Setting Range	Default	Property
B1-29	Multi-friction force compensation inflexion 5	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
B1-30	Multi-friction force compensation inflexion 6	0.00 Hz to F0-10 (Maximum frequency)	0.00 Hz	☆
B1-31	Tension establishment	0: Disabled 1: Enabled	0	★
B1-32	Tension establishment dead zone	0.0% to 100.0%	1.0%	★
B1-33	Tension establishment frequency	0.00 Hz to F0-10	0.05Hz	★
B1-34	Tension establishment Kp (only for closed-loop speed mode)	0.0% to 100.0%	1.0%	★
B1-35	Tension establishment Ki (only for closed-loop speed mode)	0.00s to 20.00s	10.00s	★
B1-37	Initial winding diameter free	0: Disabled 1: Enabled	0	★
B1-38	Rod length	1 mm to 65535 mm	300 mm	★
B1-39	Rod angle	1.0° to 360.0°	40.0°	★
Group B2: Taper				
B2-00	Taper curve	0: Curve 1: Linear	0	★
B2-01	Setting channel of tension taper	0: Set by B2-02 (Tension taper) 1: AI1 2: AI2	0	★
B2-02	Tension taper	0.0 to 100.0%	0.0%	☆
B2-03	Correction coefficient of taper compensation	0 mm to 10000 mm	0 mm	☆
B2-04	Closed-loop tension taper function	0: Disabled 1: Enabled	0	★
B2-05	Setting channel of maximum external taper	0: Set by B2-06 (Maximum external taper setting) 1: AI1 2: AI2	0	★
B2-06	Maximum external taper setting	0.0% to 100.0%	100.0%	☆
B2-07	Linear taper inflexion quantity	0 to 5	5	☆
B2-08	Taper corresponding to minimum reel diameter	0.0 to 100.0%		☆
B2-09	Linear taper switchover point 1	B0-09 (Linear taper switchover point 1) to B0-08 (Taper corresponding to minimum reel diameter) (mm)	150.0	☆
B2-10	Taper of switchover point 1	0.0 to 100.0%	100.0	☆
B2-11	Linear taper switchover point 2	B2-09 (Linear taper switchover point 1) to B0-08 (Taper corresponding to minimum reel diameter) mm)	200.0	☆
B2-12	Taper of switchover point 2	0.0 to 100.0%	90.0	☆
B2-13	Linear taper switchover point 3	B2-11 (Linear taper switchover point 2) to B0-08 (Taper corresponding to minimum reel diameter) (mm)	250.0	☆
B2-14	Taper of switchover point 3	0.0 to 100.0%	80.0	☆
B2-15	Linear taper switchover point 4	B2-13 (Linear taper switchover point 3) to B0-08 (Taper corresponding to minimum reel diameter) (mm)	300.0	☆
B2-16	Taper of switchover point 4	0.0 to 100.0%	70.0	☆
B2-17	Linear taper switchover point 5	B2-15 (Linear taper switchover point 4) to B0-08 (Taper corresponding to minimum reel diameter) (mm)	400.0	☆
B2-18	Taper of switchover point 5	0.0 to 100.0%	50.0	☆
B2-19	Taper corresponding to maximum winding diameter	0.0 to 100.0%	30.0	☆
B2-20	Taper corresponding to maximum reel diameter	0.0% to 100.0%	30.0%	☆

Para. No.	Para. Name	Setting Range	Default	Property
Group B3: Pulse Synchronization Parameters (EtherCAT Version)				
B3-00	Pulse synchronization mode	0: Speed synchronization 1: Position synchronization 2: Pulse positioning	0	★
B3-01	Pulse mode selection	0: Pulse + Direction 1: Two quadrature pulses	1	★
B3-02	Quadrature pulse AB phase sequence	0: Forward 1: Reverse	0	★
B3-03	Acceleration time (position synchronization)	0.0 to 6500.0s	0	☆
B3-04	Deceleration time (position synchronization)	0.0 to 6500.0s	0	☆
B3-05	Feedforward gain (position synchronization)	0.00 to 600.00	1.00	☆
B3-06	Proportional gain 1 (position synchronization)	0.00 to 100.00	1.50	☆
B3-07	Electronic gear ratio (numerator)	1 to 30000	1	☆
B3-08	Electronic gear ratio (denominator)	1 to 30000	1	☆
B3-09	Pulse frequency filter time	0 to 65536	0	☆
B3-10	Pulse frequency filter coefficient (moving average filter)	0 to 100	0	☆
B3-11	Proportional gain switchover selection (position synchronization)	0: No switchover 1: Automatic switchover based on the deviation	0	★
B3-12	Proportional gain 2 (position synchronization)	0.00 to 100.00	15.00	☆
B3-13	Proportional gain switchover position deviation level 1 (position synchronization)	0 to 30000	5	☆
B3-14	Proportional gain switchover position deviation level 2 (position synchronization)	0 to 30000	50	☆
B3-15	Acceleration compensation gain	0.00 to 10.00	0.00	☆
B3-16	Maximum pulse deviation	1 to 10000	5.00Hz	☆
B3-17	Position lock proportional gain	0.00 to 100.00	1.50	☆
B3-18	Minimum pulse deviation	0 to 1000	2	☆
B3-19	Minimum frequency given in pulse synchronization	0.0010 to 5.0000 Hz	0.01Hz	☆
B3-20	Frequency for pulse speed synchronization automatic switchover	0.00 to F0-12	0	☆
B3-21	Detection level of pulse deviation	0 to 20000	600	☆
B3-22	Detection time of pulse deviation	0.00 to 10.00	1.00	☆
B3-23	Forced speed synchronization switchover enabling	0 to 1	0	☆
B3-24	Threshold for forced speed synchronization frequency switchover	0.00 to 100.00	50.00	☆
B3-25	Judging time for stop upon forced speed synchronization failure	0.00 to 5.00	0.00	☆
B3-26	Frequency limit start point	0.00 to 600.00	50.00	☆
B3-27	Maximum frequency overshoot	0.00 to 50.00	0.00	☆
B3-28	Reference pulse stepping rate	0 to 60000	1000	☆

Para. No.	Para. Name	Setting Range	Default	Property
Group B4 Position Control Function				
B4-00	Position control valid	0: Disabled 1: Enabled	0	★
B4-01	Position control function	0: Incremental 1: Absolute 2: Degree 3: Fixed length degree	0	★
B4-02	Electronic gear ratio (numerator)	1 to 30000	1	★
B4-03	Electronic gear ratio (denominator)	1 to 30000	1	★
B4-04	Reserved		0	●
B4-05	Position control home signal source	Ones position: Incremental 2: Current position Tens position: Absolute 1: DI terminal Hundreds position: Degree 0: Encoder Z signal 1: DI terminal Thousands position: Fixed length degree 0: Encoder Z signal 1: DI terminal	1012	★
B4-06	Reserved	0 to 0	0	●
B4-07	DI home signal active mode	0: Active at falling edge 1: Active at rising edge	1	★
B4-08	DI home signal filter time	0 to 5.000s	0.010s	☆
B4-09	Home enabling control	0: No operation 1: Immediate home searching 2: Current position used as home 3: Clear home 4: No home, auto home searching after startup	0	☆
B4-10	Home searching mode	Ones position: Incremental 0: No operation Tens position: Absolute 0: Forward searching 1: Reverse searching 2: Forward searching, direction changed automatically in limit switch active mode 3: Reverse searching, direction changed automatically in limit switch active mode Hundreds position: Degree 0: Forward searching 1: Reverse searching Thousands position: Fixed length degree 0: Forward searching 1: Reverse searching	0020	★
B4-11	Home searching speed	0.10 Hz to 50.00 Hz	5.00 Hz	★
B4-12	Home searching acceleration time	0.10s to 600.00s	10.00s	☆
B4-13	Home searching deceleration time	0.10s to 600.00s	10.00s	☆
B4-14	Action after home searching	0: Decelerate to 0 1: Decelerate to 0 and start position control 2: Return to mechanical home 3: Return to mechanical home after relative offset	2	★
B4-15	Home offset (low bits)	0 to 65535	0	★
B4-16	Home offset (high bits)	0 to 16384	0	★
B4-17	Home offset direction	0: Forward 1: Reverse	0	★
B4-18	Home searching time limit	1.00s to 600.00s	30.00s	☆
B4-19	Home deviation threshold	4 to 60000 pulses	100 pulses	☆

Para. No.	Para. Name	Setting Range	Default	Property
B4-20	Home update mode for incremental positioning	0: Update home at zero speed 1: Update home when repositioning triggered 2: Save unexecuted position reference during running	1	★
B4-21	Judge of positioning almost completed	0: Deviation to the target position less than B4-22 (unit: quadrupled encoder resolution) for the time set by B4-23 and its output time is longer than or equal to B4-24 1: Deviation to the target position less than B4-22 (unit: determined by B5-26) for the time set by B4-23 and its output time is longer than or equal to B4-24 2: Deviation to the target position less than B4-22 (unit: quadrupled encoder resolution) for the time set by B4-23 and its output time is equal to B4-24 3: Deviation to the target position less than B4-22 (unit: determined by B5-26) for the time set by B4-23 and its output time is equal to B4-24	0	★
B4-22	Threshold of positioning almost completed	0 to 60000	500	☆
B4-23	Judge time of positioning almost completed	0 to 5.000s	0.005s	☆
B4-24	Output time of positioning almost completed	0 to 600.00s	0.05s	☆
B4-25	Output target position reference for positioning almost completed	0 to 24	0	★
B4-26	Judge of positioning completed	0: Deviation to the target position less than B4-27 (unit: quadrupled encoder resolution) for the time set by B4-28 and its output time is longer than or equal to B4-29 1: Deviation to the target position less than B4-27 (unit: determined by B5-26) for the time set by B4-28 and its output time is longer than or equal to B4-29 2: Deviation to the target position less than B4-27 (unit: quadrupled encoder resolution) for the time set by B4-28 and its output time is equal to B4-29 3: Deviation to the target position less than B4-27 (unit: determined by B5-26) for the time set by B4-28 and its output time is equal to B4-29	0	★
B4-27	Threshold of positioning completed	0 to 60000	50	☆
B4-28	Judge time of positioning completed	0 to 5.000s	0.005s	☆
B4-29	Output time of positioning completed	0 to 600.00s	0.05s	☆
B4-30	Output target position reference for positioning completed	0 to 24	0	★
B4-31	Degree position reference unit	0: Encoder resolution (quadrupled) 1: 0.1° (1 revolution corresponding to 360.0°)	0	★
B4-32	Degree position reference source selection	0: Set by B4-33 (Degree position reference digital setting) 1: Multi-position reference	0	★
B4-33	Degree position reference digital setting	0 to 60000	0	☆
B4-34	Positioning direction (Degree and fixed length degree)	0: Forward 1: Reverse	0	★
B4-35	Degree positioning direction setting channel	0: Set by B4-34 (Positioning direction) 1: Nearby positioning	1	★
B4-36	Nearby positioning failure speed	0.10 to 10.00 Hz	2.00 Hz	★
B4-37	Speed feedforward gain	0.00 to 100.00 %	100.00%	★
B4-38	Speed loop proportional gain 1	0.01 to 100.00	1.50	☆
B4-39	Speed loop proportional gain 2	0.01 to 100.00	8.00	☆

Para. No.	Para. Name	Setting Range	Default	Property
B4-40	Position loop proportional gain switchover condition	0: No switchover, fixed to position loop proportional gain 1 1: Switchover based on position deviation 2: Switchover based on speed	0	★
B4-41	Deviation 1 for position loop proportional gain switchover	0 to B4-42	20	☆
B4-42	Deviation 2 for position loop proportional gain switchover	B4-41 to 60000	100	☆
B4-43	Frequency 1 for position loop proportional gain switchover	0.00 Hz to B4-44	5.00 Hz	☆
B4-44	Frequency 2 for position loop proportional gain switchover	B4-43 to 500.00 Hz	20.00 Hz	☆
B4-45	Position loop output limit	0.01 Hz to 30.00 Hz	5.00 Hz	☆
B4-46	Positioning deviation threshold	0 to 500	2	☆
B4-47	Reserved	0 to 0	0	●
B4-48	Reserved	0 to 0	0	●
B4-49	Multi-position reference digital setting	1 to 24	1	☆
B4-50	Multi-position reference running mode	0: No switchover, fixed to position reference segment set by B4-49 1: Switchover by DI 2: Single sequential running 3: Cyclic running 4: Communication setting	0	★
B4-51	Start position No. of multi-position reference	1 to B4-52	1	★
B4-52	End position No. of multi-position reference	B4-51 to 24	1	★
B4-53	Whether to continue multi-position running mode	0: Restart from the startup segment 1: Continue uncompleted position reference segment	1	★
B4-54	Reserved	0 to 0	0	●
B4-55	Position control mode	0: Open-loop 1: Closed-loop	1	★
B4-56	Initial speed of position control switchover during running	0.50 Hz to 100.00 Hz	10.00 Hz	☆
B4-57	Position control source selection	0: Null (effective for position control) 1: DI terminal (DI-70) 2: Communication (731EH)	0	★
B4-58	DI terminal position control active mode	0: Low level active 1: High level active	1	★
B4-59	Repositioning command source selection	0: DI terminal 1: Communication (731EH)	0	★
B4-60	Reserved	0 to 0	0	●

Para. No.	Para. Name	Setting Range	Default	Property
B4-61	Position control function 1	Ones position: Home retentive at power failure 0: Disabled 1: Enabled Tens position: Home correction 0: Disabled 1: Enabled Hundreds position: Nearby positioning upon startup in fixed length degree mode 0: Disabled 1: Enabled Thousands position: Soft limit 0: Disabled 1: Enabled Ten thousands position: CiA402 protocol effective or not 0: Disabled 1: Enabled	00010	★
B4-62	Position control function 2	Ones position: Whether repositioning allowed during positioning 0: Disabled 1: Enabled Tens position: Whether positioning triggered upon startup 0: No 1: Yes	11	★
B4-63	Soft limit forward position (low bits)	0 to 65535	0	☆
B4-64	Soft limit forward position (high bits)	0 to 16384	0	☆
B4-65	Soft limit reverse position (low bits)	0 to 65535	0	☆
B4-66	Soft limit reverse position (high bits)	0 to 16384	0	☆
B4-67	Home loss threshold during home correction	0 to 1000	0	☆
B4-68	DI limit protection function	0: Coast to stop 1: Decelerate to stop 2: Lock shaft after decelerating to 0	0	★
B4-69	Minimum direction change frequency upon valid DI limit	0.10 Hz to 10.00 Hz	1.50 Hz	☆
B4-70	Direction change frequency active time upon valid DI limit	1 to 500 ms	1 ms	☆
B4-71	Position loop gain Kp upon position lock	0.01 to 100.00	1.50	☆
B4-72	Position loop output limit upon position lock	0.00 Hz to 10.00 Hz	1.00 Hz	☆
B4-73	Position deviation threshold upon position lock	0 to 5000	2	☆
B4-74	Disabling output delay	0.00s to 600.00s	0.05s	☆
Group B5 Multi-position Reference				
B5-00	Position control acceleration time 1	0.01 to 600.00s	10.00s	☆
B5-01	Position control deceleration time 1	0.01 to 600.00s	10.00s	☆
B5-02	Position control acceleration time 2	0.01 to 600.00s	10.00s	☆
B5-03	Position control deceleration time 2	0.01 to 600.00s	10.00s	☆
B5-04	Position control acceleration time 3	0.01 to 600.00s	10.00s	☆
B5-05	Position control deceleration time 3	0.01 to 600.00s	10.00s	☆
B5-06	Position control acceleration time 4	0.01 to 600.00s	10.00s	☆
B5-07	Position control deceleration time 4	0.01 to 600.00s	10.00s	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-08	Waiting time of positioning completed 1	0.00 to 600.00s	0.01s	☆
B5-09	Waiting time of positioning completed 2	0.00 to 600.00s	0.01s	☆
B5-10	Waiting time of positioning completed 3	0.00 to 600.00s	0.01s	☆
B5-11	Waiting time of positioning completed 4	0.00 to 600.00s	0.01s	☆
B5-12	Maximum frequency reference selection for position control	0: 100.00% 1: AI1 2: AI2 3: Communication setting (7320H)	0	★
B5-13	Maximum frequency digital setting for position control	1.00 Hz to 600.00 Hz	50.00 Hz	★
B5-14	Position control frequency upper limit 1	0 to 100.00%	50.00%	★
B5-15	Position control frequency upper limit 2	0 to 100.00%	50.00%	★
B5-16	Position control frequency upper limit 3	0 to 100.00%	50.00%	★
B5-17	Position control frequency upper limit 4	0 to 100.00%	50.00%	★
B5-18	Position control frequency upper limit 5	0 to 100.00%	50.00%	★
B5-19	Position control frequency upper limit 6	0 to 100.00%	50.00%	★
B5-20	Position control frequency upper limit 7	0 to 100.00%	50.00%	★
B5-21	Position control frequency upper limit 8	0 to 100.00%	50.00%	★
B5-22	Reserved	0 to 65535	0	●
B5-23	Reserved	0 to 65535	0	●
B5-24	Reserved	0 to 65535	0	●
B5-25	Position control acceleration/ deceleration base frequency	0: F0-10 (Maximum frequency) 1: 50.00 Hz	1	★
B5-26	Position reference unit	0: Pulse (encoder resolution quadrupled) 1: mm 2: cm	0	★
B5-27	Conversion coefficient between reference unit and pulse	0 to 6553.5	1.0	★
B5-28	Multi-position reference 1 (low digits)	0 to 65535	0	☆
B5-29	Multi-position reference 1 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-30	Multi-position reference 1 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-31	Multi-position reference 2 (low digits)	0 to 65535	0	☆
B5-32	Multi-position reference 2 (high digits)	0 to 16384	0	☆
B5-33	Multi-position reference 2 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-34	Multi-position reference 3 (low digits)	0 to 65535	0	☆
B5-35	Multi-position reference 3 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-36	Multi-position reference 3 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control speed upper limit 1 2: Position control speed upper limit 2 3: Position control speed upper limit 3 4: Position control speed upper limit 4 5: Position control speed upper limit 5 6: Position control speed upper limit 6 7: Position control speed upper limit 7 8: Position control speed upper limit 8	1110	☆
B5-37	Multi-position reference 4 (low digits)	0 to 65535	0	☆
B5-38	Multi-position reference 4 (high digits)	0 to 16384	0	☆
B5-39	Multi-position reference 4 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control speed upper limit 1 2: Position control speed upper limit 2 3: Position control speed upper limit 3 4: Position control speed upper limit 4 5: Position control speed upper limit 5 6: Position control speed upper limit 6 7: Position control speed upper limit 7 8: Position control speed upper limit 8	1110	☆
B5-40	Multi-position reference 5 (low digits)	0 to 65535	0	☆
B5-41	Multi-position reference 5 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-42	Multi-position reference 5 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-43	Multi-position reference 6 (low digits)	0 to 65535	0	☆
B5-44	Multi-position reference 6 (high digits)	0 to 16384	0	☆
B5-45	Multi-position reference 6 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-46	Multi-position reference 7 (low digits)	0 to 65535	0	☆
B5-47	Multi-position reference 7 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-48	Multi-position reference 7 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-49	Multi-position reference 8 (low digits)	0 to 65535	0	☆
B5-50	Multi-position reference 8 (high digits)	0 to 16384	0	☆
B5-51	Multi-position reference 8 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-52	Multi-position reference 9 (low digits)	0 to 65535	0	☆
B5-53	Multi-position reference 9 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-54	Multi-position reference 9 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-55	Multi-position reference 10 (low digits)	0 to 65535	0	☆
B5-56	Multi-position reference 10 (high digits)	0 to 16384	0	☆
B5-57	Multi-position reference 10 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-58	Multi-position reference 11 (low digits)	0 to 65535	0	☆
B5-59	Multi-position reference 11 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-60	Multi-position reference 11 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-61	Multi-position reference 12 (low digits)	0 to 65535	0	☆
B5-62	Multi-position reference 12 (high digits)	0 to 16384	0	☆
B5-63	Multi-position reference 12 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-64	Multi-position reference 13 (low digits)	0 to 65535	0	☆
B5-65	Multi-position reference 13 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-66	Multi-position reference 13 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-67	Multi-position reference 14 (low digits)	0 to 65535	0	☆
B5-68	Multi-position reference 14 (high digits)	0 to 16384	0	☆
B5-69	Multi-position reference 14 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-70	Multi-position reference 15 (low digits)	0 to 65535	0	☆
B5-71	Multi-position reference 15 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-72	Multi-position reference 15 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-73	Multi-position reference 16 (low digits)	0 to 65535	0	☆
B5-74	Multi-position reference 16 (high digits)	0 to 16384	0	☆
B5-75	Multi-position reference 16 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-76	Multi-position reference 17 (low digits)	0 to 65535	0	☆
B5-77	Multi-position reference 17 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-78	Multi-position reference 17 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-79	Multi-position reference 18 (low digits)	0 to 65535	0	☆
B5-80	Multi-position reference 18 (high digits)	0 to 16384	0	☆
B5-81	Multi-position reference 18 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-82	Multi-position reference 19 (low digits)	0 to 65535	0	☆
B5-83	Multi-position reference 19 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-84	Multi-position reference 19 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-85	Multi-position reference 20 (low digits)	0 to 65535	0	☆
B5-86	Multi-position reference 20 (high digits)	0 to 16384	0	☆
B5-87	Multi-position reference 20 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-88	Multi-position reference 21 (low digits)	0 to 65535	0	☆
B5-89	Multi-position reference 21 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-90	Multi-position reference 21 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-91	Multi-position reference 22 (low digits)	0 to 65535	0	☆
B5-92	Multi-position reference 22 (high digits)	0 to 16384	0	☆
B5-93	Multi-position reference 22 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-94	Multi-position reference 23 (low digits)	0 to 65535	0	☆
B5-95	Multi-position reference 23 (high digits)	0 to 16384	0	☆

Para. No.	Para. Name	Setting Range	Default	Property
B5-96	Multi-position reference 23 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆
B5-97	Multi-position reference 24 (low digits)	0 to 65535	0	☆
B5-98	Multi-position reference 24 (high digits)	0 to 16384	0	☆
B5-99	Multi-position reference 24 setting	Ones position: Position reference mark 0: Positive 1: Negative Tens position: Acceleration/ Deceleration time selection 1: Position control acceleration/deceleration time 1 2: Position control acceleration/deceleration time 2 3: Position control acceleration/deceleration time 3 4: Position control acceleration/deceleration time 4 Hundreds position: Waiting time after positioning completed 0: No waiting 1: Waiting time after positioning completed 1 2: Waiting time after positioning completed 2 3: Waiting time after positioning completed 3 4: Waiting time after positioning completed 4 Thousands position: Position control speed upper limit 1: Position control frequency upper limit 1 2: Position control frequency upper limit 2 3: Position control frequency upper limit 3 4: Position control frequency upper limit 4 5: Position control frequency upper limit 5 6: Position control frequency upper limit 6 7: Position control frequency upper limit 7 8: Position control frequency upper limit 8	1110	☆

C.2 Monitoring Parameters

Parameter No.	Parameter Name	Min. Unit	Communication Address
Group U0: Basic Monitoring Parameters			
U0-00	Running frequency	0.01 Hz	7000H
U0-01	Frequency reference	0.01 Hz	7001H
U0-02	Bus voltage	0.1 V	7002H
U0-03	Output voltage	1 V	7003H
U0-04	Output current	0.1 A	7004H
U0-05	Output power	0.1 kW	7005H
U0-06	Output torque	0.1%	7006H
U0-07	DI state	1	7007H
U0-08	DO state	1	7008H
U0-09	AI1 voltage	0.01 V	7009H
U0-10	AI2 voltage	0.01 V	700AH
U0-11	Motor rotation speed	1 RPM	700BH
U0-12	Count value	1	700CH
U0-13	Length value	1	700DH
U0-14	Load speed display	1	700EH
U0-15	PID reference	1%	700FH
U0-16	PID feedback	1%	7010H
U0-17	PLC stage	1	7011H
U0-18	Pulse input frequency	0.01 kHz	7012H
U0-19	Feedback frequency	0.01 Hz	7013H
U0-20	Remaining running time	0.1 min	7014H
U0-21	AI1 voltage before correction	0.001 V	7015H
U0-22	AI2 voltage before correction	0.001 V	7016H
U0-24	Linear speed	1 m/min	7018H
U0-25	Accumulative power-on time	1 min	7019H
U0-26	Accumulative running time	0.1 min	701 AH
U0-27	Pulse input frequency	1 Hz	701BH
U0-28	Communication setting	0.01%	701CH
U0-29	Encoder feedback speed	0.01 Hz	701DH
U0-30	Main frequency X display	0.01 Hz	701EH
U0-31	Auxiliary frequency Y display	0.01 Hz	701FH
U0-33	Synchronous motor rotor position	0.1°	7021H
U0-34	Motor temperature	1°C	7022H
U0-35	Target torque	0.1%	7023H
U0-37	Power factor angle	0.1°	7025H
U0-38	ABZ position	1	7026H
U0-39	Target voltage upon V/F separation	1 V	7027H
U0-40	Output voltage upon V/F separation	1 V	7028H

Parameter No.	Parameter Name	Min. Unit	Communication Address
U0-41	DI state display	1	7029H
U0-42	DO state display	1	702AH
U0-43	DI function state display 1 (functions 01 to 40)	1	702BH
U0-44	DI function state display 2 (functions 41 to 80)		702CH
U0-45	Fault subcode	1	702DH
U0-46	Heatsink temperature	1°C	702EH
U0-47	Voltage before PTC channel correction (only PT100 and PT1000 supported)	0.001 V	702FH
U0-48	Voltage after PTC channel correction (only PT100 and PT1000 supported)	0.001 V	7030H
U0-49	Pulses for position lock deviation	1	7031H
U0-58	Encoder Z signal counting	1	703AH
U0-59	Frequency reference	0.01%	703BH
U0-60	Running frequency	0.01%	703CH
U0-61	AC drive state 1 (1: Forward running; 2: Reverse running; 3. Stopped; 4: Auto-tuning; 5: Faulty)	1	703DH
U0-62	Fault code	1	703EH
U0-67	Expansion card version	1	7043H
U0-68	AC drive state 2	1	7044H
U0-69	Feedback frequency	0.01 Hz	7045H
U0-74	Target torque in torque mode (after filter time A0-04)	0.1%	704AH
U0-75	Real-time target torque in torque mode (after acceleration and deceleration time A0-07 and A0-08)	0.1%	704BH
U0-76	Target torque upper limit	0.1%	704CH
U0-77	Generation torque upper limit	0.1%	704DH
U0-80	EtherCAT slave station name (effective upon power-on)	1	7050H
U0-81	EtherCAT slave station alias (effective upon power-on)	1	7051H
U0-82	ESM transmission error code	1	7052H
U0-83	XML file version	1	7053H
U0-84	Number of synchronization loss	1	7054H
U0-85	Maximum error value and invalid frames of EtherCAT port 0 per unit time	1	7055H
U0-86	Maximum error value and invalid frames of EtherCAT port 1 per unit time	1	7056H
U0-88	Maximum transfer error of EtherCAT port per unit time	1	7058H
U0-89	Maximum EtherCAT data frame processing unit error per unit time	1	7059H
U0-90	Maximum link loss of EtherCAT port per unit time	1	705AH
U0-91	Station alias backup	1	705BH

Parameter No.	Parameter Name	Min. Unit	Communication Address
Group U1: Tension Monitoring Parameters			
U1-00	Current linear speed	0.1 m/min	7100H
U1-01	Current winding diameter	0.1 mm	7101H
U1-02	Linear speed mapping frequency	0.01 Hz	7102H
U1-03	Current tension reference	1 N	7103H
U1-04	Tension after taper calculation	1 N	7104H
U1-05	Tension calculation torque	0.1%	7105H
U1-06	PID output	0.01 Hz	7106H
U1-07	Acceleration rate	0.1 m/min/s	7107H
U1-16	Torque PID reference	0.1%	7110H
U1-17	Torque PID feedback	0.1%	7111H
U1-18	Torque PID output	0.1%	7112H
U1-19	Frequency PID reference	0.1%	7113H
U1-20	Frequency PID feedback	0.1%	7114H
U1-21	Frequency PID output	0.01 Hz	7115H
Group U2: Position Control Monitoring Parameters			
U2-60	Real-time position deviation during position control	1	723CH
U2-61	Valid home tag	1	723DH
U2-62	Home position (low 16 bits)	1	723EH
U2-63	Home position (high 16 bits)	1	723FH
U2-64	Z signal position (low 16 bits)	1	7240H
U2-65	Z signal position (high 16 bits)	1	7241H
U2-66	Current position reference segment	1	7242H
U2-67	Output flag of positioning almost completed	1	7243H
U2-68	Output flag of positioning completed	1	7244H
U2-69	Position control mode	1	7245H
U2-70	Number of pulses per revolution of encoder	1	7246H
U2-71	Number of pulses per revolution of spindle	1	7247H
U2-72	Number of pulses per revolution of motor	1	7248H
U2-73	Current encoder degree	1	7249H
U2-74	Current encoder degree (angle)	0.1°	724AH
U2-75	Adjacent home position deviation (low 16 bits)	1	724BH
U2-76	Adjacent home position deviation (high 16 bits)	1	724CH
U2-77	Home counter	1	724DH
U2-78	Position control state	1	724EH
U2-79	Real-time position deviation during position control	1	724FH
U2-80	Relative home position direction	1	7250H
U2-81	Relative home position deviation (low 16 bits)	1	7251H
U2-82	Relative home position deviation (high 16 bits)	1	7252H

Parameter No.	Parameter Name	Min. Unit	Communication Address
U2-83	Position	1	7253H
U2-84	Speed	1	7254H
U2-85	Current spindle degree	1	7255H
U2-86	Current spindle degree (angle)	0.1°	7256H
U2-87	Position control enabling flag	1	7257H
U2-88	Position control enabling command set by communication	1	7258H
U2-89	Position lock operation flag in position control	1	7259H
U2-90	Position control frequency upper limit	0.01Hz	725AH
U2-91	Spindle stopping flag	1	725BH
U2-92	Home loss counting during home correc-tion	1	725CH
U2-93	Encoder Z signal counter	1	725DH
U2-95	Encoder pulse counting (low 16 bits)	1	725FH
U2-96	Encoder pulse counting (high 16 bits)	1	7260H

Memo NO. ____________

Date / /

Appendix D Parameter Table of the Power Supply Unit

Set a non-zero value for FP-00 (Parameter initialization) to enable password protection for viewing and modifying parameters. To disable password protection, set FP-00 to zero.

The password protection only applies to the operation using the operating panel. Enter the password to view and modify the parameters. Viewing or modifying the parameters (groups FP and FF exclusive) through communication is not protected by the password.

The user-defined parameters are not protected by the password.

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

The parameter description tables in this chapter use the following symbols.

The symbols in the parameter table are described as follows:

Symbol	Meaning
☆	It is possible to modify the parameter with the AC drive in the Stop and in the Run status.
★	It is not possible to modify the parameter with the AC drive in the Run status.
●	The parameter is the actual measured value and cannot be modified.
*	The parameter is a factory parameter and can be set only by the manufacturer.

D.1 Basic Function Parameters

Param. No.	Param. Name	Setting Range	Default	Property
Group F0: Basic Parameters				
F0-00	Module type	2: Power supply unit	2	●
F0-01	Product SN	810	810	●
F0-02	Software version	General version: uxx.xx Interim version: Lxx.xx; customized version: Fxx.xx	-	●
F0-03	Software version upgrade process	xxx.xx	-	●
F0-04	Customized SN	0-9999	-	●
Group F1: Standard Parameters				
F1-00	Undervoltage threshold	300 to 500 V	350 V	☆
F1-01	Bus overvoltage threshold	700 to 850 V	820 V	☆
F1-02	Braking unit applied voltage	700 to 800 V	760 V	☆
F1-03	Soft start of a single power supply unit	0:Soft start with drive units connected in parallel 1:Soft start without drive units connected in parallel	0	☆
F1-04	Reserved	-	-	●
F1-05	Reserved	-	-	●
F1-06	Usr correction coefficient	80.0% to 140.0%	100.0%	☆
F1-07	Ust correction coefficient	80.0% to 140.0%	100.0%	☆
F1-08	Utr correction coefficient	80.0% to 140.0%	100.0%	☆
F1-09	Fan control mode	0: Automatic running The fan starts when temperature is above 45°C . The fan stops when temperature is below 40°C . 1: Always running	1	☆

Param. No.	Param. Name	Setting Range	Default	Property
F1-10	Protection of braking transistor direct connection	0: Disabled 1: Enabled Ones: Braking transistor direct connection protection (enabled forcibly) Tens: Braking transistor overcurrent protection (enabled forcibly) Hundreds: Braking transistor overload protection (enabled forcibly)	111	●
F1-11	Protection of abnormal three-phase input	0: Disabled 1: Enabled Ones: Input phase loss Tens: High three-phase input voltage Hundreds: Three-phase input voltage unbalance	111	☆
F1-12	Reserved	-	-	●
F1-13	Protection of abnormal communication	0: Disabled 1: Enabled	1	●
F1-14	IGBT overtheat protection	0: Disabled 1: Enabled Ones: Module overheat fault (enabled forcibly) Tens: Module overheat warning (enabled forcibly)	11	●
F1-15	EEPROM fault protection	0: Disabled 1: Enabled	1	●
F1-16	Reserved	-	-	●
F1-17	Protection of abnormal communication between power supply unit and drive unit	0: Disabled 1: Enabled	1	☆
F1-18	Timeout time of communication between power supply unit and drive unit	1.00s to 20.00s	5.00s	☆
Group F2: Information Exchange Between Power Supply Unit and Drive Unit				

Param. No.	Param. Name	Setting Range	Default	Property
F2-00	Drive unit protection upon high mains voltage	1: Able to run 2. Coast to stop 3: Stop according to the stop mode	2	●
F2-01	Drive unit protection upon low mains voltage		1	●
F2-02	Drive unit protection upon three-phase input voltage imbalance		3	●
F2-03	Drive unit protection upon input phase loss		3	●
F2-04	Drive unit protection upon braking transistor direct connection		2	●
F2-05	Drive unit protection upon braking transistor overcurrent		1	●
F2-06	Drive unit protection upon braking transistor overload		1	●
F2-07	Reserved		0	●
F2-08	Reserved		0	●
F2-09	Drive unit protection upon abnormal communication		1	●
F2-10	Reserved		0	●
F2-11	Drive unit protection upon EEPROM fault		3	●
F2-12	Drive unit protection upon IGBT overheat		2	●
F2-13	Drive unit protection upon IGBT overheat warning		3	☆
F2-14	Power supply unit protection upon high mains voltage	0: Able to run 1: Coast to stop	1	☆
Group F4: DI terminals				
F4-00	DI1 function selection	0: No function 1: RUN enabled 2: Incoming circuit breaker feedback 3: Auxiliary circuit breaker feedback 4: Residual current device feedback 5: Fault reset 6: RUN disabled for drive unit 7: Drive unit coasting to stop 8: Drive unit stop according to the stop mode	5	☆
F4-01	DI2 function selection		0	☆
F4-02	DI3 function selection		0	☆
F4-03	DI4 function selection		0	☆
F4-04	DI5 function selection		0	☆
F4-05	DI1 filter time	0.000s to 5.000s	0.010s	☆
F4-06	DI2 filter time			☆
F4-07	DI3 filter time			☆
F4-08	DI4 filter time			☆
F4-09	DI5 filter time			☆
F4-10	DI1 active delay	0.00s to 600.00s	0.00s	☆
F4-11	DI2 active delay			☆
F4-12	DI3 active delay			☆
F4-13	DI4 active delay			☆
F4-14	DI5 active delay			☆

Param. No.	Param. Name	Setting Range	Default	Property
F4-15	DI1 inactive delay	0.00s to 600.00s	0.00s	☆
F4-16	DI2 inactive delay			☆
F4-17	DI3 inactive delay			☆
F4-18	DI4 inactive delay			☆
F4-19	DI5 inactive delay			☆
F4-20	DI active mode selection	0: Low level active 1: High level active Ones: DI1 active mode Tens: DI2 active mode Hundreds: DI3 active mode Thousands: DI4 active mode Ten thousands: DI5 active mode	00000	☆
Group F5: DO terminals				
F5-00	RO1 function selection	0: No function 1: Able to run 2: Fault 3: Alarm 4: Circuit breaker working 5: Bus undervoltage 6: Bus overvoltage 7: Normal bus voltage 11: Abnormal bus voltage 12: Abnormal three-phase input 13: Normal three-phase input 14: Output upon heatsink overheat 15: Output upon SCR overheat warning	0	☆
F5-01	RO2 function selection		0	☆
F5-02	RO3 function selection		0	☆
F5-03	RO1 active delay	0.00s to 600.00s	0.00s	☆
F5-04	RO2 active delay		0.00s	☆
F5-05	RO3 active delay		0.00s	☆
F5-06	RO1 inactive delay	0.00s to 600.00s	0.00s	☆
F5-07	RO2 inactive delay		0.00s	☆
F5-08	RO3 inactive delay		0.00s	☆
F5-09	RO active state selection	0: High level active 1: Low level active Ones: RO1 active mode Tens: RO2 active mode Hundreds: RO3 active mode	000	☆
Group FA: Fault Record				
FA-00	Fault code upon 5th fault (the most recent fault)	-	-	●
FA-01	Fault subcode upon 5th fault	-	-	●
FA-02	Bus voltage upon 5th fault	Min. unit: 0.1 V	-	●
FA-03	Heatsink temperature upon 5th fault	Min. unit: 1°C	-	●
FA-04	Ambient temperature upon 5th fault	Min. unit: 1°C	-	●
FA-05	Braking circuit current upon 5th fault	Min. unit: 0.01 A	-	●
FA-06	Mains voltage Usr upon 5th fault	Min. unit: 1 V	-	●

Param. No.	Param. Name	Setting Range	Default	Property
FA-07	Mains voltage Ust upon 5th fault	Min. unit: 1 V	-	●
FA-08	Mains voltage Utr upon 5th fault	Min. unit: 1 V	-	●
FA-09	Degree of three-phase input voltage unbalance upon 5th fault	Min. unit: 0.01%	-	●
FA-10	DI status upon 5th fault	-	-	●
FA-11	RO status upon 5th fault	-	-	●
FA-12	Stop command sent by power supply unit upon 5th fault	1: Able to run 2. Coast to stop 3: Stop according to the stop mode	-	●
FA-13	Total power-on time (in hours) upon 5th fault	Min. unit: 1 hour	-	●
FA-14	Total power-on time (in minutes) upon 5th fault	Min. unit: 1 minute	-	●
FA-15	Total power-on time (in seconds) upon 5th fault	Min. unit: 1s	-	●
FA-20	Fault code upon 4th fault (the second most recent fault)	-	-	●
FA-21	Fault subcode upon 4th fault	-	-	●
FA-22	Bus voltage upon 4th fault	Min. unit: 0.1 V	-	●
FA-23	Heatsink temperature upon 4th fault	Min. unit: 1°C	-	●
FA-24	Ambient temperature upon 4th fault	Min. unit: 1°C	-	●
FA-25	Braking circuit current upon 4th fault	Min. unit: 0.01 A	-	●
FA-26	Mains voltage Usr upon 4th fault	Min. unit: 1 V	-	●
FA-27	Mains voltage Ust upon 4th fault	Min. unit: 1 V	-	●
FA-28	Mains voltage Utr upon 4th fault	Min. unit: 1 V	-	●
FA-29	Degree of three-phase input voltage unbalance upon 4th fault	Min. unit: 0.01%	-	●
FA-30	DI status upon 4th fault	-	-	●
FA-31	RO status upon 4th fault	-	-	●
FA-32	Stop command sending by power supply unit upon 4th fault	1: Able to run 2. Coast to stop 3: Stop in configured mode	-	●
FA-33	Total power-on time (in hours) upon 4th fault	Min. unit: 1 hour	-	●
FA-34	Total power-on time (in minutes) upon 4th fault	Min. unit: 1 minute	-	●
FA-35	Total power-on time (in seconds) upon 4th fault	Min. unit: 1s	-	●
FA-40	Fault code upon 3rd fault (the third most recent fault)	-	-	●
FA-41	Fault subcode upon 3rd fault	-	-	●
FA-42	Bus voltage upon 3rd fault	Min. unit: 0.1 V	-	●
FA-43	Heatsink temperature upon 3rd fault	Min. unit: 1°C	-	●

Param. No.	Param. Name	Setting Range	Default	Property
FA-44	Ambient temperature upon 3rd fault	Min. unit: 1°C	-	●
FA-45	Braking circuit current upon 3rd fault	Min. unit: 0.01 A	-	●
FA-46	Mains voltage Usr upon 3rd fault	Min. unit: 1 V	-	●
FA-47	Mains voltage Ust upon 3rd fault	Min. unit: 1 V	-	●
FA-48	Mains voltage Utr upon 3rd fault	Min. unit: 1 V	-	●
FA-49	Degree of three-phase input voltage unbalance upon 3rd fault	Min. unit: 0.01%	-	●
FA-50	DI status upon 3rd fault	-	-	●
FA-51	RO status upon 3rd fault	-	-	●
FA-52	Stop command sending by power supply unit upon 3rd fault	1: Able to run 2. Coast to stop 3: Stop in configured mode	-	●
FA-53	Total power-on time (in hours) upon 3rd fault	Min. unit: 1 hour	-	●
FA-54	Total power-on time (in minutes) upon 3rd fault	Min. unit: 1 minute	-	●
FA-55	Total power-on time (in seconds) upon 3rd fault	Min. unit: 1s	-	●
FA-60	Fault code upon 2nd fault (the fourth most recent fault)	-	-	●
FA-61	Fault subcode upon 2nd fault	-	-	●
FA-62	Bus voltage upon 2nd fault	Min. unit: 0.1 V	-	●
FA-63	Heatsink temperature upon 2nd fault	Min. unit: 1°C	-	●
FA-64	Ambient temperature upon 2nd fault	Min. unit: 1°C	-	●
FA-65	Braking circuit current upon 2nd fault	Min. unit: 0.01 A	-	●
FA-66	Mains voltage Usr upon 2nd fault	Min. unit: 1 V	-	●
FA-67	Mains voltage Ust upon 2nd fault	Min. unit: 1 V	-	●
FA-68	Mains voltage Utr upon 2nd fault	Min. unit: 1 V	-	●
FA-69	Degree of three-phase input voltage unbalance upon 2nd fault	Min. unit: 0.01%	-	●
FA-70	DI status upon 2nd fault	-	-	●
FA-71	RO status upon 2nd fault	-	-	●
FA-72	Stop command sending by power supply unit upon 2nd fault	1: Able to run 2. Coast to stop 3: Stop in configured mode	-	●
FA-73	Total power-on time (in hours) upon 2nd fault	Min. unit: 1 hour	-	●
FA-74	Total power-on time (in minutes) upon 2nd fault	Min. unit: 1 minute	-	●
FA-75	Total power-on time (in seconds) upon 2nd fault	Min. unit: 1s	-	●

Param. No.	Param. Name	Setting Range	Default	Property
FA-80	Fault code upon 1st fault (the fifth most recent fault)	-	-	●
FA-81	Fault subcode upon 1st fault	-	-	●
FA-82	Bus voltage upon 1st fault	Min. unit: 0.1 V	-	●
FA-83	Heatsink temperature upon 1st fault	Min. unit: 1°C	-	●
FA-84	Ambient temperature upon 1st fault	Min. unit: 1°C	-	●
FA-85	Braking circuit current upon 1st fault	Min. unit: 0.01 A	-	●
FA-86	Mains voltage Usr upon 1st fault	Min. unit: 1 V	-	●
FA-87	Mains voltage Ust upon 1st fault	Min. unit: 1 V	-	●
FA-88	Mains voltage Utr upon 1st fault	Min. unit: 1 V	-	●
FA-89	Degree of three-phase input voltage unbalance upon 1st fault	Min. unit: 0.01%	-	●
FA-90	DI status upon 1st fault	-	-	●
FA-91	RO status upon 1st fault	-	-	●
FA-92	Stop command sending by power supply unit upon 1st fault	1: Able to run 2. Coast to stop 3: Stop in configured mode	-	●
FA-93	Total power-on time (in hours) upon 1st fault	Min. unit: 1 hour	-	●
FA-94	Total power-on time (in minutes) upon 1st fault	Min. unit: 1 minute	-	●
FA-95	Total power-on time (in seconds) upon 1st fault	Min. unit: 1s	-	●
Group Fd: Communication Parameters				
Fd-00	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	5	☆
Fd-01	Modbus data format	0: No check <8,N,2> 1: Even parity check <8,E,1> 2: Odd parity check <8,O,1> 3: 8-N-1	0	☆
Fd-02	Modbus local host address	1 to 247 0: Broadcast address	1	☆
Fd-03	Modbus response delay	0 to 20 ms	2 ms	☆
Fd-04	Modbus communication timeout time	0.1s to 60.0s 0.0: Disabled	0.0	☆

Param. No.	Param. Name	Setting Range	Default	Property
Fd-09	Communication status	Ones (CANopen) 1: Initialization 2: Pre-running 8: Running 9: Stop Tens (CANlink) 1: Initialization 2: Pre-running 8: Running 9: Stop Hundreds (PROFIBUS-DP) 1: Initialization 2: Pre-running 8: Running 9: Stop	0	●
Fd-10	Communication protocol selection	0: No protocol 1: CANopen 2: CANlink 3: PROFIBUS-DP to CANopen gateway 5: PROFINET to CANopen gateway	1	☆
Fd-11	CANopen 402	0: Disabled 1: Enabled	21	☆
Fd-12	CAN baud rate	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps	5	☆
Fd-13	CAN station number	1 to 127	1	☆
Fd-14	Number of received real-time CAN frames per unit of time	-	-	●
Fd-15	Maximum value of node reception error count (real-time)	-	-	●
Fd-16	Maximum value of node sending error count (real-time)	-	-	●
Fd-17	Bus disconnection times per unit of time	-	-	●
Fd-18	Power supply unit number	1 to 99	-	☆
Fd-20	PROFIBUS-DP communication address	0 to 125	-	☆
Fd-22	Gateway mode	0: Cannot communicate 1: Able to communicate This parameter is only used by the power supply unit. It is used to enable or disable communication when the slave quantity set on the PLC is inconsistent with the slave quantity in the real network.	0	★

Param. No.	Param. Name	Setting Range	Default	Property
Fd-23	Number of online slaves	0 to 29 This parameter is only used by the power supply unit. It is used to set the number of online slaves after communication is established. When Fd-22 is set to 1, you can check this parameter to see whether the number of online slaves is consistent with the that in the real network.	0	●
Fd-24	Gateway power-on delay	5s to 20s This parameter is only used by the power supply unit upon gateway power-on delay. When many drive unit slaves share the common bus, the power-on time will be prolonged. In this case, the gateway starts communication but the slaves are not prepared, which causes an error. To solve this problem, set this parameter to a higher value.	8	★
Fd-25	Online status of slaves 1-15	0 to 65535 This parameter is only used by the power supply unit. Bit 1: Gateway Bit 2: Slave No. 2 ... 0: Offline 1: Online	0	●
Fd-26	Online status of slaves 16-30	0 to 65535 This parameter is only used by the power supply unit. Bit 0: Slave No.16 Bit 1: Slave No.17 ... 0: Offline 1: Online	0	★
Fd-30	Number of RPDO1 and RPDO2 mapped bytes	-	-	●
Fd-31	Number of TPDO1 and TPDO2 mapped bytes	-	-	●
Fd-32	Group AF mapping mode change	0: Communication not saved 1: Communication saved	-	☆
Fd-33	CANopen communication cycle	-	-	●
Fd-34	CANopen mode selection	0: Ordinary mode 1: Expert mode	0	★
Fd-35	CANopen disabled time	0 to 65535 (Unit: 100 us)	0	★
Fd-36	CANopen event time	0 to 65535 (Unit: ms)	0	★
Fd-50	Start with station lost	0 to 1	0	☆
Fd-51	CANopen slave station communication forbid time	0 to 65535 ms	-	●
Fd-52	Number of online CANopen slaves	0 to 30	-	●
Fd-53	Online status of stations No. 1 to No. 15	0 to FFFFh	-	●
Fd-54	Online status of stations No. 16 to No. 30	0 to FFFFh	-	●
Fd-55	PROFINET timeout time	0 to 65535 ms	350	☆
Fd-57	Gateway running status	0 to 3	-	●
Fd-59	PROFINET software version	-	-	●
Fd-61	High 2 bytes of MAC address	0 to FFFFh	-	●

Param. No.	Param. Name	Setting Range	Default	Property
Fd-62	Middle 2 bytes of MAC address	0 to FFFFh	-	●
Fd-63	Low 2 bytes of MAC address	0 to FFFFh	-	●
Group FP: Parameter Management				
FP-00	User password	0 to 65535	0	☆
FP-01	Parameter initialization	0: No operation 1: Restore factory parameters 2. Clear records 4: Back up current user parameters 501: Restore user backup parameters	0	☆
FP-02	Selection of parameter modification	0: Parameter modification enabled 1: Parameter modification disabled	0	☆
FP-03	Setting of monitoring parameter display 1	0000 to FFFF Bit 00: Bus voltage Bit 01: Heatsink temperature Bit 02: Ambient temperature Bit 03: Braking circuit current Bit 04: Usr input voltage Bit 05: Ust input voltage Bit 06: Utr input voltage Bit 07:Three-phase input voltage unbalance level Bit 08: DI status Bit 09: RO status Bit 10: DI function status 1 Bit 11: DI function status 2 Bit 12: Current fault code Bit 13: Current fault subcode Bit 14: Reserved Bit 15: Reserved	0x00FB	☆
FP-04	Setting of monitoring parameter display 2	Bit 00: Any memory address value Bit 01 to Bit 15: Reserved	0x0000	☆
Group AF: Process Data Address Mapping				
For details, see group AF parameter setting for drive units.				

D.2 Monitoring Parameters

Param. No.	Param. Name	Setting Range	Default	Property
Group U0: Monitoring Parameters				
U0-00	Bus voltage (V)	Min. unit: 0.1 V	-	●
U0-01	Heatsink temperature (°C)	Min. unit: 1°C	-	●
U0-02	Braking transistor temperature (°C)	Min. unit: 1°C	-	●
U0-03	Braking circuit current (A)	Min. unit: 0.01 A	-	●
U0-04	Input voltage Usr (V)	Min. unit: 1 V	-	●
U0-05	Input voltage Ust (V)	Min. unit: 1 V	-	●
U0-06	Input voltage Utr (V)	Min. unit: 1 V	-	●
U0-07	Three-phase input voltage unbalance level (%)	Min. unit: 0.01%	-	●
U0-08	DI status	-	-	●
U0-09	RO status	-	-	●
U0-10	DI function status 1	-	-	●

Param. No.	Param. Name	Setting Range	Default	Property
U0-11	DI function status 2	-	-	●
U0-12	Current fault code	-	-	●
U0-13	Current fault subcode	-	-	●
U0-14	DI status after delay	-	-	●
U0-15	DI status after positive and negative logic processing	-	-	●
U0-17	RO status after delay	-	-	●
U0-18	RO status after positive and negative logic processing	-	-	●
U0-19	Reserved	-	-	●
U0-20	Current running time (in hours)	Min. unit: 1 hour	-	●
U0-21	Current running time (in minutes)	Min. unit: 1 minute	-	●
U0-22	Current running time (in seconds)	Min. unit: 1s	-	●
U0-23	Current running time (in milliseconds)	Min. unit: 1 millisecond	-	●
U0-24	Fan control command word	0: Fan ON 1: Fan OFF	-	●
U0-25	Braking unit control command word	0: Braking transistor ON 1: Braking transistor OFF	-	●
U0-26	Reserved	-	-	●
U0-27	Command word for interaction of power supply unit and drive unit	1: Able to run 2. Coasting 3: Stop according to the stop mode	-	●
U0-28	-	-	-	●
U0-29	-	-	-	●
U0-30	Total power-on time (in hours)	-	-	●
U0-31	Total power-on time (in minutes)	-	-	●
U0-32	Total power-on time (in seconds)	-	-	●
U0-33	Total power-on time (in milliseconds)	-	-	●

Warranty Agreement

1) Inovance provides an 18-month free warranty to the equipment itself from the date of manufacturing for the failure or damage under normal use conditions.
2) Within the warranty period, maintenance will be charged for the damage caused by the following reasons:

a. Improper use or repair/modification without prior permission

b. Fire, flood, abnormal voltage, natural disasters and secondary disasters

c. Hardware damage caused by dropping or transportation after procurement

d. Operations not following the user instructions

e. Damage out of the equipment (for example, external device factors)

3) The maintenance fee is charged according to the latest Maintenance Price List of Inovance.
4) If there is any problem during the service, contact Inovance's agent or Inovance directly.
5) Inovance reserves the rights for explanation of this agreement.

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