MH860C Series

Electro-Hydraulic Servo System

User Manual

SHENZHEN INVT ELECTRIC CO., LTD.

Preface

Overview

Thank you for choosing the MH860C series electro-hydraulic servo product.

It is a high-performance hydraulic servo drive, primarily used in industries such as plastic molding, pipe extrusion, footwear manufacturing, rubber processing, die-casting, hydraulic presses, bending machines, and hydraulic power units (HPUs). This manual provides instructions for installing, wiring, parameter setting, fault diagnosis and troubleshooting, and maintenance of the servo drive. Before installing the product, read this manual carefully to ensure proper installation, operation, and optimal performance.

Intended audience

Personnel with professional electrical knowledge (such as qualified electrical engineers or personnel with equivalent knowledge).

Change history

The manual is subject to change irregularly without prior notice due to product version upgrades or other reasons.

No.	Change description	Version	Release date
1	First release.	V1.0	February 2026

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1 Safety precautions

1.1 Safety declaration

Read this manual carefully and follow all safety precautions before moving, installing, operating and servicing the drive. Otherwise, equipment damage or physical injury or death may be caused.

We shall not be liable or responsible for any physical injury or equipment damage caused due to failure to follow the safety precautions.

1.2 Safety level definition

To ensure personal safety and avoid property damage, you must pay attention to the safety symbols and warnings in the manual.

Warning symbols	Name	Description
	Danger	Severe personal injury or even death can result if related requirements are not followed.
	Electric shock	Severe personal injury or even death can result if related requirements are not followed. As high voltage may remain in the bus capacitors after power-off, wait at least 5 minutes before performing any work (or 15/25 minutes, as indicated by the warning symbols on the equipment) to prevent electric shock.
	Warning	Personal injury or equipment damage can result if related requirements are not followed.
	Electrostatic discharge	The PCBA may be damaged if related requirements are not followed.
	Hot sides	You may get burnt if related requirements are not followed.
Note	Note	Minor personal injury or equipment damage can result if related requirements are not followed.

1.3 Personnel requirements

Trained and qualified professionals: People operating the equipment must have received professional electrical and safety training, and must be familiar with all steps and requirements of equipment installing, commissioning, running and maintaining and capable to prevent any emergencies according to experience.

1.4 Safety guidelines

<table>
<tr><th colspan="2">General principles</th></tr>
<tr><td></td><td>

Only trained and qualified professionals are allowed to carry out related operations.
Do not perform wiring, inspection or component replacement when power supply is applied. Before performing these operations, ensure all the input power supplies have been disconnected, and wait for at least the time designated on the servo drive or until the DC bus voltage is less than 36V. The minimum waiting time is listed in the following.

<table>
<tr><th>Model</th><th>Minimum waiting time</th></tr>
<tr><td>380V 1.5–110kW</td><td>5 minutes</td></tr>
<tr><td>380V 132–315kW</td><td>15 minutes</td></tr>
<tr><td>380V≥355kW</td><td>25 minutes</td></tr>
</table>
</td></tr>
<tr><td></td><td>

Do not modify the servo drive unless authorized; otherwise fire, electric shock or other injury may result.
The servo drive cannot be used as an "Emergency-stop device".
The servo drive cannot provide emergency braking for the motor. A mechanical braking device must be installed.
Prevent the screws, cables and other conductive parts from falling into the servo drive.

</td></tr>
<tr><td></td><td>

The heat sink base may become hot when the servo drive is running. Do not touch it to avoid burns.

</td></tr>
<tr><td></td><td>

The electrical parts and components inside the servo drive are electrostatic sensitive. Take measures to prevent electrostatic discharge when performing related operations.

</td></tr>
</table>

<table>
<tr><th colspan="2">Delivery</th></tr>
<tr><td></td><td>

Select appropriate tools for servo drive delivery to avoid damage, and take protective measures like wearing safety shoes and working uniforms to avoid physical injury or death.
Protect the servo drive against physical shock or vibration.
Do not carry the servo drive only by its front cover as the cover may fall off.

</td></tr>
</table>

<table>
<tr><th colspan="2">Installation</th></tr>
<tr><td></td><td>

Do not install the servo drive on inflammables. In addition, prevent it from contacting or adhering to inflammables.
Do not install a damaged or incomplete servo drive.
Do not touch the servo drive with wet objects or wet body parts to avoid electric shock.

</td></tr>
</table>

Installation	
	● The installation site must be away from children and other public places. For details, see section 3.2.1 Installation environment and site. ● Connect the braking options (such as braking resistor, braking unit, or regenerative unit) according to the wiring diagram. ● As leakage current of the drive during running may exceed 3.5mA, ground properly and ensure the grounding resistance is less than 10Ω. The conductivity of PE grounding conductor is the same as that of the phase conductor. The cross-sectional area of the PE grounding conductor for 30kW and above models can be slightly smaller than the recommended cross-sectional area value. ● R, S, and T are the power input terminals, while U, V, and W are the motor output terminals. Connect the input power cables and motor cables properly; otherwise, damage to the drive may occur. ● When the drive is installed in a confined space (such as cabinet), it is necessary to provide protective devices (such as fireproof housing, electrical protective housing, mechanical protective housing, etc.) that meet the IP rating, and the IP rating shall comply with the relevant IEC standards and local regulations.

Commissioning	
	● When the power-off restart function is enabled (P01.21= 1), the servo drive may start automatically. Keep away from the servo drive and the motor.
	● Do not frequently switch the servo drive input power on and off. ● If the servo drive is put into service after long-term storage, perform an inspection, capacitor reforming (see section 9.3 Reforming), and a trial operation before use.

Running	
	● Before operating the servo drive, install the front cover; otherwise, there is a risk of electric shock. ● During operation, high voltage is present inside the servo drive. Do not perform any operation on the servo drive other than keypad settings. The control terminals of the 380V products are ELV (Extra-Low Voltage) circuits. Without additional protective isolation, avoid directly connecting the control terminals to accessible terminals of other equipment. ● For synchronous motor applications, the following additional procedures are required: ✓ Disconnect all input power supplies, including the main power supply and the control power supply. ✓ The synchronous motor has been stopped, and the voltage on output

Running	
	end of the drive is lower than 36V. ✓ After the synchronous motor has stopped, wait for at least the time indicated on the servo drive, and verify that the voltage between terminals (+) and (–) is below 36V. ✓ During operation, ensure that the synchronous motor cannot rotate again due to external loads. It is recommended to install an effective external braking device for the synchronous motor or to directly disconnect the electrical connection between the synchronous motor and the servo drive.

Maintenance	
	● Do not perform drive maintenance or component replacement when the power is on. Otherwise, electric shock may result. ● Keep the drive and its parts and components away from flammable materials and ensure they have no flammable materials adhered.
	● During maintenance and component replacement, take proper anti-static measures on the drive and its internal parts.
	● Do not carry out any insulation and voltage withstand test to the drive directly, and do not test the control circuit of the drive by megameter.
Note	● Use proper torque to tighten screws.

Disposal	
	● The components inside the drive contain heavy metals. Dispose of a scrap drive as industrial waste.

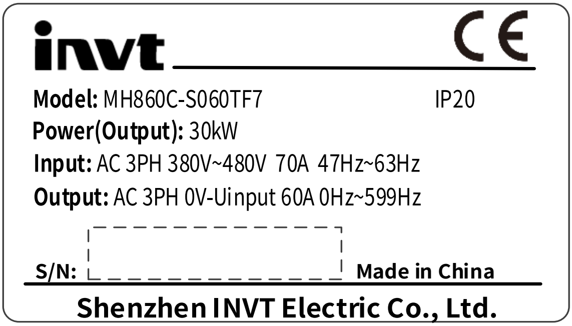
2 Product overview

2.1 Servo drive introduction

2.1.1 Servo drive nameplate and models

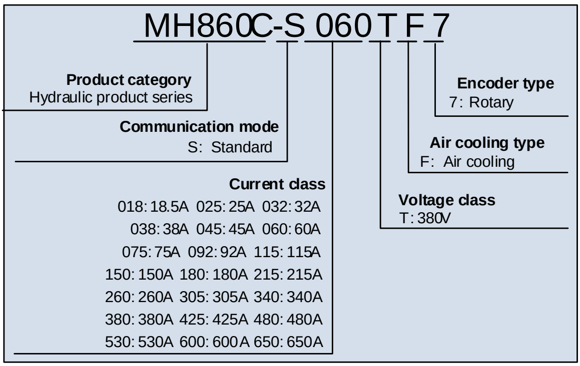
A nameplate is attached to each servo drive, showing basic specifications and certification marks it has obtained (such as CE).

Product nameplate



Note: The nameplate contains basic product data and displays certification marks (such as CE) corresponding to the obtained certifications.

Product model



2.1.2 Servo drive specifications

Item		Specification
Input	Input voltage (V)	AC 3PH 380V–480V; rated voltage: 380V
	Allowed voltage transient fluctuation	-15%–+10%
	Input current (A)	See section 2.1.3 Servo drive ratings
	Input frequency (Hz)	50Hz or 60Hz; allowed range: 47–63Hz
Output	Output voltage (V)	0–input voltage
	Output current (A)	See section 2.1.3 Servo drive ratings
	Output power (kW)	See section 2.1.3 Servo drive ratings
	Output frequency (Hz)	0–599Hz
Control performance	Control mode	Space voltage vector control, sensorless vector control (SVC), and feedback vector control (FVC) mode
	Motor type	Asynchronous motor (AM) and permanent magnetic synchronous motor (SM)
	Speed ratio	For AMs: 1:200 (SVC) For SMs: 1:200 (SVC); 1:1000 (FVC)
	Speed fluctuation	±0.3%
	Torque response	⩽5ms (SVC); ⩽2ms (FVC)
	Torque control accuracy	⩽5%
	Overload capacity	150% of the rated current for 60s
	Hydraulic pressure control	Configurable as analog input, internal input, RS485 input, CANopen input, EtherCAT input, or PROFINET input.
	Speed control	Configurable as analog input, internal input, RS485 input, CANopen input, EtherCAT input, or PROFINET input.
	Multi-pump parallel control	Supports control of up to 16 pumps, with four operating modes: multi-pump mode, hybrid mode, communication with two modes, and communication with four modes.
	Pressure control accuracy	±1bar
	Flow control accuracy	±0.5%FS
	Speed control accuracy	±0.2% (SVC); ±0.02% (FVC)

Item		Specification
Control performance	Pressure control step response	≤100ms
	Speed step response	≤50ms
	Flow calibration function	Performs output flow calibration according to different pump characteristics.
Peripheral interface	Terminal analog input resolution	No more than 20mV
	Terminal digital input resolution	No more than 2ms
	Analog input	3 inputs. AI1: 0–10 V; AI2: –10–+10V; AI3 (pressure feedback): 0–10V/0–20mA
	Analog output	2 inputs. AO1/AO2: 0–10V/0–20mA
	Digital input	5 standard inputs. Max. frequency: 1kHz; internal impedance: 3.3kΩ
	Digital output	2 opto-isolated bipolar open-collector outputs Output voltage range: 0V–30V Output current range: 0mA–100mA
	Relay output	One programmable relay output RO1A: NO; RO1B: NC; RO1C: common Contact capacity: 3A/AC250V, 1A/DC30V
	Expansion interfaces	2 expansion slots: SLOT1 and SLOT2. Supports Ethernet cards, communication cards, I/O cards, PG cards, etc. Installing two cards of the same type simultaneously is not supported.
	Type-C interface	Supports Workshop oscilloscope; sampling rate: 2kHz, supporting up to 6 data sampling channels.
Environment requirements and standards	Mounting method	Three options: wall mounting, flange mounting (for drives ≤160kW), and floor mounting.
	Operating ambient temperature	-10°C–50°C **Note:** Derating is required when the ambient temperature exceeds 40°C.
	Ingress protection (IP) rating	IP20
	Pollution degree	Degree 2
	Cooling method	Forced air cooling
	Certification	CE

2.1.3 Servo drive ratings

Model	Output power (kW)	Input current (A)	Output current (A)
AC 3PH 380V–480V			
MH860C-S018TF7	7.5	25	18.5
MH860C-S025TF7	11	32	25
MH860C-S032TF7	15	40	32
MH860C-S038TF7	18	47	38
MH860C-S045TF7	22	50	45
MH860C-S060TF7	30	61	60
MH860C-S075TF7	37	80	75
MH860C-S092TF7	45	94	92
MH860C-S115TF7	55	128	115
MH860C-S150TF7	75	160	150
MH860C-S180TF7	90	190	180
MH860C-S215TF7	110	225	215
MH860C-S260TF7	132	265	260
MH860C-S305TF7	160	310	305
MH860C-S340TF7	185	345	340
MH860C-S380TF7	200	385	380
MH860C-S425TF7	220	430	425
MH860C-S480TF7	250	460	480
MH860C-S530TF7	280	500	530
MH860C-S600TF7	315	580	600
MH860C-S650TF7	355	625	650

2.1.4 Servo drive dimensions and weight

Model	Overall dimensions W×H×D (mm)	Package dimensions W×H×D (mm)	Gross weight (kg)
MH860C-S018TF7	145×280×203	235×375×300	5.02
MH860C-S025TF7			5.08
MH860C-S032TF7	169×320×210	270×435×310	6.36
MH860C-S038TF7			6.46
MH860C-S045TF7	200×341×208	315×485×310	8.70
MH860C-S060TF7	250×400×222	395×580×360	13.98
MH860C-S075TF7			14.15
MH860C-S092TF7	282×560×258	440×695×405	21.44
MH860C-S115TF7			22.05
MH860C-S150TF7			26.79
MH860C-S180TF7	338×554×330	495×725×500	45
MH860C-S215TF7			
MH860C-S260TF7	338×825×389	971×631×565	78
MH860C-S305TF7			
MH860C-S340TF7	330×1288×535	1438×668×531	122
MH860C-S380TF7			122
MH860C-S425TF7			122
MH860C-S480TF7			124
MH860C-S530TF7			124
MH860C-S600TF7			124
MH860C-S650TF7	330×1398×535	1558×678×530	175

2.1.5 Servo drive heat dissipation

<table>
<tr><th>Model</th><th>Entire machine full load power dissipation (W)</th><th>Entire machine standby power dissipation (W)</th><th>Heat dissipation (BTU/hr)</th><th>Airflow (m^3/h)</th><th>Airflow (CFM) (ft^3/min)</th></tr>
<tr><td colspan="6">AC 3PH 380V–480V</td></tr>
<tr><td>MH860C-S018TF7</td><td>320</td><td>14</td><td>1092</td><td rowspan="2">105</td><td rowspan="2">61</td></tr>
<tr><td>MH860C-S025TF7</td><td>385</td><td>14</td><td>1314</td></tr>
<tr><td>MH860C-S032TF7</td><td>460</td><td>14</td><td>1513</td><td rowspan="2">120</td><td rowspan="2">68</td></tr>
<tr><td>MH860C-S038TF7</td><td>520</td><td>14</td><td>1696</td></tr>
<tr><td>MH860C-S045TF7</td><td>768</td><td>25</td><td>2620</td><td>140</td><td>83</td></tr>
<tr><td>MH860C-S060TF7</td><td>1090</td><td>25</td><td>3719</td><td rowspan="2">290</td><td rowspan="2">171</td></tr>
<tr><td>MH860C-S075TF7</td><td>1344</td><td>25</td><td>3719</td></tr>
<tr><td>MH860C-S092TF7</td><td>1837</td><td>25</td><td>6268</td><td rowspan="3">500</td><td rowspan="3">295</td></tr>
<tr><td>MH860C-S115TF7</td><td>2400</td><td>30</td><td>8189</td></tr>
<tr><td>MH860C-S150TF7</td><td>2082</td><td>30</td><td>7104</td></tr>
<tr><td>MH860C-S180TF7</td><td>2114</td><td>48</td><td>7213</td><td rowspan="2">670</td><td rowspan="2">394</td></tr>
<tr><td>MH860C-S215TF7</td><td>2360</td><td>48</td><td>8052</td></tr>
<tr><td>MH860C-S260TF7</td><td>2780</td><td>55</td><td>9861</td><td rowspan="2">1443</td><td rowspan="2">848.8</td></tr>
<tr><td>MH860C-S305TF7</td><td>3004</td><td>55</td><td>10714</td></tr>
<tr><td>MH860C-S340TF7</td><td>3177</td><td>70</td><td>12597</td><td rowspan="3">1798</td><td rowspan="3">1057.7</td></tr>
<tr><td>MH860C-S380TF7</td><td>3609</td><td>70</td><td>15514</td></tr>
<tr><td>MH860C-S425TF7</td><td>3927</td><td>70</td><td>17149</td></tr>
<tr><td>MH860C-S480TF7</td><td>5598</td><td>70</td><td>19274</td><td rowspan="4">2697</td><td rowspan="4">1586.5</td></tr>
<tr><td>MH860C-S530TF7</td><td>6121</td><td>70</td><td>21820</td></tr>
<tr><td>MH860C-S600TF7</td><td>6608</td><td>70</td><td>23638</td></tr>
<tr><td>MH860C-S650TF7</td><td>6976</td><td>85</td><td>27112</td></tr>
</table>

2.1.6 Servo drive structure

Figure 2-1 Product component diagram (taking the 380V 37kW model as an example)

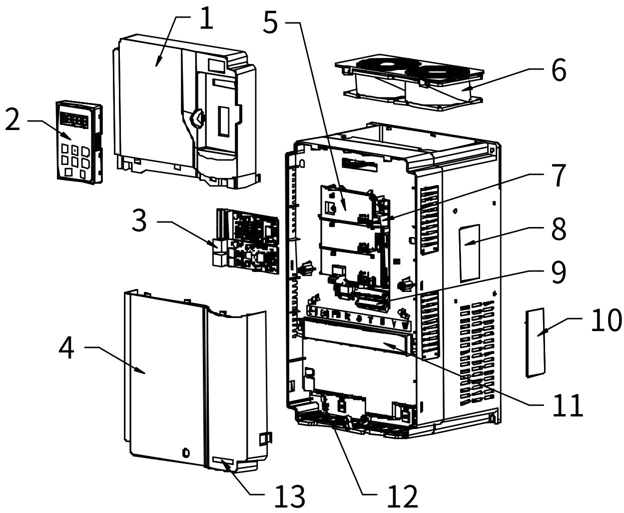
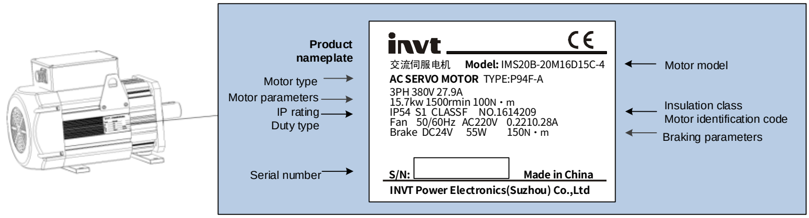


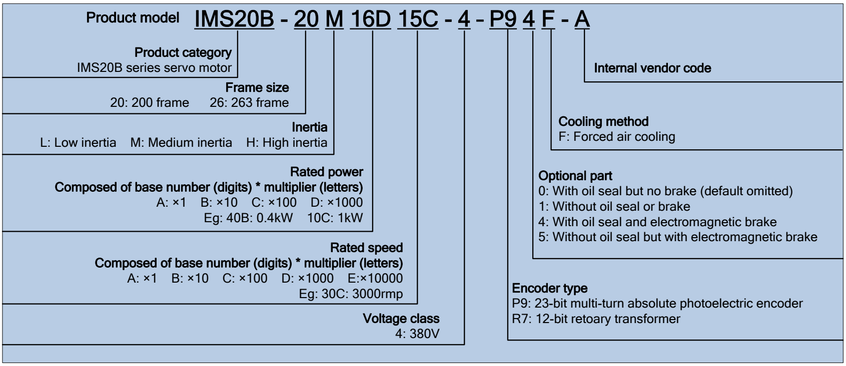
Table 2-1 Product component description

No.	Component	Description
1	Upper cover	Protects internal components and parts.
2	Keypad	See section 5.2.2 Keypad operation.
3	Expansion card	Optional. For details, see Appendix E Expansion card.
4	Lower cover	Protects internal components and parts.
5	Control board cover	For control board protection and expansion card installation.
6	Cooling fan	See chapter 9 Inspection and maintenance.
7	Keypad interface	Connects the keypad.
8	Nameplate	See section 2.1 Servo drive introduction.
9	Control terminals	See chapter 4 Electrical installation.
10	Vent hole cover	Optional. Installing the cover increases the protection level but also causes the internal temperature to rise. Therefore, derating is required.
11	Main circuit terminals	See chapter 4 Electrical installation.
12	POWER indicator	Power supply indicator
13	MH860C series product label	See section 2.1 Servo drive introduction.

2.2 Servo motor overview

2.2.1 Servo Motor nameplate and model





2.2.2 Servo motor specifications

Model	IMS20B-20M					
	80C20C	71C17C	63C15C	12D20C	11D17C	94C15C
Rated voltage (V)	380					
Rated speed (rpm)	2000	1700	1500	2000	1700	1500
Rated power (kW)	8	7.1	6.3	21.1	10.7	9.4
Rated frequency (Hz)	133.3	113.3	100	133.3	113.3	100
Rated current (A)	14.7	13.3	12.4	20.7	19.3	16.3
Rated torque (N・m)	39	40	40	58	60	60
Peak current at 0.5×rated speed (A)	39.8	34.6	33.4	54.4	52	43.8
Peak torque at 0.5×rated speed (N・m)	97.5	100	100	145-	150	150
Peak speed (rpm)	3000	2700	2500	3000	2700	2500
Peak current at rated speed (A)	31.3	32.4	32	39	39.1	31.6
Peak torque at rated speed (N・m)	75	95	79	101	107	106
Torque constant (N・m/A)	2.65	3.01	3.23	2.80	3.11	3.68
Winding resistance (Ω)	1.2	1.58	2.01	0.67	0.93	1.13

Model		IMS20B-20M					
		80C20C	71C17C	63C15C	12D20C	11D17C	94C15C
Counter-emf constant (V/krpm)		174.8	199.9	224	181.4	205	237.7
Moment of inertia (kg • cm²)	Standard type	52	52	52	73	73	73
Motor weight (kg)	Standard type	35.2	35.2	35.2	40.6	40.6	40.6
Motor specifications	Type	AC centrifugal fan					
	Rated power (W)	50/64					
	Rated voltage (VAC)	230					
	Rated frequency (Hz)	50/60					

Model		IMS20B-20M					
		17D20C	14D17C	13D15C	20D20C	18D17C	16D15C
Rated voltage (V)		380					
Rated speed (rpm)		2000	1700	1500	2000	1700	1500
Rated power (kW)		16.8	14.2	12.6	20	17.8	15.7
Rated frequency (Hz)		133.3	113.3	100	133.3	113.3	100
Rated current (A)		29.5	25.5	22.5	34.2	31.1	27.9
Rated torque (N • m)		80	80	80	96	100	100
Peak current at 0.5×rated speed (A)		80	68.5	59.5	90	86	72.7
Peak torque at 0.5×rated speed (N • m)		200	200	200	238	250	250
Peak speed (rpm)		3000	2700	2500	3000	2700	2500
Peak current at rated speed (A)		50	38.3	39.4	77.5	54.6	52.9
Peak torque at rated speed (N • m)		130	120	136	188	159	182
Torque constant (N • m/A)		2.71	3.14	3.56	2.81	3.22	3.58
Winding resistance (Ω)		0.48	0.57	0.81	0.35	0.45	0.61
Counter-emf constant (V/krpm)		186.5	203.6	242.5	186.5	209.8	233.3
Moment of inertia (kg • cm²)	Standard type	94	94	94	115	115	115
Motor weight (kg)	Standard type	46	46	46	51.5	51.5	51.5
Motor specifications	Type	AC centrifugal fan					
	Rated power (W)	50/64					
	Rated voltage (VAC)	230					
	Rated frequency (Hz)	50/60					

Model		IMS20B-20M					
		24D20C	21D17C	19D15C	27D20C	25D17C	22D15C
Rated voltage (V)		380					
Rated speed (rpm)		2000	1700	1500	2000	1700	1500
Rated power (kW)		24.1	21.4	18.9	27.4	24.9	22
Rated frequency (Hz)		133.3	113.3	100	133.3	113.3	100
Rated current (A)		41.7	38.0	32.2	48.6	44.8	38.6
Rated torque (N • m)		115	120	120	131	140	140
Peak current at 0.5×rated speed (A)		110.0	103.0	84.4	125.0	114.2	100.7
Peak torque at 0.5×rated speed (N • m)		288	300	300	327	350	350
Peak speed (rpm)		3000	2700	2500	3000	2700	2500
Peak current at rated speed (A)		78.5	78.8	51.7	113	77.2	78.9
Peak torque at rated speed (N • m)		208	216	189	282	241	268
Torque constant (N • m/A)		2.76	3.16	3.73	2.70	3.13	3.63
Winding resistance (Ω)		0.26	0.35	0.45	0.21	0.29	0.38
Counter-emf constant (V/krpm)		181.9	206	237.9	176	207	240
Moment of inertia ($kg \cdot cm^2$)	Standard type	135	135	135	156	156	156
Motor weight (kg)	Standard type	56.8	56.8	56.8	62.3	62.3	62.3
Motor specifications	AC centrifugal fan	AC centrifugal fan					
	50/64	50/64					
	230	230					
	50/60	50/60					

Model	IMS20B-20M					
	32D20C	29D17C	25D15C	36D20C	32D17C	28D15C
Rated voltage (V)	380					
Rated speed (rpm)	2000	1700	1500	2000	1700	1500
Rated power (kW)	31.6	28.5	25.1	35.6	32	28.3
Rated frequency (Hz)	133.3	113.3	100	133.3	113.3	100
Rated current (A)	54.0	51.4	43.3	62.2	55.7	47.5
Rated torque (N • m)	151	160	160	170	180	180
Peak current at 0.5×rated speed (A)	139.0	136	109.3	154.0	146.9	118.9
Peak torque at 0.5×rated speed (N • m)	376	400	400	424	450	450
Peak speed (rpm)	3000	2700	2500	3000	2700	2500

Model		IMS20B-20M					
		32D20C	29D17C	25D15C	36D20C	32D17C	28D15C
Peak current at rated speed (A)		113	113	109.3	123.8	108	113
Peak torque at rated speed (N • m)		284	308	400	318	328	366
Torque constant (N • m/A)		2.80	3.11	3.70	2.73	3.23	3.79
Winding resistance (Ω)		0.19	0.23	0.31	0.17	0.20	0.3
Counter-emf constant (V/krpm)		186.5	205.2	243.3	186.0	208	252.6
Moment of inertia (kg • cm²)	Standard type	177	177	177	196	196	196
Motor weight (kg)	Standard type	67.7	67.7	67.7	73.1	73.1	73.1
Motor specifications	Type	AC centrifugal fan					
	Rated power (W)	50/64					
	Rated voltage (VAC)	230					
	Rated frequency (Hz)	50/60					

Model		IMS20B-20M					
		31D15C	36D17C	40D20C	-	-	-
Rated voltage (V)		380					
Rated speed (rpm)		1500	1700	2000	-	-	-
Rated power (kW)		31	36	40	-	-	-
Rated frequency (Hz)		100	113.3	113.3	-	-	-
Rated current (A)		55	61	66	-	-	-
Rated torque (N • m)		200	200	190	-	-	-
Peak current at 0.5×rated speed (A)		140	158	168	-	-	-
Peak torque at 0.5×rated speed (N • m)		500	500	475	-	-	-
Peak speed (rpm)		2500	2700	3000	-	-	-
Peak current at rated speed (A)		110	110	140	-	-	-
Peak torque at rated speed (N • m)		384	350	370	-	-	-
Torque constant (N • m/A)		3.64	3.28	2.88	-	-	-
Winding resistance (Ω)		0.224	0.186	0.144	-	-	-
Counter-emf constant (V/krpm)		231.1	210.7	185.2	-	-	-
Moment of inertia (kg • cm²)	Standard type	230	230	230	-	-	-
Motor weight (kg)	Standard type	78	78	78	-	-	-

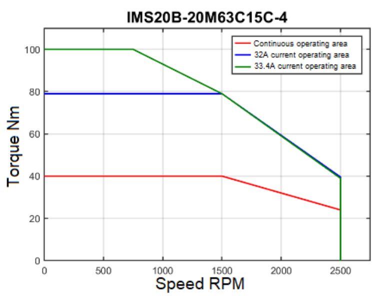
Model		IMS20B-20M					
		31D15C	36D17C	40D20C	-	-	-
Motor specifications	Type	AC centrifugal fan					
	Rated power (W)	50/64					
	Rated voltage (VAC)	230					
	Rated frequency (Hz)	50/60					

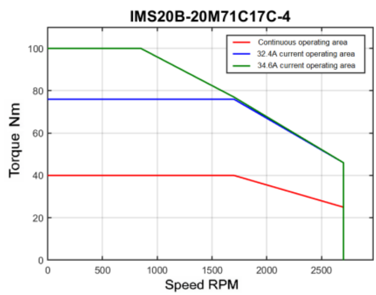
Model		IMS20B-26M								
		28D15C	32D17C	37D20C	35D15C	39D17C	45D20C	41D15C	46D17C	50D20C
Rated voltage (V)		380								
Rated speed (rpm)		1500	1700	2000	1500	1700	2000	1500	1700	2000
Rated power (kW)		28	32	37	34.6	39	45	40.8	46	49.8
Rated frequency (Hz)		100	113.3	133.3	100	113.3	133.3	100	113.3	133.3
Rated current (A)		50.4	58.8	65.7	64.1	65.1	81.2	71.4	81.3	86.6
Rated torque (N・m)		180	180	175	221	217	214	260	259	238
Peak current at 0.5×rated speed (A)		155.2	183.7	192.1	183.5	192	232	198.9	242.9	234
Peak torque at 0.5×rated speed (N・m)		479	467	447	555	571	541.7	654	671	624
Peak speed (rpm)		2500	2700	3000	2500	2700	3000	2500	2700	3000
Peak current at rated speed (A)		107	110.3	133.9	117	139.8	162.6	136	167.5	168.3
Peak torque at rated speed (N・m)		316	288	196	379	393	378	441	460	413
Torque constant (N・m/A)		3.57	3.06	2.66	3.45	3.33	2.64	3.64	3.19	2.75
Winding resistance (Ω)		0.27	0.21	0.14	0.20	0.17	0.11	0.15	0.13	0.10
Counter-emf constant (V/krpm)		233.3	196.2	168.6	224.3	214.3	168	230.4	202.9	181.1
Moment of inertia (kg・cm^2)	Standard type	242	242	242	297	297	297	351	351	351
Motor weight (kg)	Standard type	82	82	82	93	93	93	104		
Motor specifications	Type	AC centrifugal fan								
	Rated power (W)	135/175								
	Rated voltage (VAC)	230								
	Rated frequency (Hz)	50/60								

Model		IMS20B-26M								
		47D15C	53D17C	58D20C	53D15C	61D17C	65D20C	60D15C	68D17C	74D20C
Rated voltage (V)		380								
Rated speed (rpm)		1500	1700	2000	1500	1700	2000	1500	1700	2000
Rated power (kW)		47	53	58	53.4	60.5	65	60	67.6	74
Rated frequency (Hz)		100	113.3	133.3	100	113.3	133.3	100	113.3	133.3
Rated current (A)		82.2	93.9	99.7	92.9	101.7	113	104.7	118.8	127.1
Rated torque (N・m)		300	300	276	340	340	310	382	380	351
Peak current at 0.5×rated speed (A)		209.4	257	253.4	240	252.4	297.3	273.5	311	340.8
Peak torque at 0.5×rated speed (N・m)		753.6	776	706	862	819	844	971	950	898.9
Peak speed (rpm)		2500	2700	3000	2500	2700	3000	2500	2700	3000
Peak current at rated speed (A)		167.7	202	220.2	161	225.9	215.5	218.5	275.3	250.9
Peak torque at rated speed (N・m)		530	514	503	546	624	538	674	707	647
Torque constant (N・m/A)		3.65	3.19	2.77	3.66	3.34	2.74	3.65	3.20	2.76
Winding resistance (Ω)		0.14	0.11	0.08	0.12	0.10	0.07	0.1	0.08	0.06
Counter-emf constant (V/krpm)		241.5	210.9	185	245.7	218.4	180.6	242.2	203.2	175.7
Moment of inertia (kg・cm²)	Standard type	406	406	406	461	461	461	515	515	515
Motor weight (kg)	Standard type	115	115	115	126	126	126	137	137	137
Motor specifications	Type	AC centrifugal fan								
	Rated power (W)	135/175								
	Rated voltage (VAC)	230								
	Rated frequency (Hz)	50/60								

Model	IMS20B-26M								
	66D15C	75D17C	82D20C	78D15C	86D17C	90D20C	-	-	-
Rated voltage (V)	380								
Rated speed (rpm)	1500	1700	2000	1500	1700	2000	-	-	-
Rated power (kW)	66	75	82	78	86	90	-	-	-
Rated frequency (Hz)	100	113.3	133.3	100	113.3	133.3	-	-	-
Rated current (A)	120	141	138	151	152	148	-	-	-
Rated torque (N・m)	420	420	392	495	485	430	-	-	-

Model		IMS20B-26M								
		66D15C	75D17C	82D20C	78D15C	86D17C	90D20C	-	-	-
Peak current at 0.5×rated speed (A)		321	333	347	334	348	348	-	-	-
Peak torque at 0.5×rated speed (N・m)		754	958	980	1050	1075	1075	-	-	-
Peak speed (rpm)		2500	2700	3000	2500	2700	3000	-	-	-
Peak current at rated speed (A)		220	279	284	275	296	295	-	-	-
Peak torque at rated speed (N・m)		754	800	710	838	825	712	-	-	-
Torque constant (N・m/A)		3.50	2.98	3000	3.28	3.19	2.91	-	-	-
Winding resistance (Ω)		0.084	0.059	0.059	0.063	0.063	0.063	-	-	-
Counter-emf constant (V/krpm)		224.5	191.2	191.2	207.1	207.1	207.1	-	-	-
Moment of inertia (kg・cm²)	Standard type	574	574	574	629	629	629	-	-	-
Motor weight (kg)	Standard type	148	148	148	159	159	159	-	-	-
Motor specifications	Type	AC centrifugal fan								
	Rated power (W)	135/175								
	Rated voltage (VAC)	230								
	Rated frequency (Hz)	50/60								





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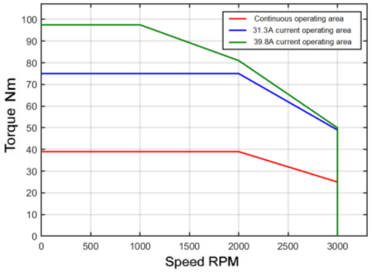

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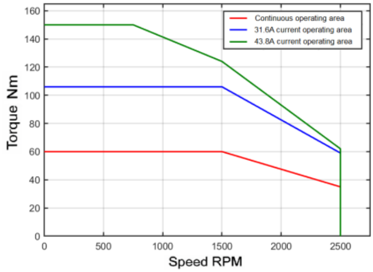

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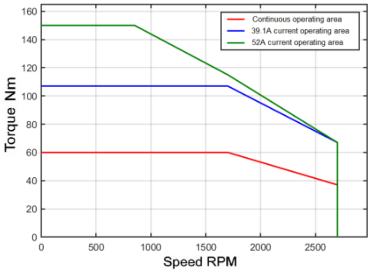

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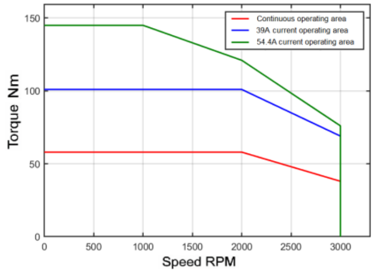

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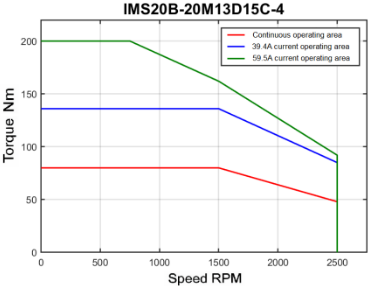

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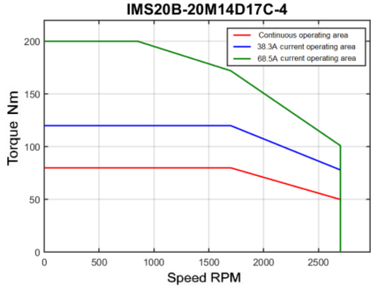

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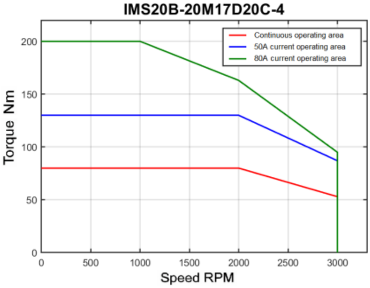

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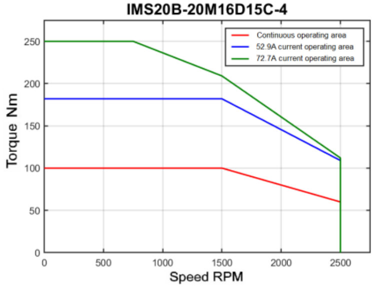

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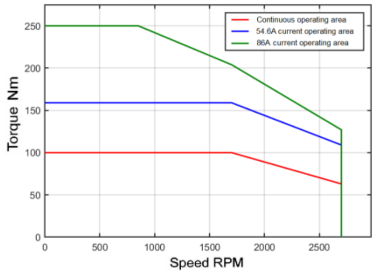

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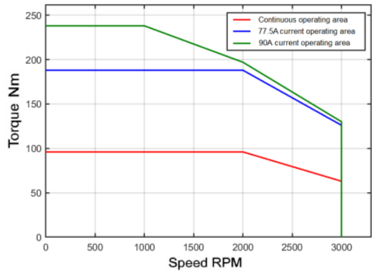

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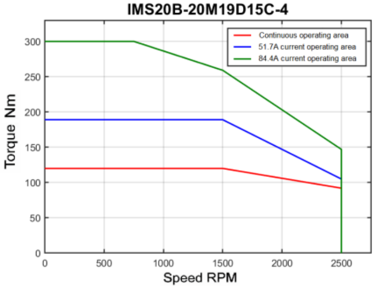

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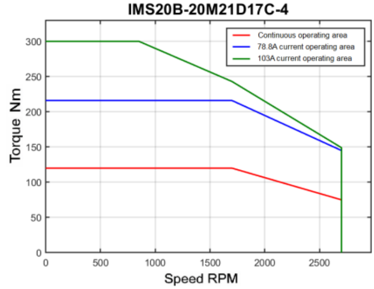

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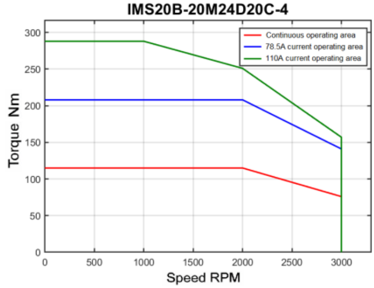

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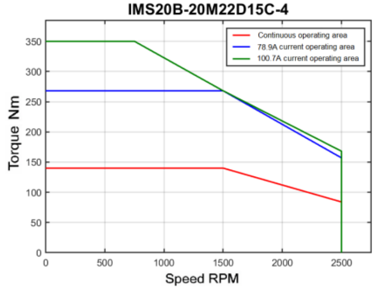

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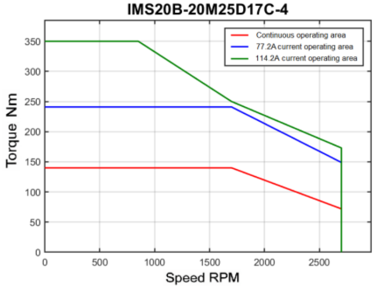

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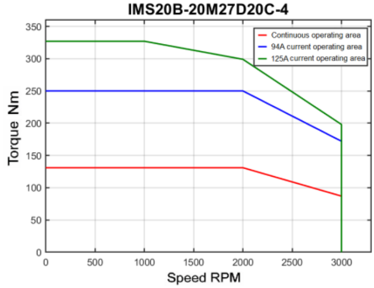
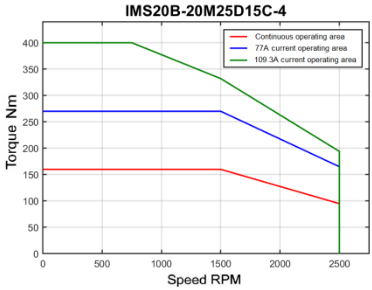
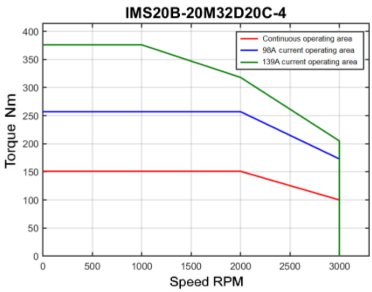
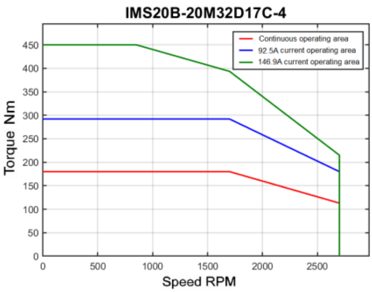



IMS20B-20M25D15C-4
Continuous operating area
77A current operating area
109.3A current operating area
Torque Nm
Speed RPM


IMS20B-20M29D17C-4
Continuous operating area
94.6A current operating area
136A current operating area
Torque Nm
Speed RPM


IMS20B-20M32D20C-4
Continuous operating area
98A current operating area
139A current operating area
Torque Nm
Speed RPM


IMS20B-20M28D15C-4
Continuous operating area
94.2A current operating area
118.9A current operating area
Torque Nm
Speed RPM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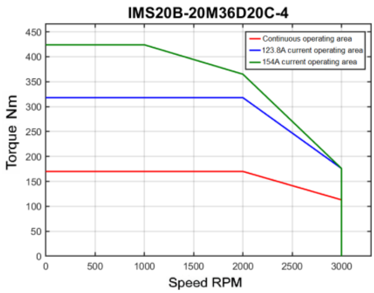
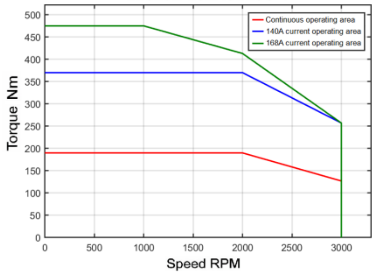
Continuous operating area
92.5A current operating area
146.9A current operating area
Torque Nm
Speed RPM


IMS20B-20M36D20C-4
Continuous operating area
123.8A current operating area
154A current operating area
Torque Nm
Speed RPM


IMS20B-20M31D15C-4
Continuous operating area
110A current operating area
140A current operating area
Torque Nm
Speed RPM


IMS20B-20M36D17C-4
Continuous operating area
110A current operating area
158A current operating area
Torque Nm
Speed RPM

IMS20B-20M40D20C-4



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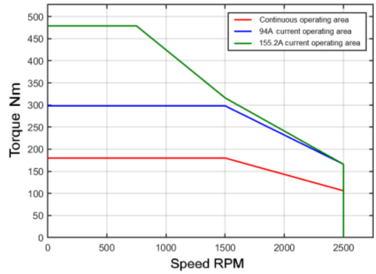

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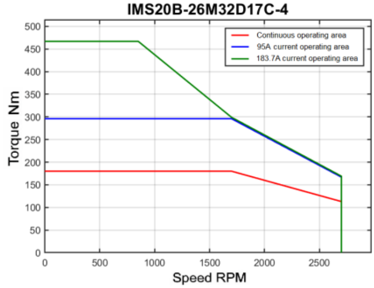

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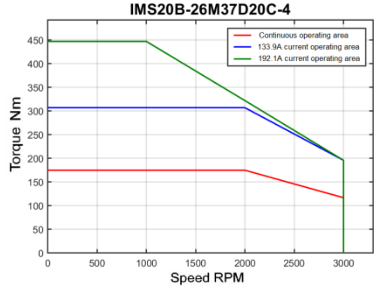

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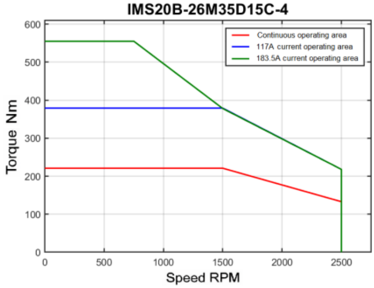

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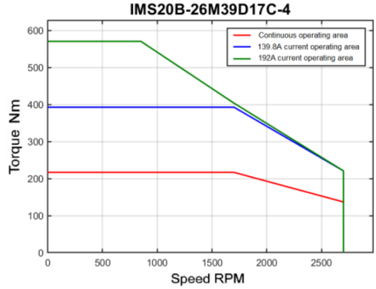

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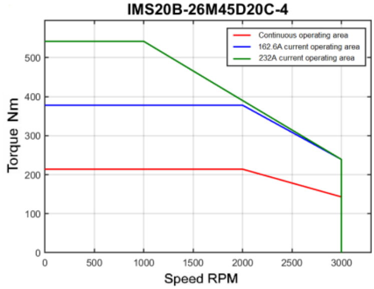

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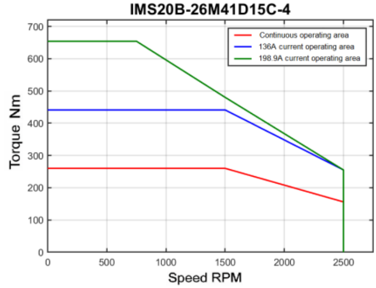

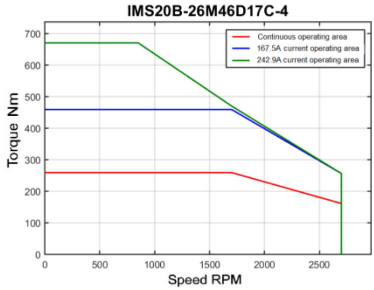
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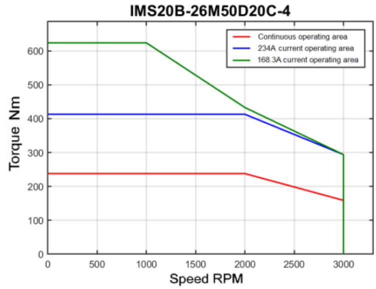
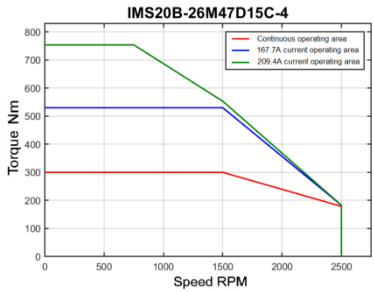
Continuous operating area
167.5A current operating area
242.9A current operating area
Torque Nm
Speed RPM


IMS20B-26M50D20C-4
Continuous operating area
234A current operating area
168.3A current operating area
Torque Nm
Speed RPM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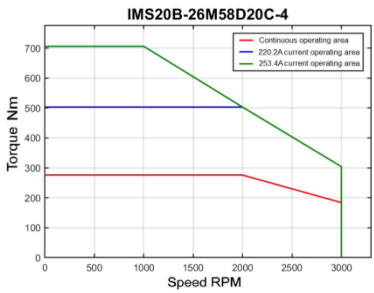
Continuous operating area
167.7A current operating area
209.4A current operating area
Torque Nm
Speed RPM


IMS20B-26M53D17C-4
Continuous operating area
202A current operating area
257A current operating area
Torque Nm
Speed RPM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220.2A current operating area
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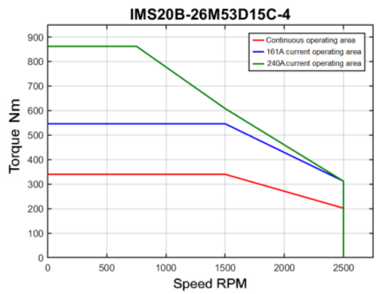
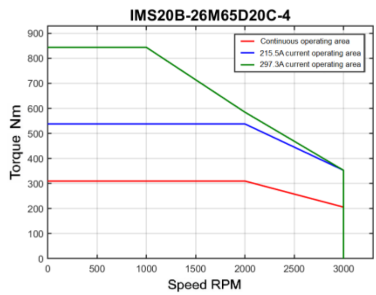
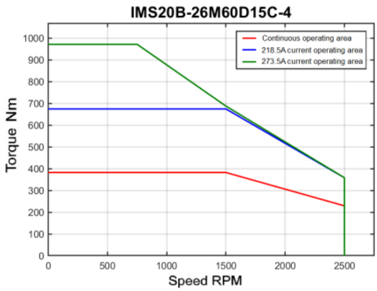
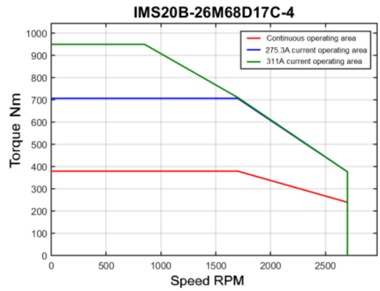
Torque Nm
Speed RPM

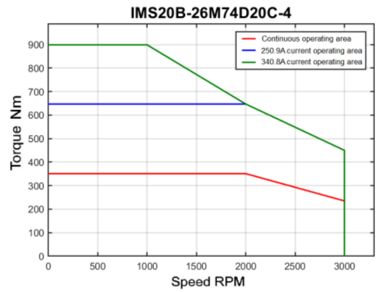

IMS20B-26M53D15C-4
Continuous operating area
161A current operating area
240A current operating area
Torque Nm
Speed RPM

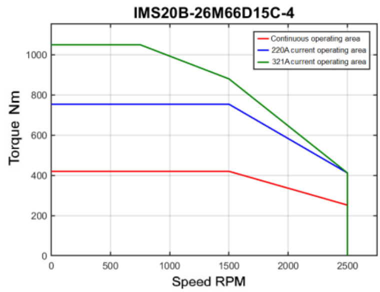

IMS20B-26M61D17C-4
Continuous operating area
225.9A current operating area
252.4A current operating area
Torque Nm
Speed RPM


IMS20B-26M65D20C-4
Continuous operating area
215.5A current operating area
297.3A current operating area
Torque Nm
Speed RPM

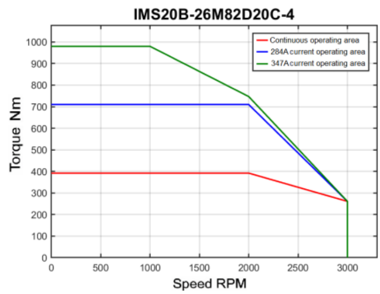

IMS20B-26M60D15C-4
Continuous operating area
218.5A current operating area
273.5A current operating area
Torque Nm
0 100 200 300 400 500 600 700 800 900 1000
0 500 1000 1500 2000 2500
Speed RPM

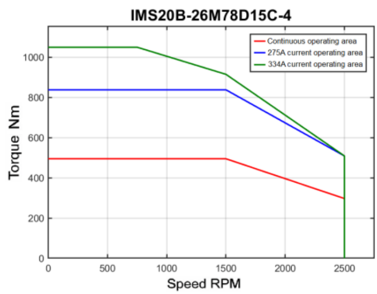

IMS20B-26M68D17C-4
Continuous operating area
275.3A current operating area
311A current operating area
Torque Nm
0 100 200 300 400 500 600 700 800 900 1000
0 500 1000 1500 2000 2500
Speed RPM

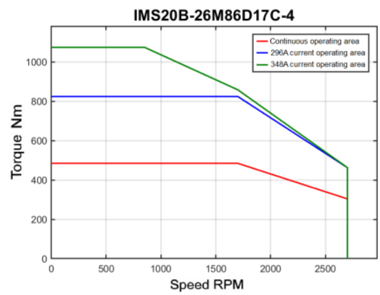

IMS20B-26M74D20C-4
Continuous operating area
250.9A current operating area
340.8A current operating area
Torque Nm
0 100 200 300 400 500 600 700 800 900
0 500 1000 1500 2000 2500 3000
Speed RPM

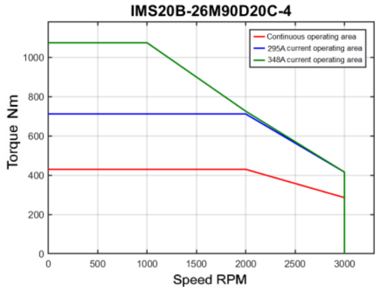

IMS20B-26M66D15C-4
Continuous operating area
220A current operating area
321A current operating area
Torque Nm
0 200 400 600 800 1000
0 500 1000 1500 2000 2500
Speed RPM


IMS20B-26M75D17C-4
Continuous operating area
279A current operating area
333A current operating area
Torque Nm
0 100 200 300 400 500 600 700 800 900 1000
0 500 1000 1500 2000 2500
Speed RPM


IMS20B-26M82D20C-4
Continuous operating area
284A current operating area
347A current operating area
Torque Nm
0 100 200 300 400 500 600 700 800 900 1000
0 500 1000 1500 2000 2500 3000
Speed RPM


IMS20B-26M78D15C-4
Continuous operating area
275A current operating area
334A current operating area
Torque Nm
0 200 400 600 800 1000
0 500 1000 1500 2000 2500
Speed RPM


IMS20B-26M86D17C-4
Continuous operating area
296A current operating area
348A current operating area
Torque Nm
0 200 400 600 800 1000
0 500 1000 1500 2000 2500
Speed RPM



2.2.3 Servo motor mechanical specifications

Item	Medium-power servo motor
Duty type	S1 (continuous duty)
Operating ambient temperature	-20°C–+40°C, non-freezing
Storage temperature	-20°C–+60°C
Operating ambient humidity	20%–90%RH (no condensation)
Vibration	$25m/s^2$
Shock	$50m/s^2$
Excitation method	Permanent magnet
Mounting method	IMB35 (horizontal, foot- and flange-mounted), IMB5
Insulation class	F
Insulation resistance	DC500V, > 100MΩ
Insulation voltage	AC 1500V for 1 minute (220V); AC 1800V for 1 minute (380V)
Degree of protection	IP54 (excluding the shaft extension and cable entries)
Direction of rotation	CCW when viewed from the load side under a forward rotation command
Altitude	⩽1000m; derating required above 1000m (see altitude derating curve)

Note: Refer to section C.3 Servo motor dimensions for servo motor mounting dimensions, motor terminals, and the terminal box.

2.3 System configuration

2.3.1 System composition and configuration

When configuring a control system with a servo drive and motor, various electrical components must be installed on the input and output sides of the servo drive to ensure stable system operation.

Figure 2-2 System composition

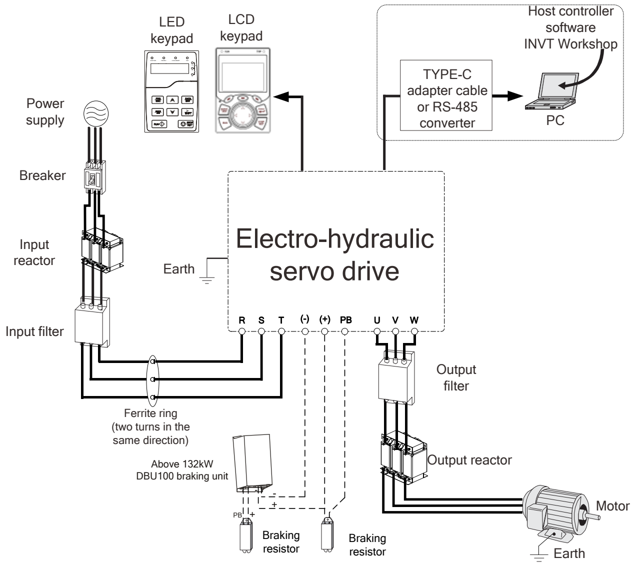
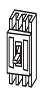
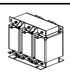
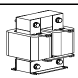
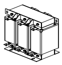
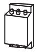
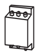
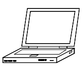


Table 2-2 System configuration

Component		Position	Description
	Breaker	Between the power supply and the drive input side	Device for electric shock prevention and protection against short-to-ground that may cause current leakage and fire. (Select residual-current circuit breakers (RCCBs) that are applicable to drives and can restrict high-order harmonics, and of which the rated sensitive current for one drive is larger than 30mA.)
	Input reactor	Drive input side	Used to improve the input power factor of the drive and suppress high-order harmonic currents. Models of 75kW and above come standard with a built-in DC reactor.
	DC reactor	No external terminals	

<table>
<tr><th colspan="2">Component</th><th>Position</th><th>Description</th></tr>
<tr><td></td><td>Output reactor</td><td>Installed between the drive output and the motor, close to the drive.</td><td>(Optional) Accessory used to lengthen the valid transmission distance of the drive, which effectively restricts the transient high voltage generated during the switch-on and switch-off of the IGBT module of the drive.</td></tr>
<tr><td></td><td>Input filter</td><td>Drive input side</td><td rowspan="2">(Optional) Input filter: Suppresses electromagnetic interference (EMI) transmitted from the drive to the public power grid via input power lines. Install it as close to the drive's input terminals as possible.
(Optional) Output filter: Suppresses interference generated from the wiring on the drive output side.
Note: For details about the motor, motor cable, and filter assembly, observe the technical requirements specified in the appendix.</td></tr>
<tr><td></td><td>Output filter</td><td>As close as possible to the drive output terminals</td></tr>
<tr><td></td><td>Braking unit</td><td>Between the drive main circuit terminals (+) and (−)</td><td rowspan="2">Consumes the motor's regenerative energy using a resistor or resistor unit to reduce the deceleration time.
● Braking unit: Built in on 7.5–110kW models
● Braking resistor: Externally-connected option for all models</td></tr>
<tr><td></td><td>Braking resistor</td><td>Between the drive main circuit terminals (+) and PB.</td></tr>
<tr><td></td><td>Host controller software</td><td>Installed in the host controller which controls the drive.</td><td>INVT Workshop software is used to configure and monitor the drives. Its main functions include:
● Monitor multiple drives.
● Set and monitor function code parameters, and upload and download parameters in batch.
● View modified function codes, compare with default values, and follow up and query for function codes.
● Query for and follow up status parameters.
● View real-time and historical faults.
● Display function codes in configuration mode.
● Control device startup, stop, forward running, reverse running, and other operations.</td></tr>
</table>

Component		Position	Description
			● View oscillographic curves, save and replay waveform data, operate waveforms through cursor, and simulate waveform data. Visit www.invt.com to obtain it for free.

For details about optional part model selection, see Appendix D Peripheral accessories.

2.3.2 System configuration recommendations

Table 2-3 Recommended drive and motor combinations

Drive model	Output power (kW)	Output current (A)	Motor model	Rated power (kW)	Rated torque (N • m)	Rated current (A)
MH860C-S018TF7	7.5	18.5	IMS20B-20M71C17C-4-R7F-A	7.1	40	13.3
MH860C-S025TF7	11	25	IMS20B-20M63C15C-4-R7F-A	6.3	40	12.4
			IMS20B-20M80C20C-4-R7F-A	8	39	14.7
MH860C-S032TF7	15	32	IMS20B-20M94C15C-4-R7F-A	9.4	60	16.3
			IMS20B-20M11D17C-4-R7F-A	10.7	60	19.3
			IMS20B-20M12D20C-4-R7F-A	21.1	58	20.7
			IMS20B-20M13D15C-4-R7F-A	12.6	80	22.5
			IMS20B-20M14D17C-4-R7F-A	14.2	80	25.5
			IMS20B-20M17D20C-4-R7F-A	16.8	80	29.5
			IMS20B-20M16D15C-4-R7F-A	15.7	100	27.9
MH860C-S038TF7	18	38	IMS20B-20M18D17C-4-R7F-A	17.8	100	31.1
MH860C-S045TF7	22	45	IMS20B-20M19D15C-4-R7F-A	18.9	120	32.2
			IMS20B-20M20D20C-4-R7F-A	20	96	34.2
			IMS20B-20M21D17C-4-R7F-A	21.4	120	38.0
			IMS20B-20M22D15C-4-R7F-A	22	140	38.6
MH860C-S060TF7	30	60	IMS20B-20M24D20C-4-R7F-A	24.1	115	41.7
			IMS20B-20M25D17C-4-R7F-A	24.9	140	44.8
			IMS20B-20M27D20C-4-R7F-A	27.4	131	48.6
			IMS20B-20M25D15C-4-R7F-A	25.1	160	43.3
			IMS20B-20M29D17C-4-R7F-A	28.5	160	51.4
			IMS20B-20M28D15C-4-R7F-A	28.3	180	47.5
			IMS20B-26M32D17C-4-R7F-A	32	180	55.7
			IMS20B-26M35D15C-4-R7F-A	34.6	220	60.4
MH860C-S075TF7	37	75	IMS20B-20M32D20C-4-R7F-A	31.6	151	54
			IMS20B-20M28D15C-4-R7F-A	28.3	180	47.5
			IMS20B-20M32D17C-4-R7F-A	32	180	55.7

Drive model	Output power (kW)	Output current (A)	Motor model	Rated power (kW)	Rated torque (N • m)	Rated current (A)
			IMS20B-20M36D20C-4-R7F-A	35.6	170	62.2
			IMS20B-26M37D20C-4-R7F-A	37	175	65
			IMS20B-26M39D17C-4-R7F-A	39	217	65.1
			IMS20B-26M41D15C-4-R7F-A	40.8	260	71.4
MH860C-S092TF7	45	92	IMS20B-26M45D20C-4-R7F-A	45	214	81.2
			IMS20B-26M46D17C-4-R7F-A	46	259	81.3
			IMS20B-26M50D20C-4-R7F-A	49.8	238	86.6
			IMS20B-26M47D15C-4-R7F-A	47	300	82.2
			IMS20B-26M53D17C-4-R7F-A	53	300	93.9
MH860C-S115TF7	55	115	IMS20B-26M58D20C-4-R7F-A	58	276	99.7
			IMS20B-26M53D15C-4-R7F-A	53.4	340	92.9
			IMS20B-26M61D17C-4-R7F-A	60.5	340	101.7
			IMS20B-26M60D15C-4-R7F-A	60	382	104.7
MH860C-S150TF7	75	150	IMS20B-26M65D20C-4-R7F-A	65	310	113
			IMS20B-26M68D17C-4-R7F-A	67.6	380	118.8
			IMS20B-26M74D20C-4-R7F-A	74	351	127.7
			IMS20B-26M66D15C-4-R7F-A	66	420	120
			IMS20B-26M75D17C-4-R7F-A	75	420	141
MH860C-S180TF7	90	180	IMS20B-26M82D20C-4-R7F-A	82	392	138
			IMS20B-26M78D15C-4-R7F-A	78	495	151
			IMS20B-26M86D17C-4-R7F-A	86	485	152
			IMS20B-26M90D20C-4-R7F-A	90	430	148

2.4 Quick startup

Task	Reference
1. Unpack and inspect.	See section 3.1 Unpacking inspection.
2. Verify that the connected load and power supply match the drive specifications.	See section 2.1.1 Servo drive nameplate and models.
3. Check the installation environment.	See section 3.2 Preparation.
4. Mount the drive on a wall or inside a cabinet.	See section 3.3 Installation method.
5. Perform wiring.	See chapter 4 Electrical installation.
6. Commission the drive.	See chapter 6 Commissioning.

3 Mechanical installation

3.1 Unpacking inspection

After receiving the product, perform the following steps to ensure the product use safety.

■ **Check the package**

Before unpacking, check whether the product package is intact–whether the package is damaged, dampened, soaked, or deformed. After unpacking, check whether the interior surface of the packing box is abnormal, for example, in wet condition.

■ **Check the machine and parts**

After unpacking, check whether the equipment housing is damaged or cracked, whether the parts (including the drive, keypad, and manual) inside the packing box are complete, and whether the nameplate and label on the product body are consistent with the model ordered.

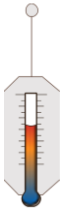
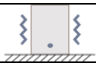
3.2 Preparation

Only trained and qualified professionals are allowed to carry out the operations mentioned in this chapter. Read the following installation preparation carefully before installation to ensure smooth installation and avoid personal injury or equipment damage.

Warning	
	● Carry out operations according to instructions presented in section 1.4 Safety guidelines. Ensure the drive power has been disconnected before installation. If the drive has been powered on, disconnect the drive and wait for at least the time designated on the drive, and ensure the POWER indicator is off. Alternatively, use a multimeter to verify that the DC bus voltage of the drive is below 36V. ● The drive installation must be designed and done according to applicable local laws and regulations. We do not assume any liability whatsoever for any equipment installation which breaches local laws or regulations.

3.2.1 Installation environment and site

■ **Environment requirements**

<table>
<tr><th>Environment</th><th colspan="2">Requirement</th></tr>
<tr><td>Temperature</td><td></td><td>● -10°C–+50°C
● Do not use the drive when the ambient temperature exceeds 50°C. When the ambient temperature exceeds 40°C, derate 1% for every increase of 1°C.
● There is no sudden temperature change.
● When the drive is installed in an enclosed space, such as a control cabinet, use a cooling fan or air conditioner for temperature control if necessary.
● When the temperature is too low, if you want to use the drive that has been idled for a long time, install an external heating device before the use to eliminate the freeze inside the drive. Otherwise, the drive may be damaged.</td></tr>
<tr><td>Humidity</td><td></td><td>● RH: less than 90%, no condensation
● The max. RH cannot exceed 60% in the environment with corrosive gases.</td></tr>
<tr><td>Altitude</td><td></td><td>● Lower than 1000m
● When the altitude exceeds 1000m, derate by 1% for every increase of 100m.
● When the altitude exceeds 3000m, consult our local dealer or office for details.</td></tr>
<tr><td>Vibration</td><td></td><td>Max. vibration ACC: 5.8m/s² (0.6g)</td></tr>
</table>

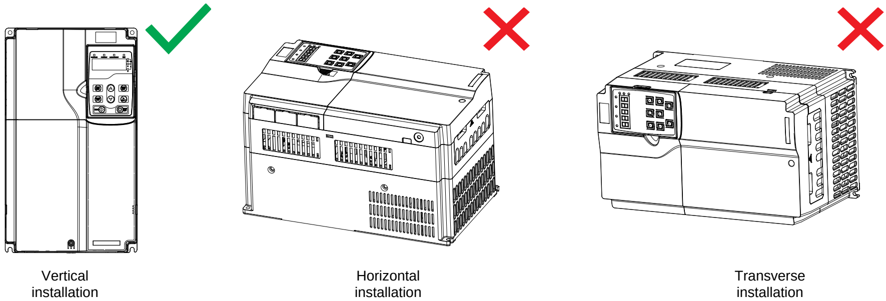
■ **Site requirement**

<table>
<tr><th>Site</th><th colspan="2">Requirement</th></tr>
<tr><td rowspan="4">Indoor</td><td></td><td>Without electromagnetic radiation sources and direct sunlight.
Note: The drive must be installed in a clean and well-ventilated environment based on the housing IP rating.</td></tr>
<tr><td></td><td>Without foreign objects such as oil mist, metal powder, conductive dust, and water.</td></tr>
<tr><td></td><td>Without radioactive, corrosive, hazardous, flammable, and explosive substances.
Note: Do not install the drive on flammable surfaces.</td></tr>
<tr><td></td><td>Low-salinity environment.</td></tr>
</table>

3.2.2 Installation direction

The drive may be mounted on a wall or inside a cabinet. It must be installed vertically. Do not install it horizontally (flat), sideways, inverted, or in any other orientation.

Figure 3-1 Mounting direction



3.2.3 Installation space

3.2.3.1 Single drive

Figure 3-2 Single drive installation space

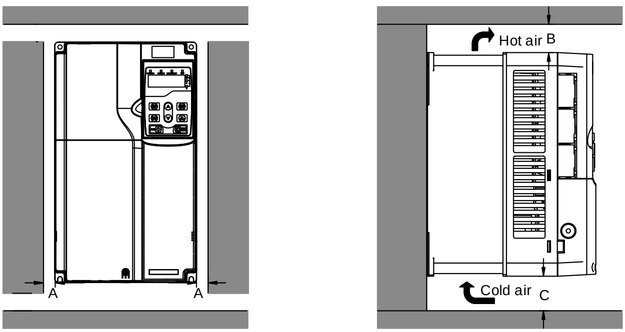


Table 3-1 Single drive installation space dimensions

Power (kW)	Dimensions (mm)		
	A	B	C
7.5–160kW	⩾100	⩾100	⩾100
185–355kW	⩾100	⩾100	0

3.2.3.2 Multiple drives

- **Parallel installation**

Parallel installation is recommended for multiple drives. When you install drives in different sizes, align the top of each drive before installation for the convenience of future maintenance.

Figure 3-3 Multiple drive installation space

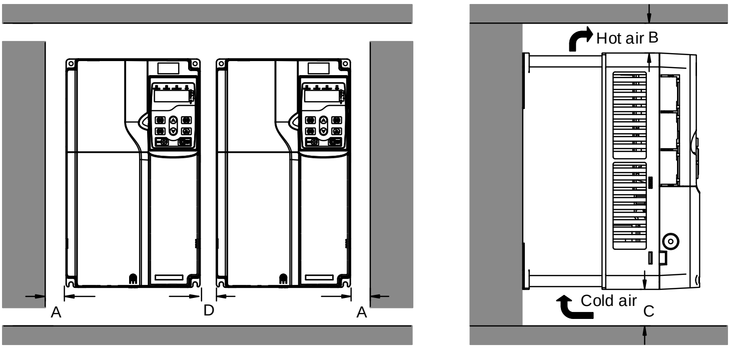
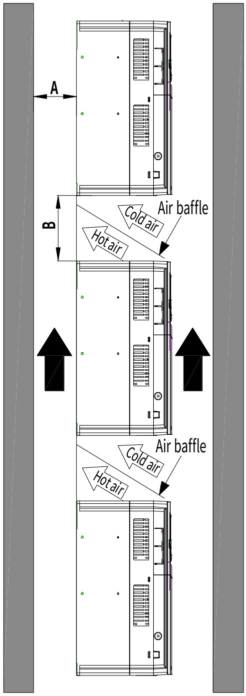


Table 3-2 Multiple drive installation space dimensions

Power (kW)	Dimensions (mm)			
	A	B	C	D
7.5–160kW	⩾100	⩾100	⩾100	⩾100
185–355kW	⩾100	⩾100	0	⩾100

■ **Vertical installation**

Figure 3-4 Vertical installation space

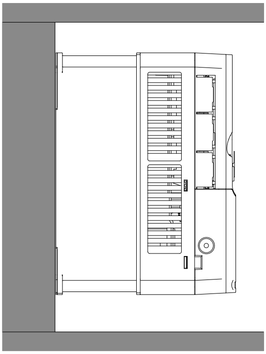


Note:

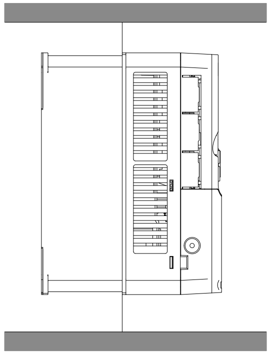
- An air baffle is required when drives are installed vertically. Otherwise, the drives may affect each other thermally, leading to poor heat dissipation.
- The minimum dimensions for A and B shall be ⩾ 50n (where n is the number of drives, and n shall be > 1).

3.3 Installation method

The drive supports three mounting methods: wall mounting, flange mounting (for drives ⩽160kW), and floor mounting (for drives rated 185–355kW).



Wall mounting

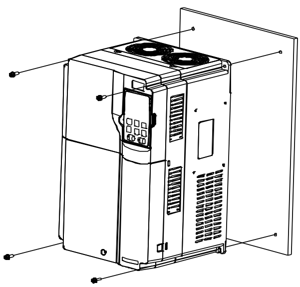
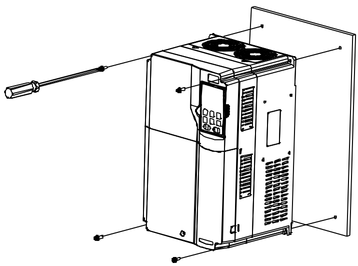


Flange mounting

Note: For 380V drives rated 7.5–160kW, a mounting bracket (optional) is required for flange mounting. See section D.3.5 Flange mounting bracket for details.

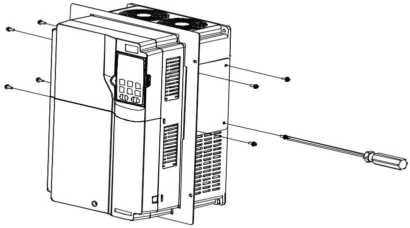
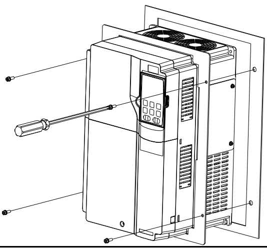
3.3.1 Wall mounting

The mounting procedures are as follows:

Step 1	Mark the installation hole positions. Install screws or bolts at the marked positions. For details about the installation hole positions, see section C.2 Drive outline dimensions. 	Step 2	Mount the drive onto the wall or mounting plate, and tighten the fastening screws. 

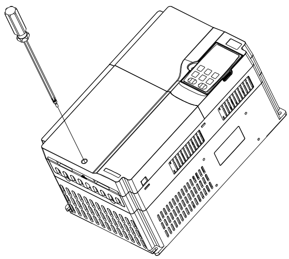
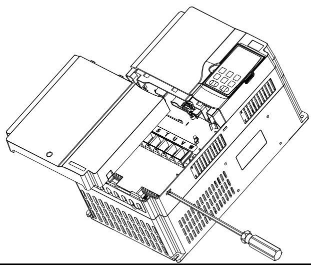
3.3.2 Flange mounting

The mounting procedures are as follows:

Step 1 Fix the bracket on both sides of the drive body, and tighten the screws on both sides of the bracket. 	Step 2 Fix the drive with bracket on the control cabinet, and tighten the screws on the front of the bracket. 

3.4 Removing the lower cover

The lower cover must be removed to perform main circuit and control circuit wiring. The removal procedure is as follows:

Step 1 Identify the positions of the lower cover screws. Loosen the screws using a tool and remove them. 	Step 2 Use a tool to pry up the snaps on both sides of the lower cover. Gently lift the bottom of the lower cover and remove it. 

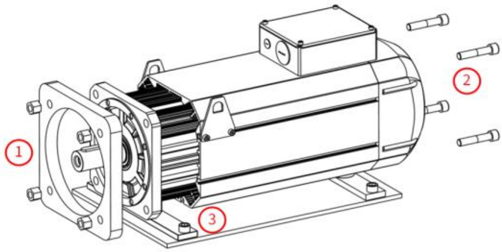
3.5 Installing the servo motor

The installation procedure is as follows:

Step 1 Clean the installation site and prepare the necessary tools and components.

Step 2 Check that all components are intact and verify that the motor rotates smoothly.

Step 3 Select a suitable mounting method and ensure the centerlines of the shafts are properly aligned within the permissible tolerance. Secure the motor using bolts. Do not strike the motor, as this may cause damage.



①Flange mounting nut ②Flange mounting bolt ③Foundation anchor bolt

Note:

- Do not pull the motor leads or the output shaft when handling the motor. It is recommended to use the lifting lugs on both sides of the housing to lift and position the motor.
- IMB35 mounting is recommended. The flange and feet must be secured on a flat supporting surface. If shims are required to compensate for center height differences between the motor and the driven machine, the shim area shall be larger than the contact area of the motor feet.
- When using a coupling, ensure that the motor shaft centerline is aligned with the load shaft centerline.
- Ensure that all mounting holes are securely fastened using steel bolts (strength grade 8.8 or higher) and nuts. Use stainless steel bolts in environments prone to rust/corrosion. In high-vibration environments, anti-vibration pads should be used.
- During assembly, do not strike or hammer the motor, as this may damage the encoder or bearings.
- After installation, inspect each component individually. Ensure all fasteners are securely tightened before starting trial operation.
- Wipe the slushing oil on the motor shaft before using.

4 Electrical installation

4.1 Insulation inspection

Before shipment, each drive undergoes an insulation withstand voltage test between the main circuit and the housing. The drive features internal voltage-limiting circuits that automatically cut off the test voltage. Therefore, do not perform any voltage withstand or insulation resistance tests (such as high-voltage insulation and megohmmeter tests) on the drive or its components. Contact us if you need to perform an insulation resistance test on the drive.

Note: When performing insulation resistance tests on the input/output power cables, disconnect the cable terminals from the drive.

- **Input power cable**

Before connecting the input power cable to the drive, check the insulation of the cable in accordance with local regulations.

- **Motor cable**

After verifying that the motor cable is connected to the motor, disconnect the motor cable from the drive output terminals U, V, and W. Then use a 500VDC megohmmeter to measure the insulation resistance between each phase conductor and the protective earth conductor. For the motor insulation resistance, refer to the motor manufacturer’ s instructions.

Note: If moisture is present inside the motor, the insulation resistance will decrease. If moisture is suspected, dry and re-measure the insulation resistance.

4.2 Cable selection and routing

4.2.1 Cable model selection

- **Power cable**

Power cables mainly include input power cables and motor cables. To meet the EMC requirements stipulated in the CE standards, it is recommended to use symmetrical shielded cables as motor cables and input power cables. See section D.1.1 Power cable.

Note: If the conductivity of the motor cable shield layer does not meet the requirements, a separate PE conductor must be used.

- **Control cable**

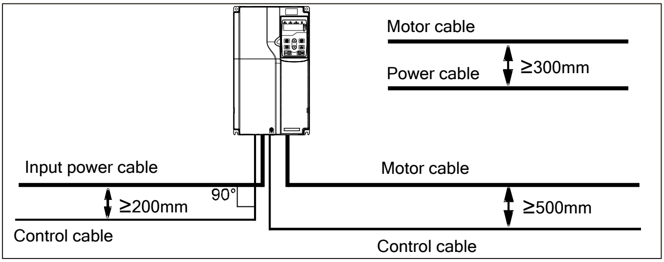
Control cables mainly include analog signal control cables and digital signal control cables. For analog signal control cables, use double-shielded twisted pair cable with a individually-shielded pair for each signal and different ground conductors for different analog signals. For digital signal control cables, a double-shielded cable is preferred, but single-shielded or unshielded twisted pairs can also be used. See section D.1.2 Control cable.

4.2.2 Cable routing

Route motor cables away from other cables. The dv/dt from the drive output increases electromagnetic interference on other cables. Motor cables from multiple drives may be routed in parallel. It is recommended to route motor cables, input power cables, and control cables in separate cable trays.

If a control cable and a power cable must cross, ensure that they cross at 90°. The cable trays must be connected properly and well grounded. See Figure 4-1 for cable routing and separation distances.

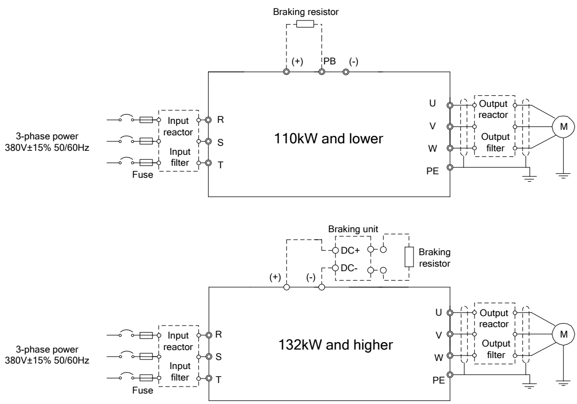
Figure 4-1 Cable separation distances



4.3 Main circuit wiring

4.3.1 Main circuit wiring diagram

Figure 4-2 Main circuit wiring

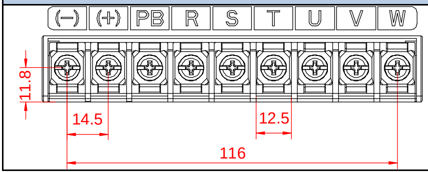


Note:

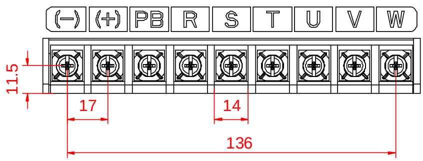
- Fuses, braking resistors, input reactors, input filters, output reactors, and output filters are optional. For details, refer to Appendix D Peripheral accessories.
- Models rated 75–355kW come standard with a built-in DC reactor. For 7.5–55kW models, the reactor is optional.
- Models rated 7.5–110kW come standard with a built-in braking unit.
- Before connecting the braking resistor, remove the yellow warning labels marked PB, (+), or (-) from the terminal block; otherwise, poor contact may occur.

4.3.2 Main circuit terminals

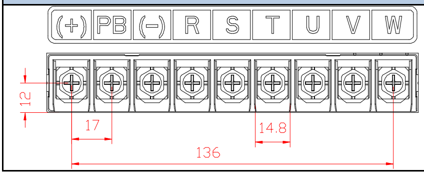
Main circuit terminal diagram for 380V 7.5–11kW models



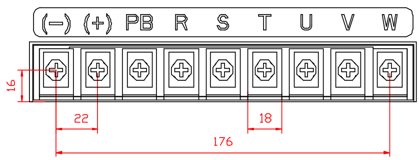
Main circuit terminal diagram for 380V 15–18.5kW models



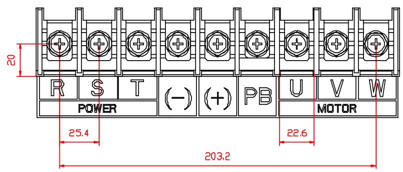
Main circuit terminal diagram for 380V 22kW models



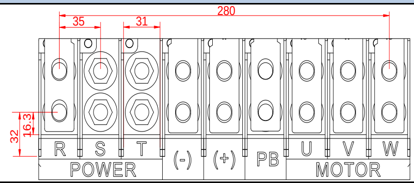
Main circuit terminal diagram for 380V 30–37kW models



Main circuit terminal diagram for 380V 45–75kW models



Main circuit terminal diagram for 380V 90–110kW models



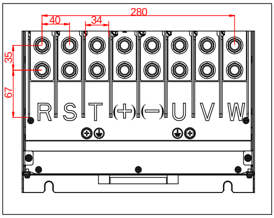
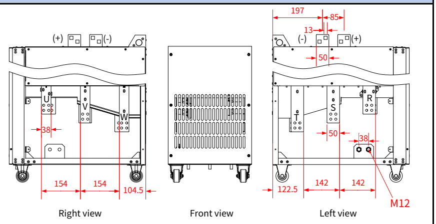
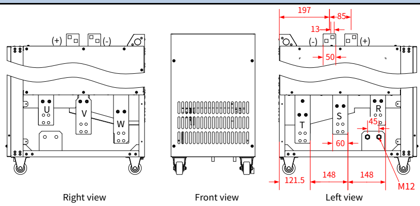
Main circuit terminal diagram for 380V 132–160kW models	Main circuit terminal diagram for 380V 185–315kW models
	
Main circuit terminal diagram for 380V 355kW models	
	

Table 4-1 Main circuit terminals

Terminal symbol	Terminal name	Function description
R, S, T	Main circuit power input	3PH AC input terminals, connected to the grid
U, V, W	Drive output	3PH AC output terminals, connected to the motor usually
(+)	Bus terminal 1	(+) and (-) connect to an external braking unit or the shared DC bus
(-)	Bus terminal 2	
PB	Braking resistor terminal	(+) and PB connect to an external braking resistor
PE	Protective Earth (PE) terminal	Each drive is equipped with two PE terminals as standard. The drive must be reliably grounded.

Note:

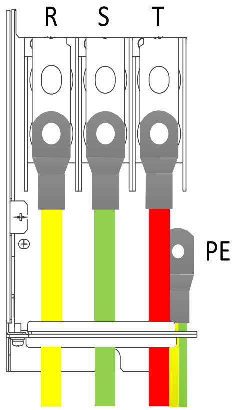
- It is recommended to use a 4-core cable (with a PE conductor) to connect the U, V, W, and PE terminals of the drive and the motor respectively.
- The braking resistor and DC reactor (for 7.5–55kW models) are optional accessories.
- In shared DC bus running mode, the drives must have the same power rating and be powered on and off simultaneously.

- In shared DC bus running mode, current balance on the drive input side must be considered during wiring, and equalizing reactors are recommended to be configured.

4.3.3 Wiring procedures

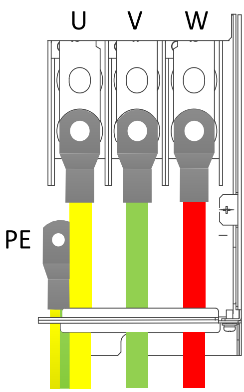
Step 1 Connect the grounding line of the input power cable to the grounding terminal (PE) of the drive, and connect the 3PH input cable to R, S and T terminals and tighten up.

Figure 4-3 Input power cable connection



Step 2 Connect the ground wire of the motor cable to the PE terminal of the drive, connect the motor 3PH cable to the U, V and W terminals, and tighten up.

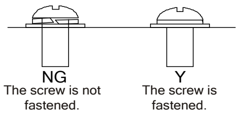
Figure 4-4 Motor cable connection



Step 3 Connect optional parts such as the braking resistor with cables to designated positions. For details, see section 4.3.1 Main circuit wiring diagram.

Step 4 If possible, mechanically secure all cables outside the drive.

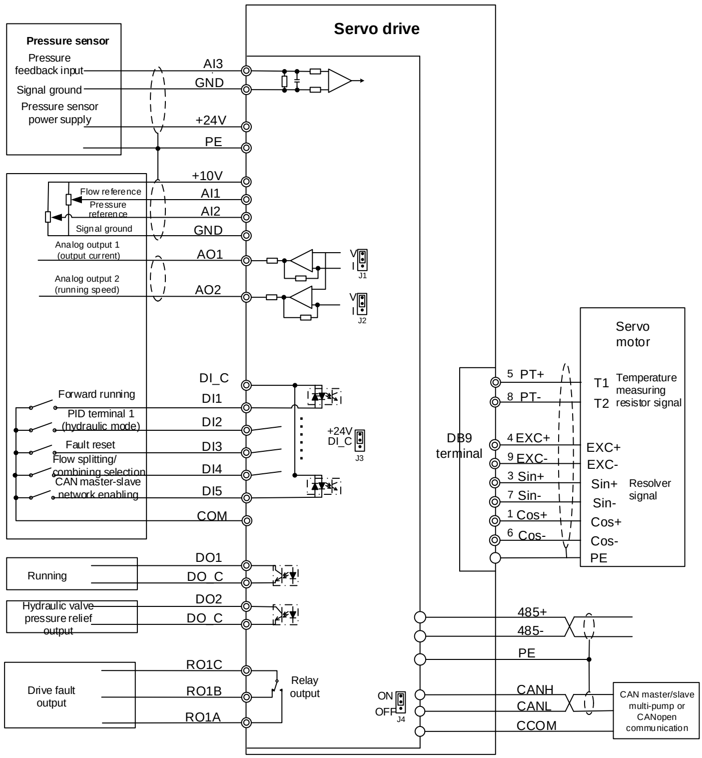
Figure 4-5 Correct and incorrect screw installation



4.4 Control circuit wiring

4.4.1 Control circuit wiring

Figure 4-6 Control circuit wiring



Note: If wire-passing board outlet space is insufficient when all terminals on the control board are wired, cut the knock-out hole on the lower cover for wire outlet. If a dangerous situation occurs when the knock-out hole is cut for a purpose other than a wire outlet, we will not bear any responsibility.

4.4.2 Control circuit terminals

Figure 4-7 Control circuit terminals

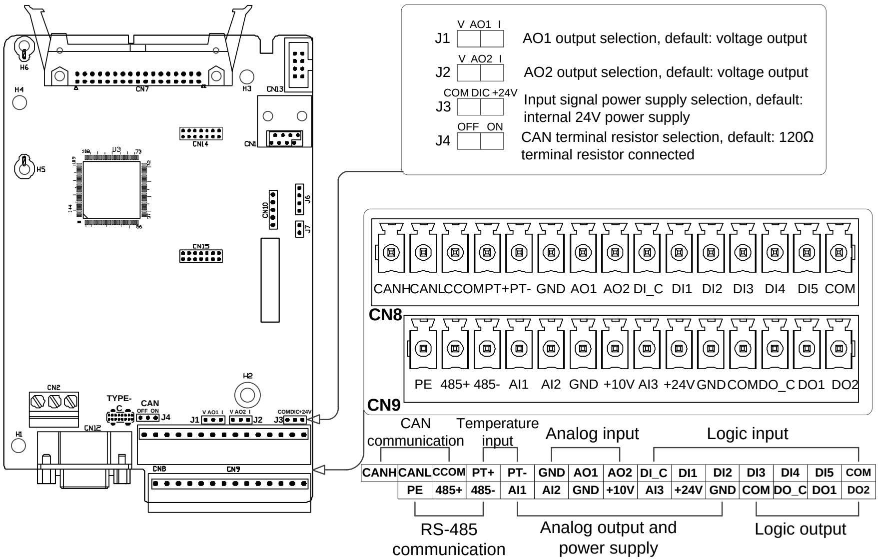


Table 4-2 Control circuit terminals

Terminal name	Specifications
+10V	+10V power supply Generally used as the power supply for pressure and flow references.
+24V	Power supply for pressure sensor Voltage: +24VDC, ±20% (in full scale range), output < 50mA at 25°C.
DI_C DI1 DI2 DI3 DI4 DI5	Internal impedance: 3.3kΩ 12V–30V voltage input is acceptable. DI1–DI5 are bidirectional input terminals, supporting NPN or PNP wiring. External or internal power drive can be selected through the J3 jumper DI_C on the control board. Max. input frequency: 1kHz Programmable digital input terminals, the functions of which can be set through the related parameters.
GND	+10V, +24V reference ground, analog ground

<table>
<tr><th>Terminal name</th><th>Specifications</th></tr>
<tr><td>COM</td><td>DI1–DI5 reference ground, digital ground</td></tr>
<tr><td>DO_C</td><td>DO1 and DO2 reference ground, digital ground</td></tr>
<tr><td>AI1</td><td>Input range: 0–10V
Calibration accuracy: Input 0–2V, error ≤0.05V; input 2–10V, error ≤1%
Input impedance: 13.9kΩ</td></tr>
<tr><td>AI2</td><td>Input range: -10–10V
Calibration accuracy: Input -10–-6V, error ≤0.05V; input -6–10V, error ≤1%
Input impedance: 13.9kΩ</td></tr>
<tr><td>AI3</td><td>Input range: 0–10V/0–20mA
Input impedance: 113kΩ for voltage input; 500Ω for current input.
Whether voltage or current is used for input is set through P73.72.</td></tr>
<tr><td>AO1</td><td rowspan="2">Output range: 0–10V/0–20mA
Whether voltage or current is used for output is set through jumpers J1 and J2.
Current mode: Maximum load resistance ≤ 500Ω
Voltage mode: Minimum load resistance > 1kΩ</td></tr>
<tr><td>AO2</td></tr>
<tr><td>DO1</td><td rowspan="2">Digital output 1–2
Opto-isolated bipolar open-collector outputs
● Output voltage range: 0V–30V
● Output current range: 0mA–100mA
Note: An external power supply is required for DO1 and DO2.</td></tr>
<tr><td>DO2</td></tr>
<tr><td>RO1A</td><td rowspan="3">Relay output: RO1A: NO; RO1B: NC; RO1C: common
Contact capacity: 3A/AC 250V, 1A/DC 30V</td></tr>
<tr><td>RO1B</td></tr>
<tr><td>RO1C</td></tr>
<tr><td>CANH</td><td rowspan="3">CAN communication
Equipped with one isolated CAN communication, used for communication between a host controller (or PLC) and the drive.
Maximum communication rate: 1Mbps. The 120Ω terminal resistor can be enabled or disabled via jumper J4.
Note: The maximum communication distance is 75m at a CAN baud rate of 500kbps, and 100m at 250kbps. Use shielded twisted pair cables for communication. It is recommended to route communication cables separately from power cables to prevent interference.</td></tr>
<tr><td>CANL</td></tr>
<tr><td>CCOM</td></tr>
<tr><td>485+</td><td rowspan="2">RS485 communication
RS485 communication interface supports the standard Modbus RTU communication protocol. It is configured with a built-in 1kΩ terminal resistor.
Semi-duplex. Supports 9600bps, 19200bps, 38400bps, and 57600bps (19200bps by default).</td></tr>
<tr><td>485-</td></tr>
<tr><td>PE</td><td>Grounding terminal for signal cable shield</td></tr>
</table>

<table>
<tr><th>Terminal name</th><th>Specifications</th></tr>
<tr><td>PT+</td><td rowspan="2">Motor temperature sampling signal
The motor temperature sensor terminals (PTC+ and PTC-) are not polarity-sensitive.
The drive supports KTY84, PT1000, and PTC130 motor temperature sensors (resistive). You can select the motor temperature sensor type through P73.68.
PT1000 temperature sensor:
Resolution: 1°C; detection range: -30°C–150°C; detection accuracy: ±5°C
KTY84 temperature sensor:
Resolution: 1°C; detection range: -30°C–150°C; detection accuracy: ±5°C
PTC130 thermistor:
Protection temperature: 130°C</td></tr>
<tr><td>PT-</td></tr>
</table>

4.4.3 Resolver signal connection diagram

Figure 4-8 DB9 pinout

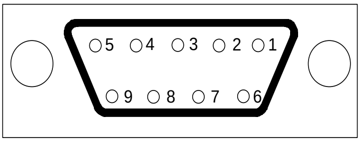
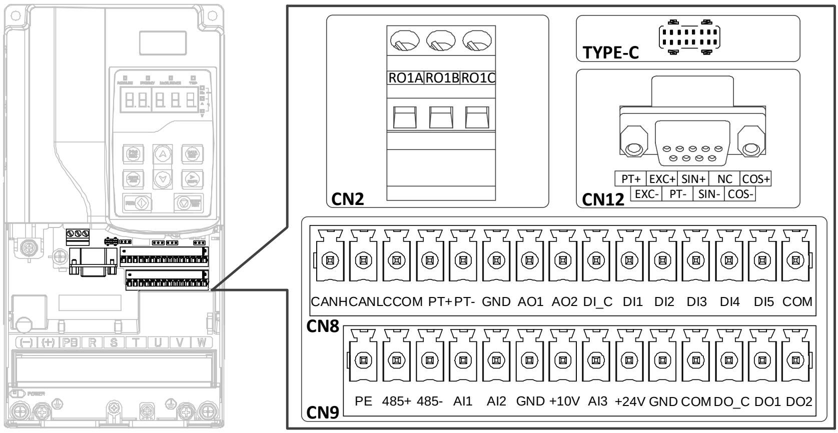


Table 4-3 DB9 terminal interface

<table>
<tr><th>Pin</th><th>Code</th><th>Signal name</th><th>Function</th></tr>
<tr><td>4</td><td>EXC+</td><td>Excitation signal +</td><td rowspan="2">Resolver excitation signal</td></tr>
<tr><td>9</td><td>EXC-</td><td>Excitation signal -</td></tr>
<tr><td>3</td><td>SIN+</td><td>Resolver sine input +</td><td rowspan="2">Resolver sine feedback signal</td></tr>
<tr><td>7</td><td>SIN-</td><td>Resolver sine input -</td></tr>
<tr><td>1</td><td>COS+</td><td>Resolver cosine input +</td><td rowspan="2">Resolver cosine feedback signal</td></tr>
<tr><td>6</td><td>COS-</td><td>Resolver cosine input -</td></tr>
<tr><td>5</td><td>PT+</td><td>Motor resistance +</td><td rowspan="2">Motor temperature sensor signal</td></tr>
<tr><td>8</td><td>PT-</td><td>Motor resistance -</td></tr>
<tr><td>Metal housing</td><td>PE</td><td>Ground</td><td>Connects to the shield</td></tr>
</table>

4.4.4 Input/output signal connection diagram

Figure 4-9 Terminal definition diagram



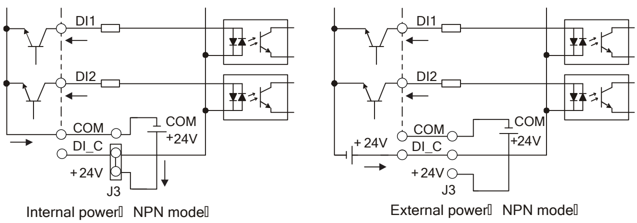
Note: The Type-C port can be used for commissioning via the Workshop host controller software.

4.4.4.1 Input signal wiring diagram

Select the appropriate wiring method based on the transistor type (NPN or PNP) and the power supply mode (internal or external).

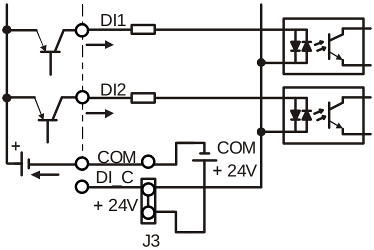
Method 1 When the input signal is from an NPN transistor, set the J3 terminal jumper cap position according to the power used, as shown in the figure.

Figure 4-10 NPN mode diagram



Method 2 When the input signal is from a PNP transistor, set the J3 terminal jumper cap position according to the power used, as shown in the figure.

Figure 4-11 PNP mode diagram

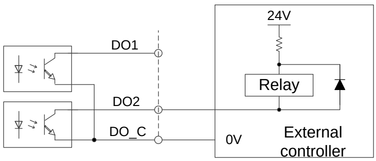


Note: PNP mode with internal power supply is not supported.

4.4.4.2 Output signal wiring diagram

Method 1 Relay wiring

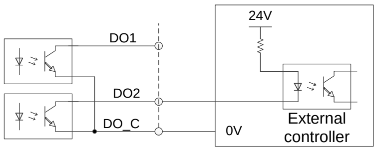
Figure 4-12 DO terminals wiring to external controller 1



Note: When the output terminals are used to drive a relay, install a flyback diode across the relay coil. Ensure the diode polarity is correct. For this type of application, pay attention to relay selection. Since the drive capacity of the DO output is not greater than 100mA, the relay coil resistance shall be within an appropriate range (not less than 300Ω).

Method 2 Optocoupler wiring

Figure 4-13 DO terminals wiring to external controller 2



Note: Output voltage range: 0–30V; output current range: 0–100mA.

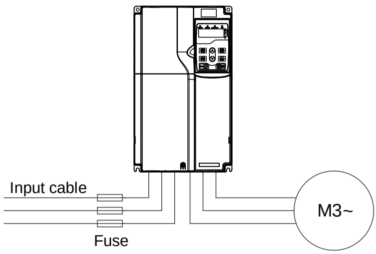
4.5 Power distribution protection

	Do not connect the power supply to the drive output terminals U, V, and W. Applying voltage to the motor cables may cause permanent damage to the drive.

- **Power cable and drive protection**

In case of short circuit, the fuse protects input power cables to avoid damage to the drive; if internal short circuit occurs in the drive, it can protect neighboring equipment from being damaged. The wiring diagram is as follows.

Figure 4-14 Fuse configuration



Note: Select the fuse according to section D.2 Breaker and electromagnetic contactor.

- **Motor and motor cable short-circuit protection**

If the motor cable is selected based on drive rated current, the drive is able to protect the motor cable and motor without other protective devices during short circuit.

- **Motor thermal overload protection**

Once overload is detected, the power supply must be cut off. The drive is equipped with a motor thermal overload protection function. This function protects the motor by blocking the output and cutting off the current when necessary.

- **Bypass connection protection**

In some critical scenarios, the power/variable frequency conversion circuit needs to be configured to ensure proper operation of the system when a fault occurs in the drive.

In some special scenarios, such as in soft startup, power-frequency running is directly performed after the startup, which requires bypass connection.

If drive status needs to be switched frequently, you can use the switch which carries mechanical interlock or a contactor to ensure motor terminals are not connected to input power cables and drive output ends simultaneously.

5 Keypad operation guidelines

5.1 Keypad panel display

The MH860C series drive comes standard with an LED keypad, used for controlling the start/stop of the drive, reading status data, and adjusting parameters. An LCD keypad is available as an option. It features a high-definition display and supports copying multiple sets of parameters. Its overall dimensions are identical to those of the LED keypad, as shown in the figure below:

Figure 5-1 LED keypad

Figure 5-2 LCD keypad (optional)

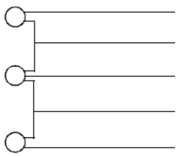
Note:

- The 7.5–18.5kW models are equipped with an integrated keypad as standard.
- The 22–355kW models come standard with an LED keypad, which can be externally connected. If needed, purchase the optional bracket.

5.2 LED keypad display and operation

5.2.1 LED keypad component description

5.2.1.1 Indicators

<table>
<tr><th>No.</th><th>Name</th><th colspan="2">Label</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Status indicator</td><td colspan="2">RUN/TUNE</td><td colspan="2">Off: The drive is stopped.
Blinking: The drive is in low voltage or factory test state.
On: The drive is running.</td></tr>
<tr><td colspan="2">FWD/REV</td><td colspan="2">Forward or reverse running indicator
Off: The drive is running forward.
On: The drive is running reversely.</td></tr>
<tr><td colspan="2">LOCAL/REMOT</td><td colspan="2">Command mode indicator
Off: Digital input (keypad, HMI panel, or PC software input)
Blinking: Analog input or internal reference
On: Continuous RS485 communication input, CANopen input, EtherCAT input, or PROFINET input</td></tr>
<tr><td colspan="2">TRIP</td><td colspan="2">Fault indicator
Off: The drive is in normal state.
Blinking: The drive is in pre-alarm state.
On: The drive is in fault state.</td></tr>
<tr><td rowspan="5">2</td><td rowspan="5">Unit indicator</td><td colspan="2" rowspan="5"></td><td>Hz</td><td>Frequency unit</td></tr>
<tr><td>rpm</td><td>Rotational speed unit</td></tr>
<tr><td>A</td><td>Current unit</td></tr>
<tr><td>%</td><td>Percentage</td></tr>
<tr><td>V</td><td>Voltage unit</td></tr>
</table>

5.2.1.2 Display screen

The display shows different content depending on the operating scenario.

No.	Name	Display	Description
1	Digital display zone	Five-digit LED displays various monitoring data (such as speed feedback and pressure feedback) and alarm codes.	

- **LED display reference table:**

Display	Means	Display	Means	Display	Means	Display	Means	Display	Means	Display	Means
	0		1		2		3		4		5
	6		7		8		9		A		b
	C		d		E		F		G		h
	I		J		K		L		M		N
	O		P		q		R		S		T
	U		V		W		X		Y		Z
	.		-	-	-	-	-	-	-	-	-

- **Keypad display:**

When the drive is powered on, the LED turns on. By default, it displays the motor frequency (Hz) with a precision of two decimal places.

If a fault occurs during power-on or running, the TRIP indicator will be on and the LED numeric display will display the fault code. You can perform fault reset by using the STOP/RST key, control terminals, or communication commands.

If the fault persists, the fault code will be continuously displayed.

5.2.1.3 Keys

No.	Name	Key	Description	
1	Keys		Programming key	To switch between modes or return to the previous menu level.
			Confirm key	To enter next menu in parameter mode and to confirm the setting of parameter in edit mode.
			Up key	To increase data or move upward.
			Down key	To decrease data or move downward.
			Right shift key	Press it to select display parameters rightward in the interface for the drive in stopped or running state or to select digits to change during parameter setting.

No.	Name	Key	Description	
			Multifunction shortcut key	The function of this key is determined by the ones place of P07.02.
			Run key	Press it to run the drive when using the keypad for control.
			Stop/Reset key	When using the keypad for control, press it to stop the drive that is running. The function of this key is restricted by P07.04. In fault alarm state, this key can be used for reset in any control modes.

5.2.2 Keypad operation

The MH860C series drive is equipped with an LED keypad as standard, which is used to control the start/stop of the drive, read status data, and set parameters.

Once a fault is detected, the keypad displays the fault code and fault information with the TRIP indicator on the keypad turning on. The fault can be reset using the STOP/RST key, control terminals, or communication commands.

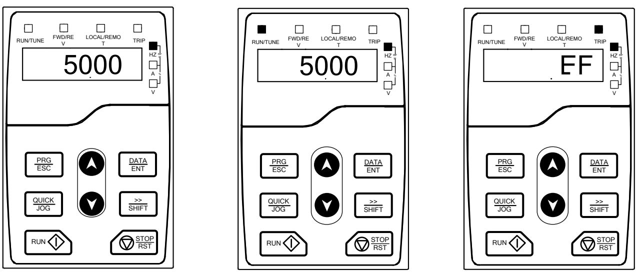
The display states of the MH860C series drive keypad include: stopped-state parameter display, running-state parameter display, fault display, and function code editing.

You can perform various operations on the drive via the keypad. For details on the function codes, refer to Appendix F Function parameter list.

5.2.2.1 Stopped-state parameter display

When the drive is in the stopped state, the keypad displays the corresponding parameters, as shown in Figure 5-3.

Figure 5-3 Status display



Parameter displayed in the stopped state | Parameter displayed in the running state | Faulty state displayed

In the stopped state, various kinds of parameters can be displayed. You can determine which parameters are displayed in stopped state by setting function code P07.07. For details, see the description of P07.07.

There are 10 parameters available for selection: set frequency, bus voltage, input terminal status, output terminal status, torque setting, analog AI1 value, analog AI2 value, analog AI3 value, count value, and frequency upper limit (with the Hz indicator ON). The display selection is configured via function code P07.07 (converted to binary). Press the 》/SHIFT key to cycle through the selected parameters from left to right.

5.2.2.2 Running-state parameter display

After the drive receives a valid run command, it enters the running state. The keypad displays the corresponding parameters and the RUN/TUNE indicator lights up. The FWD/REV indicator's on/off status is determined by the current running direction, as shown in Figure 5-3.

In the running state, there are 21 parameters available for selection: running frequency, set frequency, bus voltage, output voltage, output current, running speed, output power, output torque, input terminal status, output terminal status, torque setting, pulse count value, motor overload percentage, analog AI1 value, analog AI2 value, analog AI3 value, drive overload percentage, ramp frequency reference, linear speed, AC input current, and frequency upper limit (with the Hz indicator ON). The display of these parameters is selected bitwise via function codes P07.05 and P07.06 (converted to binary). Press the 》/SHIFT key to cycle through the selected parameters from left to right.

5.2.2.3 Fault display

When the drive detects a fault signal, it enters the fault display state. The fault code flashes on the keypad, and the TRIP indicator turns ON. You can perform fault reset by using the STOP/RST key, control terminals, or communication commands.

If the fault persists, the fault code will be continuously displayed.

5.2.2.4 Function code editing

You can press the PRG/ESC key to enter the editing mode in stopped, running, or fault state (if a user password is used, see the description of P07.00). The editing mode contains two levels of menus in the following sequence: function code group or function code number → function code setting. You can press the DATA/ENT key to enter the function parameter display interface. In the function parameter display interface, you can press the DATA/ENT key to save parameter settings or press the PRG/ESC key to exit the parameter display interface.

5.2.2.5 Modifying drive function codes

The drive menu consists of three levels:

- Function code group number (level-1 menu)
- Function code number (level-2 menu)
- Function code setting (level-3 menu)

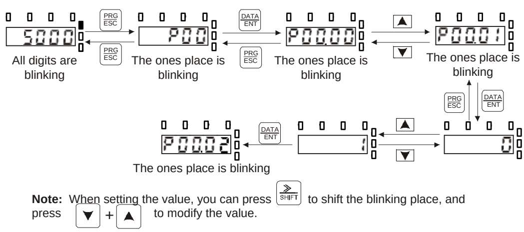
Note: When performing operations on the level-3 menu, you can press the PRG/ESC or DATA/ENT key to return to the level-2 menu. If you press the DATA/ENT key, the set parameter value will be saved to the control board. The system will return to the level-2 menu, displaying the next function code. If you press the PRG/ESC key, the system will return to the level-2 menu without saving the set parameter value, displaying the current function code.

In the Level-3 menu, if there is no blinking digit, it indicates that the function code cannot be modified. Possible reasons include:

- The function code is a non-modifiable parameter, such as monitoring parameters or recorded operating parameters.
- The function code cannot be modified during operation; it can only be modified after stopping the drive.

Example: Changing the value of P00.01 from 0 to 1.

Figure 5-4 Modifying a parameter

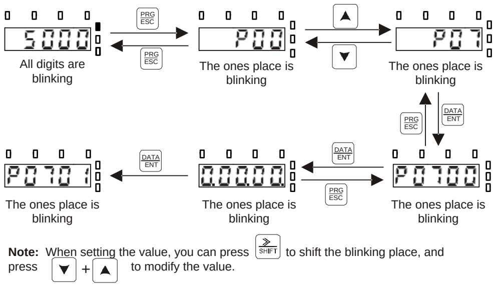


5.2.2.6 Modifying the drive password

The MH860C series drive provides user password protection. When function code P07.00 is set to a non-zero value, it serves as the user password. To disable the function, set P07.00 to 0.

After you exit the function code editing interface, the password protection function is enabled within 1 minute. If password protection is enabled, 0.0.0.0.0 is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password to enter the interface.

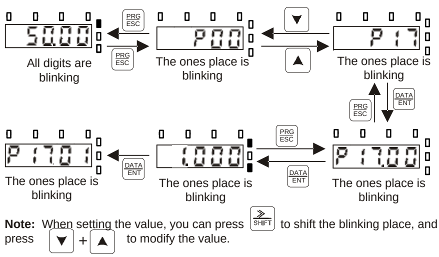
Figure 5-5 Setting a password



5.2.2.7 Viewing the drive status via function codes

The MH860C series drive provides the P17 group for status viewing. You can access this group to view the status.

Figure 5-6 Viewing a parameter



5.3 LCD keypad display and operation

5.3.1 LCD keypad component description

<table>
<tr><th>No.</th><th>Name</th><th>Display</th><th>Description</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Status indicator</td><td>RUN</td><td>Off: The drive is stopped.
Blinking: The drive is in low voltage or factory test state.
On: The drive is running.</td></tr>
<tr><td>TRIP</td><td>Fault indicator
Off: The drive is in normal state.
Blinking: The drive is in pre-alarm state.
On: The drive is in fault state.</td></tr>
<tr><td>QUICK/JOG</td><td>Short-cut key indicator
The displayed state varies depending on the short-cut key function. For details, see the definition of QUICK/JOG.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Keys</td><td></td><td>Function Keys
The functions vary depending on the menu; the specific function of each key is displayed in the bottom of the display area.</td></tr>
<tr><td></td><td>Short-cut key
Re-definable. It is defined as JOG function by default, namely jogging. The function of short-cut key can be set by the ones of P07.02, as shown in the following:
0: No function
1: Jogging (short-cut key indicator: steady on)
2: Reserved
3: Switch between forward and reverse rotation (short-cut key indicator: off)
4: Clear the UP/DOWN setting (short-cut key indicator: off)
5: Coast to stop (short-cut key indicator: off)
6: Switch command channels in sequence (short-cut key indicator: off)
7: Reserved
Note: After restoring factory default settings, the default function of the short-cut key is 1.</td></tr>
</table>

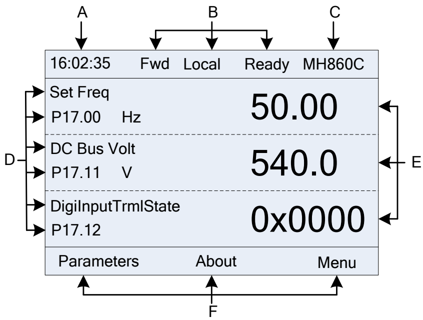
No.	Name	Display	Description
2	Keys		Confirm key The function varies depending on the menu. It is used to confirm parameter settings, select parameters, or enter the next-level menu.
			Under keypad operation mode, the running key is used for running or autotuning.
			Press it to stop the drive that is running or autotuning. The function of this key is restricted by P07.04. In fault alarm state, this key can be used for reset in any control modes.
			Up: The function of Up key varies with interfaces, such as shifting up the displayed item, shifting up the selected item, and changing digits. DOWN: The function of DOWN key varies with interfaces, such as shifting down the displayed item, shifting down the selected item, changing digits. Left: The function of Left key varies with interfaces, such as switching the monitoring interface, shifting the cursor leftward, exiting current menu, and returning to previous menu. Right: The function of Right key varies with interfaces, such as switching the monitoring interface, shifting the cursor rightward, and entering the next-level menu.
3	Display	LCD screen	240×160 dot-matrix LCD; displays three monitoring parameters or six sub-menu items simultaneously.
4	Other	RJ45 interface	RJ45 interface is used to connect to the drive.
		Battery cover	Remove this cover when replacing or installing clock battery, and reattach the cover after battery is installed.

No.	Name	Display	Description
4	Other	USB terminal	Interface for connecting to a USB flash drive via an adapter.

5.3.2 LCD keypad interface description

The LCD has different display areas, which display different content under different interfaces. The following figure shows the main interface when the drive is in the stopped state.

Figure 5-7 LCD display main interface



Area	Name	Display
Header A	Real-time clock display area	Displays the current time; clock battery is not included; the time needs to be reset when powering on the drive.
Header B	Running state display area	Displays motor rotation direction: ● FWD: Run forward during operation ● REV: Run reversely during operation ● No REV: Reverse running is disallowed
		Displays channels of running commands ● Local: Keypad running command channel ● Terminal: Terminal running command channel ● Remote: Communication running command channel
		Display the current running state ● Ready: The drive is in stopped state (no fault) ● Run: The drive is in running state ● Jog: The drive is in jogging state ● Pre-alarm: The drive is under pre-alarm state during

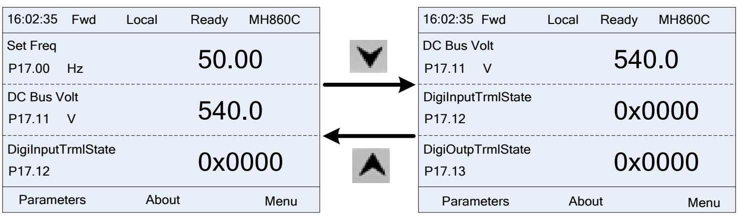
Area	Name	Display
		running ● Fault: Drive fault occurred
Header C	Model display area	Displays the drive model MH860C: The current drive is the MH860C series drive.
Display D	Parameter names and function codes on the drive homepage	Display a maximum of three parameter names and function codes on the homepage. The parameters displayed on the homepage can be managed.
Display E	Values of parameters on the drive homepage	Display the values of parameters on the drive homepage, which are updated in real time.
Footer F	The menus corresponding to the function keys	The corresponding menu of the function key varies with interfaces, and the content in this area also varies.

5.3.3 LCD keypad operation

5.3.3.1 Stopped-state parameter display

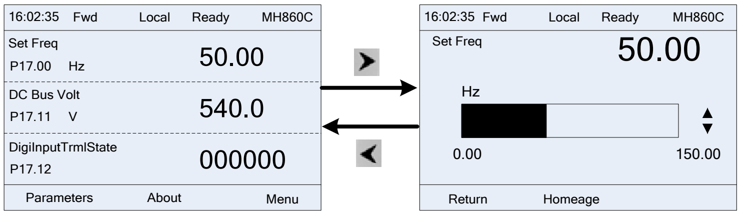
When the drive is in stopped state, the keypad displays stopped-state parameters. This interface is the main interface during power-on by default. Under stop state, parameters in various states can be displayed. Press or to shift the displayed parameter up or down.

Figure 5-8 Stopped-state parameter display 1



Press or to switch between different display styles, including list display style and progress bar display style.

Figure 5-9 Stopped-state parameter display 2

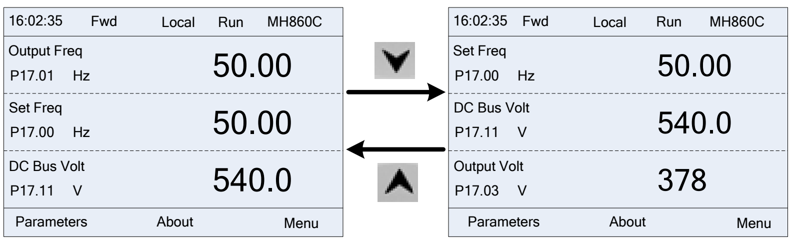


The stopped-state parameter display list is user defined, and each state variable function code can be added to the list as needed. The state variable which has been added to the list can also be deleted or shifted.

5.3.3.1 Running-state parameter display

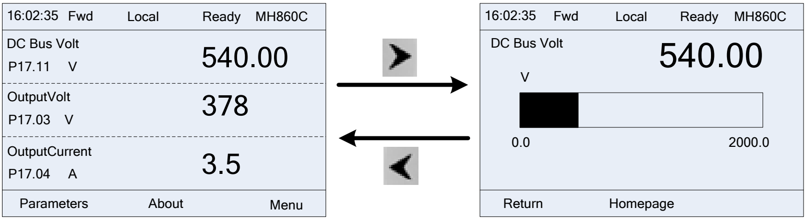
After receiving valid running command, the drive will enter running state, and the keypad displays running state parameter with RUN indicator on the keypad turning on. Under the running state, multiple types of state parameters can be displayed. Press or to shift up or down.

Figure 5-10 Running-state parameter display 1



Press or to switch between different display styles, including list display style and progress bar display style.

Figure 5-11 Running-state parameter display 2



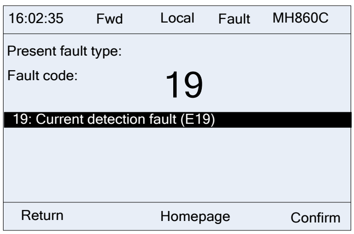
Under running state, multiple kinds of state parameters can be displayed. The running display parameter list is user defined, and each state variable function code can be added to the running display parameter list as needed. The state variable which has been added to the running display parameter list can also be deleted or shifted.

5.3.3.2 Fault display

When the drive detects a fault signal, it automatically enters the fault display status. The keypad displays the fault code and related fault information, and the TRIP indicator on the keypad lights up. You can perform fault reset by using the STOP/RST key, control terminals, or communication commands.

If the fault persists, the fault code will be continuously displayed.

Figure 5-12 Running-state parameter display 2

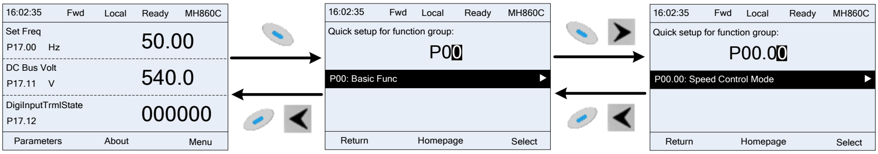


You can operate the drive through the keypad, including entering/exiting menus, selecting parameters, setting parameters, and modifying parameter lists.

5.3.3.3 Entering/Exiting menus

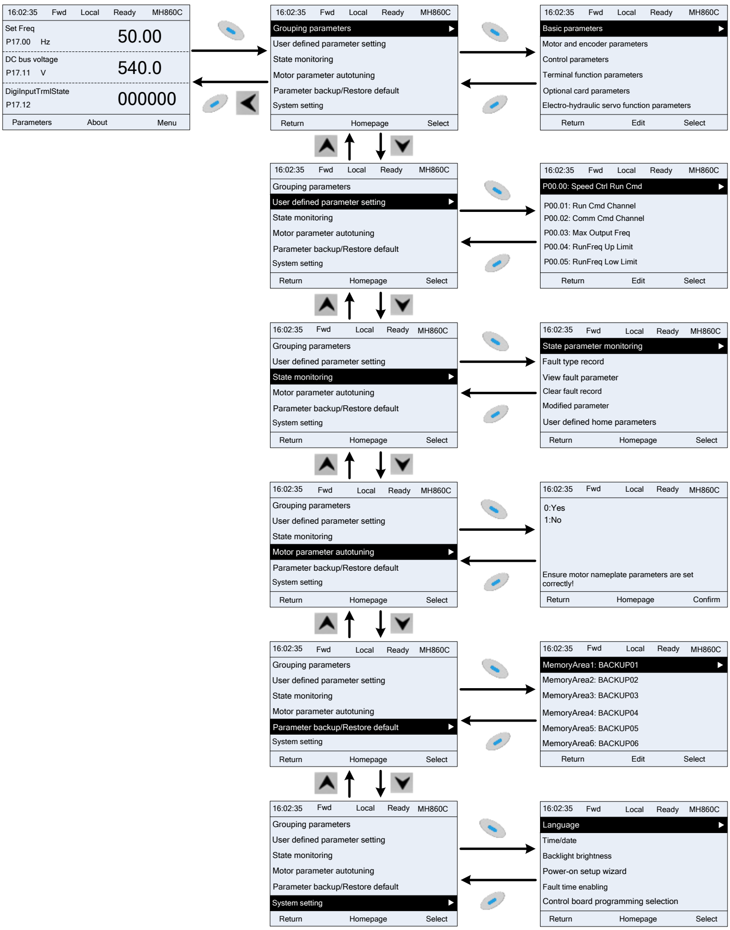
The following figure shows how to enter or exit the parameter menu step by step.

Figure 5-13 Entering/exiting the parameter menu



The following figure shows how to enter or exit different menus step by step.

Figure 5-14 Entering/exiting different menus



The keypad menu setup is shown as follows:

<table>
<tr><th>Level 1</th><th>Level 2</th><th>Level 3</th><th>Level 4</th></tr>
<tr><td rowspan="23">Grouping parameters</td><td rowspan="5">Basic PARAMETERs</td><td>P00: Basic functions</td><td>P00.xx</td></tr>
<tr><td>P07: Human-machine interface</td><td>P07.xx</td></tr>
<tr><td>P08: Enhanced functions</td><td>P08.xx</td></tr>
<tr><td>P11: Protection parameters</td><td>P11.xx</td></tr>
<tr><td>P14: Serial communication functions</td><td>P14.xx</td></tr>
<tr><td rowspan="2">Motor and encoder parameters</td><td>P02: Motor 1 parameters</td><td>P02.xx</td></tr>
<tr><td>P20: Motor 1 encoder</td><td>P20.xx</td></tr>
<tr><td rowspan="5">Control parameters</td><td>P01: Start and stop control</td><td>P01.xx</td></tr>
<tr><td>P03: Vector control of motor 1</td><td>P03.xx</td></tr>
<tr><td>P04: V/F control</td><td>P04.xx</td></tr>
<tr><td>P13: SM control parameters</td><td>P13.xx</td></tr>
<tr><td>P21: Position control</td><td>P21.xx</td></tr>
<tr><td rowspan="3">Terminal function parameters</td><td>P05: Input terminal functions</td><td>P05.xx</td></tr>
<tr><td>P06: Output terminal functions</td><td>P06.xx</td></tr>
<tr><td>P98: AIAO calibration functions</td><td>xxxxx</td></tr>
<tr><td rowspan="4">Optional card parameters</td><td>P15: Communication expansion card 1 functions</td><td>P15.xx</td></tr>
<tr><td>P16: Communication expansion card 2 functions</td><td>P16.xx</td></tr>
<tr><td>P25: Expansion I/O card input functions</td><td>P25.xx</td></tr>
<tr><td>P28: Master/slave control</td><td>P28.xx</td></tr>
<tr><td rowspan="2">Electro-hydraulic servo function parameters</td><td>P73: Electro-hydraulic basic control functions</td><td>P73.xx</td></tr>
<tr><td>P74: Electro-hydraulic dedicated PID functions</td><td>P74.xx</td></tr>
</table>

Level 1	Level 2	Level 3	Level 4
Grouping parameters	Electro-hydraulic servo function parameters	P75: Electro-hydraulic enhanced functions	P75.xx
		P76: Electro-hydraulic state viewing	P76.xx
	Factory defined function parameter setting	P99: Factory functions	xxxxx
User defined parameter setting	-	-	P00.00: Speed control mode
			P00.01: Running command channel
			Pxx.xx: Parameter setup xx
State monitoring	State parameter monitoring	P07: Human-machine interface	P07.xx
		P17: State viewing functions	P17.xx
		P18: Closed-loop vector state viewing	P18.xx
		P19: Expansion card state viewing	P19.xx
		P76: Electro-hydraulic state viewing	P76.xx
	Fault type record	-	P07.27: Type of present fault
			P07.28: Last fault type
			P07.29: 2nd-last fault type
			P07.30: 3rd-last fault type
			P07.31: 4th-last fault type
			P07.32: 5th-last fault type
	View fault parameter	-	P07.33: Running frequency at present fault
			P07.34: Ramp reference frequency at present fault

Level 1	Level 2	Level 3	Level 4
State monitoring	View fault parameter	-	P07.xx: xx state at xx-last fault
	Clear fault record	-	Sure to clear fault records?
	Modified parameter	-	Pxx.xx: Modified parameter 1
			Pxx.xx: Modified parameter 2
			Pxx.xx: Modified parameter xx
	User defined home parameters	User defined parameter displayed in stopped state	-
		User defined parameter displayed in running state	-
Motor parameter autotuning	-	Ensure motor nameplate parameters are set correctly!	Complete parameter rotary autotuning
			Complete parameter static autotuning
			Partial parameter static autotuning
			Drive autotuning
Parameter backup/ Restore default	-	Memory area 1: BACKUP01	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.

Level 1	Level 2	Level 3	Level 4
Parameter backup/ Restore default	-	Memory area 2: BACKUP02	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.
		Memory area 3: BACKUP03	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.
		Memory area 4: BACKUP04	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.

Level 1	Level 2	Level 3	Level 4
Parameter backup/ Restore default	-	Memory area 5: BACKUP05	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.
		Memory area 6: BACKUP06	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.
		Memory area 7: BACKUP07	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.

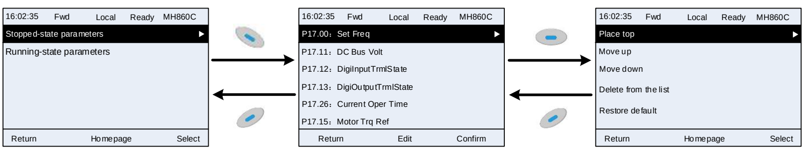
Level 1	Level 2	Level 3	Level 4
Parameter backup/ Restore default	-	Memory area 8: BACKUP08	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.
		Memory area 9: BACKUP09	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.
		Memory area 10: BACKUP10	Upload local function parameters to keypad.
			Download complete function parameters of keypad.
			Download non-motor group function parameters of keypad.
			Download motor group function parameters of keypad.

Level 1	Level 2	Level 3	Level 4
Parameter backup/ Restore default	-	Restore to default (except motor parameters)	Restore to default (except motor prm)
		Restore to default (test mode)	Restore to default (test mode)
		Restore default (include motor parameters)	Restore to default (include motor prm)
System setting	-	-	Language selection
			Time/date
			Backlight brightness regulation
			Power-on setup wizard
			Fault time enabling
			Control board programming selection

5.3.3.4 Editing list

The monitoring items in the parameter list displayed of stop state can be added as needed (through the **State monitoring** menu). The list can also be edited, with options such as **Place top**, **Move up**, **Move down**, **Delete from the list** and **Restore to default parameters**. The following figure shows the interface.

Figure 5-15 Editing list 1



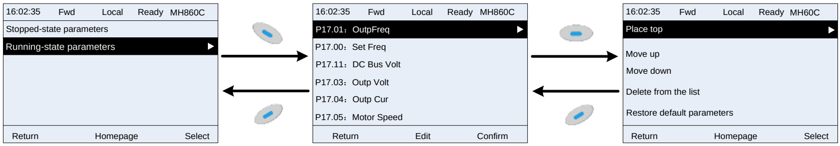
Press the key  to enter the editing interface. Select the desired operation and press  or  to apply the change and return to the previous menu (the parameter list), which will reflect the update. Press the  key without selecting an operation to cancel the edit and return to the previous menu (the parameter list remains unchanged).

Note: For the parameter objects in the list header, the move-up operation will be unavailable. The same principle applies to items in the list footer. After deleting a certain parameter, the parameter objects under it will be shifted up automatically.

The monitoring items displayed in the parameter list of running state can be added as needed (through the state viewing function codes in **State monitoring** > **State parameter**

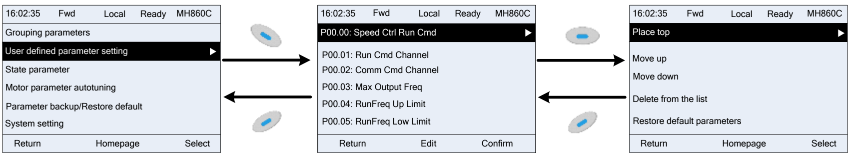
monitoring). The list can also be edited, with options such as **Place top**, **Move up**, **Move down**, **Delete from the list** and **Restore to default parameters**. The following figure shows the interface.

Figure 5-16 Editing list 2



The parameter list of **User defined parameter setting** can be added, deleted or adjusted as needed, including **Place top**, **Move up**, **Move down**, **Delete from the list** and **Restore to default parameters**. New parameters are added through a specific function code within a function group (**Menu** > **Grouping parameters**). The following figure shows the interface.

Figure 5-17 Editing list 3



5.3.3.5 Adding parameters to the parameter list displayed in stopped/running state

In the fourth-level menu of **State monitoring**, the parameters in the list can be added to the **Stopped-state parameters** list or **Running-state parameters** list as shown as follows.

Figure 5-18 Adding parameters 1

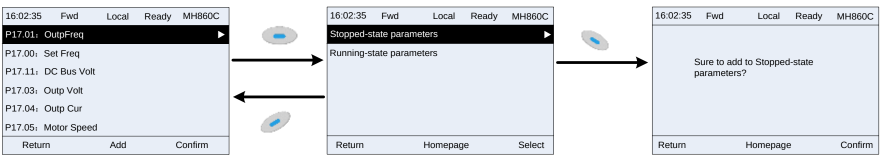
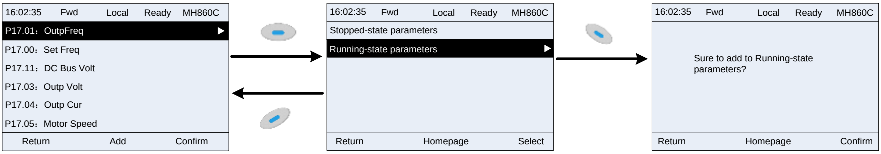


Figure 5-19 Adding parameters 2



Press the key to enter the parameter addition interface, select the operation needed, and press the key or key to confirm. If this parameter is not included in the **Stopped-state parameters** or **Running-state parameters** list, the parameter added will be added to the end of the list; if the parameter is already in the list, the addition will be invalid. If the key is pressed without selecting the addition operation in the interface, it will return to the monitoring parameter list menu.

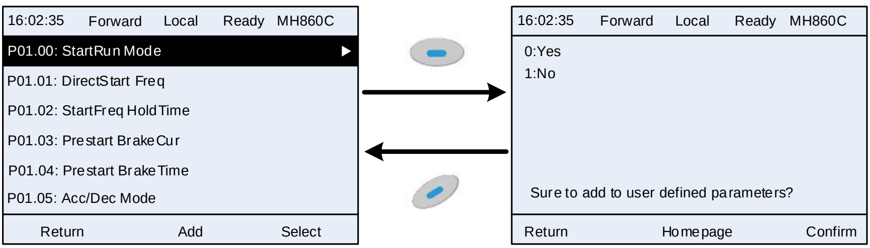
Part of the monitoring parameters in P07 HMI group can be added to the **Stopped-state parameters** list or **Running-state parameters** list. All the parameters in P17, P18 and P19 groups can be added to the **Stopped-state parameters** list or **Running-state parameters** list.

Up to 16 monitoring parameters can be added to the **Stopped-state parameters** list; up to 32 monitoring parameters can be added to the **Running-state parameters** list.

5.3.3.6 Adding parameters to the user defined parameter setting list

In fourth-level menu of **Grouping parameters**, the parameter in the list can be added to the user defined parameter list, as shown in the following figure.

Figure 5-20 Adding parameters 3



Press the key to enter the parameter addition interface, select the operation needed, and press the key or key to confirm. If this parameter is not included in the **User defined parameter setting** list, the parameter added will be added to the end of the list;

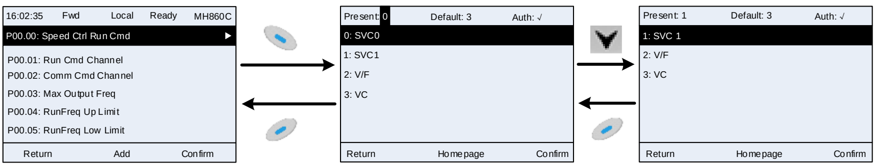
if the parameter is already in the list, the addition will be invalid. If the key is pressed without selecting the addition operation in the interface, it will return to the monitoring parameter list menu.

All the function code groups under the **Grouping parameters** menu can be added to **User defined parameter setting** list. Up to 64 function codes can be added.

5.3.3.7 Parameter selection edit interface

In the fourth-level menu of **Grouping parameters** menu, press the key or key to enter parameter selection edit interface. After entering the edit interface, the current value will be highlighted. Press the key or key to edit current parameter value, and the corresponding parameter item of current value will be highlighted automatically. After parameter selection is done, press key or key to save the selected parameter and return to the previous menu. In the edit interface, press key to maintain the parameter value and return to the previous menu.

Figure 5-21 Parameter selection edit interface



In parameter value modification interface, **Auth** on the top right indicates whether the parameter can be modified.

"√" indicates the set value of this parameter can be modified under present drive state.

"×" indicates the set value of this parameter cannot be modified under current drive state.

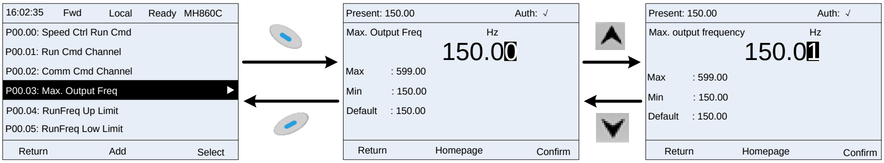
"Present" indicates the current value.

"Default" indicates the default value.

5.3.3.8 Parameter setup edit interface

In fourth-level menu of **Grouping parameters** menu, press the key or key to enter the parameter setup edit interface. After entering the edit interface, set the parameter from low bit to high bit, and the bit under setting will be highlighted. Press the key or key to increase or decrease the parameter value (this operation is valid until the parameter value exceeds the max. value or min. value); press the or to shift the bit to edit. After the parameter is set, press the key or key to save the parameter setting and return to the previous menu. In parameter setup edit interface, press to maintain the original parameter value and return to the previous menu.

Figure 5-22 Parameter setup edit interface



In parameter setup edit interface, **Auth** on the top right indicates whether the parameter can be modified.

"√" indicates the set value of this parameter can be modified under present drive state.

"×" indicates the set value of this parameter cannot be modified under current drive state.

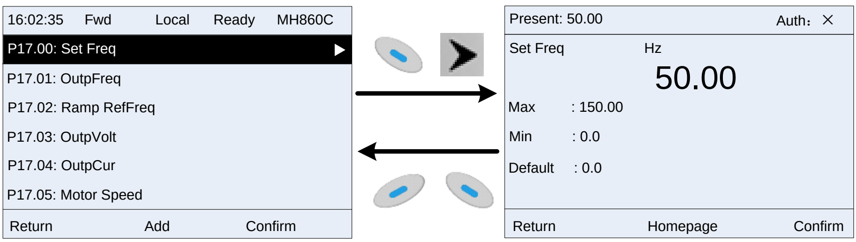
"Present" indicates the value saved last time.

"Default" indicates the default value.

5.3.3.9 State monitoring interface

In the fourth-level menu of **State monitoring**, press the key or key to enter the state monitoring interface. After entering the interface, the present parameter value will be displayed in real time. This value is the actual detected value which cannot be modified. In the interface, press the key or key to return to the previous menu.

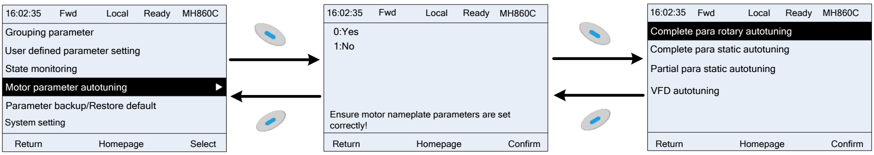
Figure 5-23 State monitoring interface



5.3.3.10 Performing motor parameter autotuning

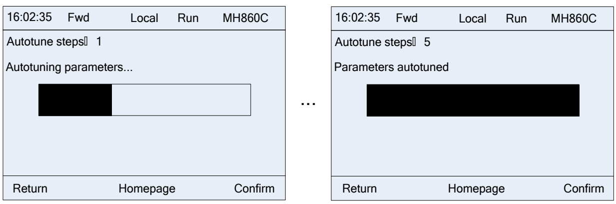
In the **Motor parameter autotuning** menu, press the key or key to enter motor parameter autotuning selection interface. Before entering, you must set the motor nameplate parameters correctly. Then select an autotuning type and start autotuning. In the autotuning interface, press the key to return to the previous menu.

Figure 5-24 Parameter autotuning operation



After selecting the motor autotuning type, the system enters the motor parameter autotuning interface. Press the RUN key to start motor parameter autotuning. After autotuning is done, a prompt will pop up indicating autotuning is succeeded, and then it will return to the stop-state main interface. During autotuning, you can press the STOP/RST key to terminate autotuning; if any fault occurs during autotuning, the fault interface will be displayed.

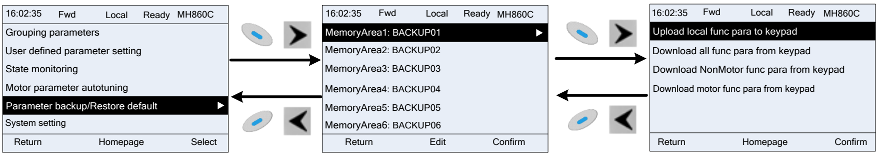
Figure 5-25 Parameter autotuning finished



5.3.3.11 Backing up parameters

In **Parameter backup/Restore default** menu, press key or key to enter function parameter backup setting interface and function parameter restoration setup interface to upload/download drive parameters, or restore drive parameters to default value. The keypad has 10 different storage areas for parameter backup, and each storage area can save the parameters of 1 drive, namely it can save parameters of 10 drives in total.

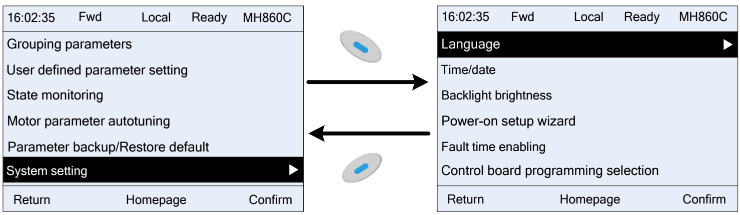
Figure 5-26 Parameter backup



5.3.3.12 System setting

In the **System setting** menu, press the key or key to enter the system setting interface to set the keypad language, time/date, backlight brightness, backlight time, and power-on guiding.

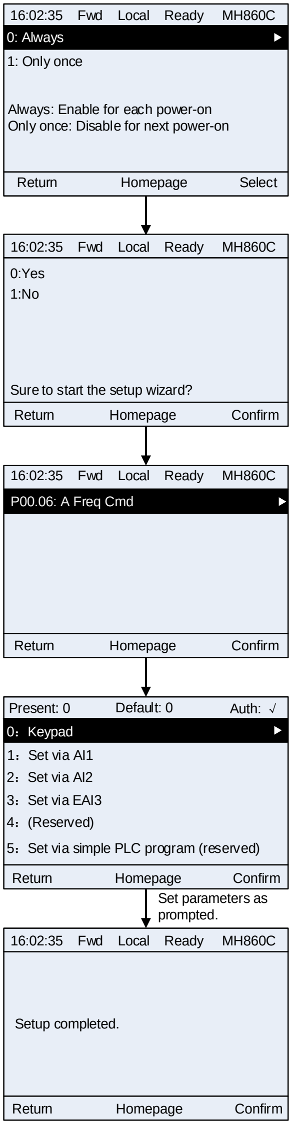
Figure 5-27 System configuration



Note: No clock battery is equipped by default. The keypad time/date needs to be reset after keypad re-power on. If time-keeping after power-off is needed, you should purchase the clock batteries separately.

5.3.3.13 Power-on setup wizard

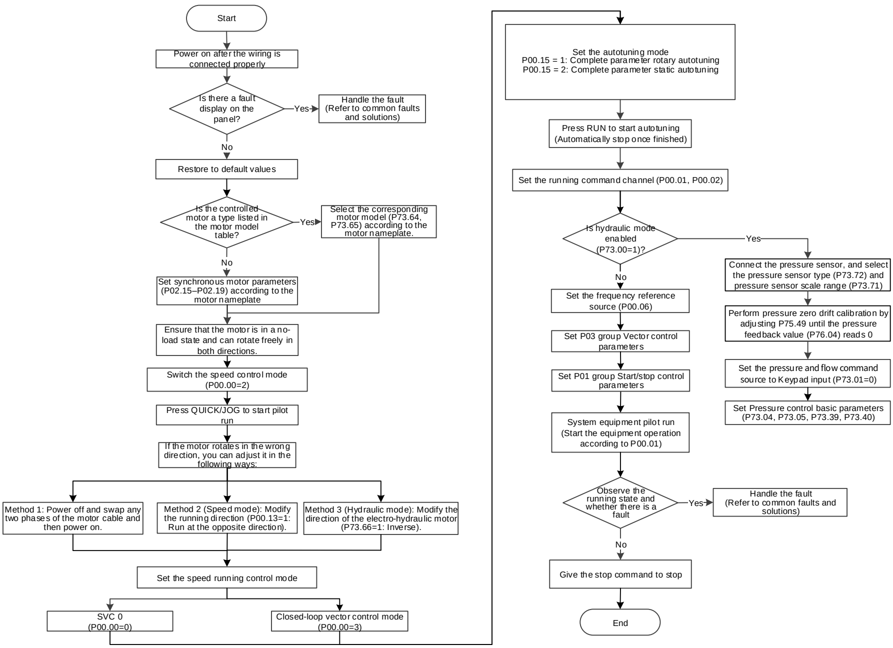
The keypad supports a power-on guiding function, designed primarily for the initial power-up. It guides you into the setup menu to perform essential startup functions step-by-step, including basic parameter settings, rotation direction check, mode settings, and autotuning. The menu guides you through the settings step by step by function. It is shown in the figure below.


16:02:35 Fwd Local Ready MH860C
0: Always
1: Only once
Always: Enable for each power-on
Only once: Disable for next power-on
Return Homepage Select
16:02:35 Fwd Local Ready MH860C
0:Yes
1:No
Sure to start the setup wizard?
Return Homepage Confirm
16:02:35 Fwd Local Ready MH860C
P00.06: A Freq Cmd
Return Homepage Confirm
Present: 0 Default: 0 Auth: √
0: Keypad
1: Set via AI1
2: Set via AI2
3: Set via EAI3
4: (Reserved)
5: Set via simple PLC program (reserved)
Return Homepage Confirm
Set parameters as prompted.
16:02:35 Fwd Local Ready MH860C
Setup completed.
Return Homepage Confirm

6 Commissioning

This chapter describes the basic commissioning procedures for the drive. Key topics include frequency command settings in speed mode, flow and pressure command settings in hydraulic mode, and start/stop control. By following the instructions in this chapter, you can perform a trial operation of the motor under drive control.

6.1 Drive commissioning flowchart



6.2 Motor parameter settings

6.2.1 Rated motor parameter settings

Set the rated parameters of the three-phase permanent magnet synchronous motor (PMSM) according to the motor nameplate. The parameters for synchronous motor 1 (SM 1) are set via P02.15 to P02.19.

Function code	Name	Default	Setting range	Description
P02.15	Rated power of SM 1	Model depended	0.1–3000.0kW	-
P02.16	Rated frequency of SM 1	120.00Hz	0.01Hz–P00.03	P00.03 specifies the max. output frequency.
P02.17	Number of pole pairs of SM 1	4	1–128	-
P02.18	Rated voltage of SM 1	Model depended	0–1200V	-
P02.19	Rated current of SM 1	Model depended	0.8–6000.0A	-

6.2.2 Motor nameplate parameter input

If the current motor type is included in the motor model list, enter P73.64 (Electro-hydraulic motor model MSB) and P73.65 (Electro-hydraulic motor model LSB) by referring to Appendix G Motor model and code table.

6.3 Parameter autotuning setting

To improve the motor control performance, it is recommended to set the motor rated parameters based on the motor nameplate at first power-on, and then perform parameter autotuning. This drive supports three auto-tuning modes: motor parameter autotuning, motor inertia autotuning, and SM initial pole angle autotuning. Select the appropriate mode based on the on-site operating conditions:

Note: After correctly inputting the motor parameters, verify the rotation direction. Set the speed control mode parameter P00.00 to 2, then press and hold the QUICK/JOG key on the keypad. The motor will operate at a frequency of 5Hz and stop when the key is released. Confirm that the motor's actual rotation direction matches the required direction; if the rotation is opposite, set parameter P73.66 to 1 to invert the running direction before proceeding with parameter autotuning.

6.3.1 Motor parameter autotuning

Motor parameters have a significant impact on the calculations of the control model, especially when using vector control. Therefore, motor parameter autotuning must be performed first.

After setting the motor parameters, set P00.15 to select the autotuning mode to perform motor parameter autotuning. The setting procedure is as follows.

Step 1 Set P00.01 to 0 to select the keypad as the command running channel.
Step 2 Set P00.15 to select a motor parameter autotuning method.

Step 3 Press the **RUN** key to give the start command to perform motor parameter autotuning.

Function code	Name	Default	Setting range	Description
P00.15	Motor parameter autotuning	0x000	0x000–0x133	Ones place: Motor basic parameter autotuning 0: No operation 1: Complete parameter rotary autotuning 2: Complete parameter static autotuning 3: Partial parameter static autotuning Tens place: Initial pole angle autotuning 0: No operation 1: Rotary autotuning 2: Static autotuning 3: Rotary autotuning 2 Hundreds place: System inertia autotuning 0: Disable 1: Enable

Note:

- When P00.15 is set to 0x001, disconnect the motor from the load to put the motor in static and no-load state.
- When P00.15 is set to 0x002 or 0x003, there is no need to disconnect the motor from the load.

Table 6-1 Motor parameters autotuned in different autotuning methods

Autotuning method	SM 1
0x001	P02.20–P02.23
0x002	P02.20–P02.22
0x003	

Note: If the autotuned parameters have deviation, SM counter-emf constant P02.23 can be calculated.

It can also be calculated based on the parameters on the motor nameplate, and there are three calculation methods.

Method 1: If the back-EMF coefficient K_e is marked on the nameplate, the calculation is as follows:

$$E = (K_e \times n_N \times 2\pi) / 60$$

Method 2: If the back-EMF E' (V/1000r/min) is marked on the nameplate, the calculation is as follows:

$$E = E' \times n_N / 1000$$

Method 3: If none of the two preceding parameters is marked on the nameplate, the calculation is as follows:

$$E = P / (\sqrt{3} I)$$

In the preceding formulas, n_N indicates the rated rotation speed, P indicates the rated power, and I indicates the rated current.

6.3.2 Motor inertia autotuning

Inertia autotuning is applicable to the scenarios where large inertia exists and speed dynamic response follows up well in the closed-loop vector control mode. Inertia autotuning is required before inertia compensation enabling. During the autotuning process, the drive controls the automatic start and stop of the motor and prompts for autotuning completion. Set P03.44 to perform the motor inertia autotuning. The setting procedure is as follows:

Step 1 Set P00.01 to 0 to select the keypad as the command running channel.

Step 2 Set P03.44 to 1 for enabling.

Step 3 After the RUN key is pressed to give the drive start command, the drive starts inertia identifying and automatically controls the motor start and stop.

Function code	Name	Default	Setting range	Description
P03.43	Inertia identification torque	10.0%	0.0–100.0% (of the motor rated torque)	Due to friction force, certain identification torque needs to be set for the inertia identification to be performed properly.
P03.44	Enabling motor inertia identification	0	0–1	0: No operation 1: Enable

Note: If the motor is running at low speed for a long time, which indicates that P03.43 (Inertia identification torque) is set too low, perform manual stop, increase the value of P03.43, and execute inertia identification again.

6.3.3 SM initial pole angle autotuning

SM initial pole angle autotuning is applicable to the scenarios where an absolute position encoder is installed in the closed-loop vector control mode. Set P20.11 to perform the SM initial pole angle autotuning. The procedure is as follows:

Step 1 Set P00.01 to 0 to select the keypad as the command running channel.

Step 2 Set P02.00 or P12.00 to 1 to select synchronous motor.

Step 3 Set P02.11 to select an autotuning method.

Step 4 Press the **RUN** key to give the drive a start command. It enters parameter autotuning.

Function code	Name	Default	Setting range	Description
P20.11	Initial pole position autotuning	0	0–3	0: No operation 1: Rotary autotuning (DC braking first, applicable to encoders with Z signals) 2: Static autotuning (applicable to resolver encoders or sin/cos encoders with CD signal feedback) 3: Rotary autotuning 2 (initial angle static autotuning first, applicable to encoders with Z signals) **Note:** The pole initial angle obtained through option 1: Rotary autotuning is accurate. This option is recommended in most cases, in which the motor needs to be decoupled from the load or the motor load is light.

6.4 Running command selection

The running commands are used to control the start, stop, forward running, reverse running, and jogging of the drive. The channels of running commands include keypad, terminal, and communication. Set P00.01 to select a channel of running commands.

Function code	Name	Default	Setting range	Description
P00.01	Channel of running commands	0	0–3	0: Keypad 1: Terminal 2: Communication

Running commands set through the keypad

When P00.01 is set to 0, you can control the drive start or stop through the keypad key **RUN** or **STOP/RST**. After pressing the key, the drive starts running, and the RUN indicator turns on. In running state, if you press the key, the drive stops running, and the RUN indicator turns off. For details about the keypad, see chapter 5 Keypad operation guidelines.

Running commands set through the terminal

When P00.01 is set to 1, you can control the drive start or stop by setting commands through external terminals. The setting procedure is as follows:

Step 1 Set any terminal function of P05.01–P05.05 to any of 1–6.

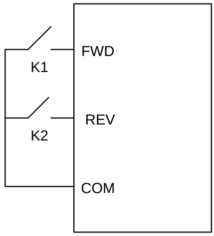
<table>
<tr><th>Function code</th><th>Name</th><th>Default</th><th>Setting range</th><th>Description</th></tr>
<tr><td rowspan="5">P05.01–P05.05</td><td rowspan="5">Function selection of multifunction digital input terminals (DI1–DI5)</td><td>1</td><td rowspan="5">0–95</td><td rowspan="5">1: Run forward (FWD)
7: Fault reset
73: Flow splitting/combining selection
76: PID terminal 1 (hydraulic mode)
82: CAN master/slave network enable</td></tr>
<tr><td>76</td></tr>
<tr><td>7</td></tr>
<tr><td>73</td></tr>
<tr><td>82</td></tr>
</table>

Step 2 Set P05.11 to select the terminal control mode.

Function code	Name	Default	Setting range	Description
P05.11	Terminal control mode	0	0–3	0: Two-wire control mode 1 1: Two-wire control mode 2 2: Three-wire control mode 1 3: Three-wire control mode 2

Two-wire control mode 1: P05.11= 0

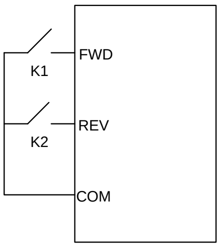
The enabling is combined with the direction. This mode is widely used. The defined FWD/REV terminal command determines the motor rotation direction.



FWD	REV	Running command
OFF	OFF	Stop
ON	OFF	Forward running
OFF	ON	Reverse running
ON	ON	Hold

Two-wire control mode 2: P05.11= 1

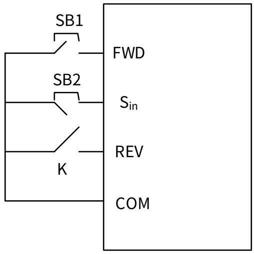
The enabling is separated from the direction. In this mode, FWD is the enabling terminal. The direction depends on the defined REV state.



FWD	REV	Running command
OFF	OFF	Stop
ON	OFF	Forward running
OFF	ON	Stop
ON	ON	Reverse running

Three-wire control mode 1: P05.11= 2

This mode defines S_{in} as the enabling terminal, and the running command is generated by FWD, while the direction is controlled by REV. During running, the S_{in} terminal needs to be closed, and when terminal FWD generates a rising edge signal, the drive starts to run in the direction set by the state of terminal REV; the drive needs to be stopped by disconnecting terminal S_{in}.

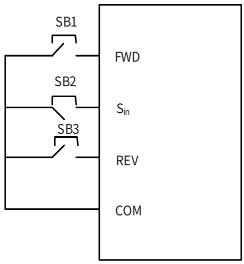


The direction control is as follows during running:

S_{in}	REV	Previous running direction	Present running direction
ON	OFF→ON	FWD run	REV run
		REV run	FWD run
ON	ON→OFF	REV run	FWD run
		FWD run	REV run
ON→OFF	ON	Decelerate to stop	
	OFF		

Three-wire control mode 2: P05.11= 3

This mode defines S_{in} as the enabling terminal, and the running command is generated by FWD or REV, but the direction is controlled by both FWD and REV. During running, the S_{in} terminal needs to be closed, and terminal FWD or REV generates a rising edge signal to control the running and direction of the drive; the drive needs to be stopped by disconnecting terminal S_{in}.



The direction control is as follows during running:

S_{in}	FWD	REV	Running direction
ON	OFF→ON	ON	FWD run
		OFF	FWD run
ON	ON	OFF→ON	REV run
	OFF		REV run
ON→OFF	-	-	Decelerate to stop

Note: For two-wire controlled running mode, when the FWD/REV terminal is valid, if the drive stops due to a stop command given by another source, the drive does not run again after the stop command disappears even if the control terminal FWD/REV is still valid. To make the drive run, the FWD/REV signal must be re-triggered. This applies, for example, to a stop caused by a valid STOP/RST signal during terminal control (refer to P07.04).

Running commands set through communication

When P00.01 is set to 2, you can control the drive run or stop by giving commands through communication. For details, see chapter 7 Communication.

Function code	Name	Default	Setting range	Description
P00.02	Communication channel of running commands	0	0–6	0: Modbus/Modbus TCP communication 1: PROFIBUS/CANopen/DeviceNet communication 2: Ethernet communication 3: EtherCAT/PROFINET/Ethernet IP communication 4–6: Reserved 7: USB communication **Note:** The Modbus TCP communication mode of option 0, and options 1, 2, and 3 are extended functions, which are valid only when corresponding expansion cards are configured.

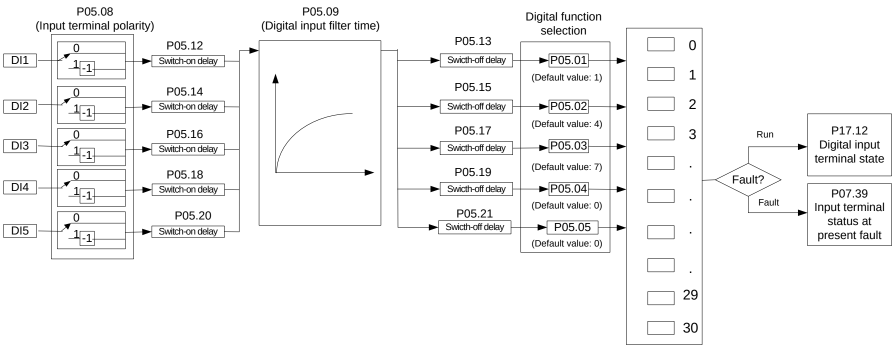
6.5 Input and output

6.5.1 Digital input and output

6.5.1.1 Digital input

The drive carries five programmable digital input terminals. The function of all the digital input terminals can be programmed through function codes.

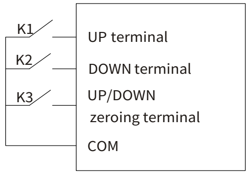
Note: For the wiring method, see section 4.4.4.1 Input signal wiring diagram.



Note: Two different multifunction input terminals cannot be configured with the same function.

P05.01–P05.06 are used to set the functions of multifunction digital input terminals. Terminal functions are set as follows.

Set value	Function	Description
0	No function	The drive does not act even if there is signal input. Set unused terminals to no function to avoid misaction.
1	Running forward (FWD)	Control the forward/reverse running of the drive by external terminals.
2	Reverse running (REV)	
3	Three-wire control (S_{in})	The terminal is used to determine the three-wire running control of the drive. For details, see the description for P05.13.
4	Forward jogging	For details about frequency of jogging running and ACC/DEC time of jogging running, see the description for P08.06, P08.07, and P08.08.
5	Reverse jogging	
6	Coast to stop	The drive blocks output, and the stop process of motor is not controlled by the drive. This method is commonly adopted for high-inertia loads where specific stopping time is not required. Its definition is the same as P01.08, and it is mainly used in remote control.
7	Fault reset	External fault reset function, same as the reset function of the STOP/RST key on the keypad. You can use this function to reset faults remotely.
8	Running pause	The drive decelerates to stop; however, all the running parameters are stored in memory, such as PLC parameters, wobble parameters, and PID parameters. After this signal disappears, the drive will revert to the state before stop.
9	External fault input	After receiving the external fault signal, the drive reports the fault and stops.
10	Increase frequency setting (UP)	When the reference frequency is provided via external terminals, the UP and DOWN commands are used to adjust the frequency.
11	Decrease frequency setting (DOWN)	
12	Clear frequency increase/decrease setting	

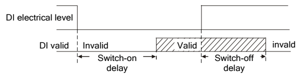
Set value	Function	Description
12	Clear frequency increase/decrease setting	 The terminal used to clear frequency-increase/decrease setting can clear the frequency value of auxiliary channel set by UP/DOWN, thus restoring the reference frequency to the frequency given by main reference frequency command channel.
29	Switch between speed control and torque control	The drive switches from torque control mode to speed control mode, or vice versa.
33	Clear the frequency increase/decrease setting temporarily	When the terminal is closed, the frequency value set by the UP/DOWN setting can be cleared to restore the reference frequency to the value given by frequency command channel; when the terminal is opened, the reference frequency returns to the value set by the UP/DOWN setting.
36	Switch the running command channel to keypad	When the function is enabled, the running command channel is switched to keypad. When the function is disabled, the running command channel is restored to the previous setting.
37	Switch the running command channel to terminal	When the function is enabled, the running command channel is switched to terminal. When the function is disabled, the running command channel is restored to the previous setting.
38	Switch the running command channel to communication	When the function is enabled, the running command channel is switched to communication. When the function is disabled, the running command channel is restored to the previous setting.
42	Switch the setting source of torque upper limit to keypad	The torque upper limit is set through the keypad when the command is valid.
56	Emergency stop	When the function is enabled, the motor decelerates to stop in emergency manner according to the time specified by P01.26.

<table>
<tr><th>Set value</th><th>Function</th><th>Description</th></tr>
<tr><td>57</td><td>Motor overtemperature fault input</td><td>When there is motor overtemperature fault input, the motor stops due to the fault.</td></tr>
<tr><td>60</td><td>Switch to FVC control</td><td>When the function is enabled in stopped state, FVC is used.</td></tr>
<tr><td>64</td><td>FWD max. limit</td><td>Max frequency limit on forward rotation.</td></tr>
<tr><td>65</td><td>REV max. limit</td><td>Max frequency limit on reverse rotation.</td></tr>
<tr><td>71</td><td>Switch to master</td><td>When the function is enabled in stopped state, master mode is used.</td></tr>
<tr><td>72</td><td>Switch to slave</td><td>When the function is enabled in stopped state, slave mode is used.</td></tr>
<tr><td>73</td><td>Flow splitting/combining selection</td><td rowspan="2">When P75.04 is set to 1 (hybrid mode), the flow splitting/combining selection terminal is used to set whether the unit operates in flow splitting/combining mode.
<table>
<tr><th>Flow splitting/combining selection</th><th>Working mode</th></tr>
<tr><td>0</td><td>Flow combining</td></tr>
<tr><td>1</td><td>Flow splitting</td></tr>
</table>
When P75.04 is set to 3 (communication with two modes), the flow splitting/combining selection terminal is used to determine the flow splitting/combining node. For details, see section 6.8.3 Communication with two modes.
When P75.04 is set to 4 (communication with four modes), the flow splitting/combining selection terminal and the flow splitting/combining selection 1 terminal are used to determine the flow splitting/combining node. For details, see section 6.8.4 Communication with four modes.</td></tr>
<tr><td>74</td><td>Flow splitting/combining selection 1</td></tr>
<tr><td>76</td><td>PID terminal 1 (hydraulic mode)</td><td rowspan="2">When pressure multi-step PID is enabled (P74.01 = 1), this is used to select the pressure-loop PID parameters. For details, see section 6.7.5.5 DI terminal selection.</td></tr>
<tr><td>77</td><td>PID terminal 2 (hydraulic mode)</td></tr>
<tr><td>82</td><td>CAN master/slave network enable</td><td>This function is used only when CAN master/slave communication is enabled.</td></tr>
<tr><td>84</td><td>Internal multi-step reference 1 (pressure and flow)</td><td>When P73.01 (pressure and flow command source selection) is set to 3 (internal multi-step reference), the</td></tr>
</table>

<table>
<tr><th>Set value</th><th>Function</th><th>Description</th></tr>
<tr><td>85</td><td>Internal multi-step reference 2 (pressure and flow)</td><td rowspan="2">internal multi-step pressure and flow references (P74.67-P74.82) are selected via internal multi-step reference 1 (pressure and flow), internal multi-step reference 2 (pressure and flow), and internal multi-step reference 3 (pressure and flow). A total of eight internal pressure and flow references are available for selection, as shown in the table below.
<table>
<tr><th>Internal multi-step reference 3 (pressure and flow)</th><th>Internal multi-step reference 2 (pressure and flow)</th><th>Internal multi-step reference 1 (pressure and flow)</th><th>Internal multi-step pressure and flow reference</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Internal reference pressure/flow 1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal reference pressure/flow 2</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal reference pressure/flow 3</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal reference pressure/flow 4</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal reference pressure/flow 5</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal reference pressure/flow 6</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal reference pressure/flow 7</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal reference pressure/flow 8</td></tr>
</table></td></tr>
<tr><td>86</td><td>Internal multi-step reference 3 (pressure and flow)</td></tr>
<tr><td>87</td><td>Internal multi-step pressure and flow reference lock (P74.67–P74.82)</td><td>When this command is valid, the current internal pressure/flow reference is locked. Even if the status of internal multi-step reference 1–3 (pressure and flow) terminals changes, the drive continues to operate according to the current internal pressure/flow reference until this command becomes invalid.</td></tr>
<tr><td>90</td><td>Reserved</td><td>-</td></tr>
</table>

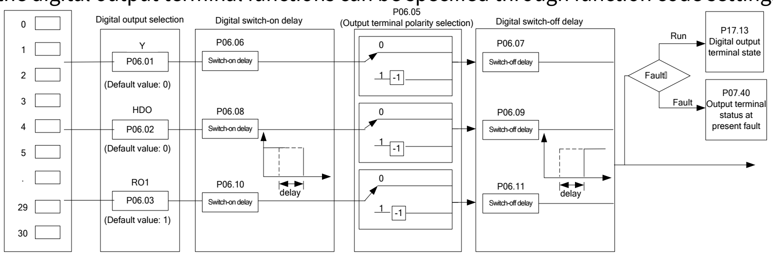
The related parameters are listed in the following table.

Function code	Name	Default	Setting range	Description
P05.01	Function of DI1	1	0–95	For details, see the preceding table.
P05.02	Function of DI2	76		
P05.03	Function of DI3	7		
P05.04	Function of DI4	73		
P05.05	Function of DI5	82		
P05.08	Input terminal polarity selection	0x00	0x00–0x3F	The function code is used to set the polarity of input terminals. When a bit is 0, the input terminal is positive. When a bit is 1, the input terminal is negative.
P05.09	Digital filter time	0.010s	0.000–1.000s	Used to specify the sampling filter time of the DI1–DI5 terminals. In strong interference cases, increase the value to avoid maloperation.
P05.10	Virtual terminal setting	0x00	0x000–0x3F	Bit 0: DI1 virtual terminal Bit 1: DI2 virtual terminal Bit 2: DI3 virtual terminal Bit 3: DI4 virtual terminal Bit 4: DI5 virtual terminal Bit 5: Reserved
P05.11	Terminal control mode	0	0.000–50.000s	For details, see the running commands set through the terminal in section 6.4 Running command selection. **Note:** For two-wire controlled running mode, when the FWD/REV terminal is valid, if the drive stops due to a stop command given by another source, the drive does not run again after the stop command disappears even if the control terminal FWD/REV is still valid. To make the drive run, the FWD/REV
P05.12	DI1 switch-on delay	0.000s		
P05.13	DI1 switch-off delay	0.000s		
P05.14	DI2 switch-on delay	0.000s		
P05.15	DI2 switch-off delay	0.000s		
P05.16	DI3 switch-on delay	0.000s		
P05.17	DI3 switch-off delay	0.000s		
P05.18	DI4 switch-on delay	0.000s		

Function code	Name	Default	Setting range	Description
P05.19	DI4 switch-off delay	0.000s	0.000–50.000s	signal must be re-triggered. For example, fixed-length stop, and valid STOP/RST stop during terminal control. (See P07.04.) The function codes specify the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off.  **Note:** When the terminal status is changed by means of RS485 communication, the communication address is 0x200A.
P05.20	DI5 switch-on delay	0.000s		
P05.21	DI5 switch-off delay	0.000s		
P07.39	Input terminal state at present fault	0x0000	0x0000–0xFFFF	-
P17.12	Digital input terminal state	0x00	0x00–0x3F	-

6.5.1.2 Digital output

Standard configuration includes one relay output terminal and two DO output terminal. All the digital output terminal functions can be specified through function code setting.



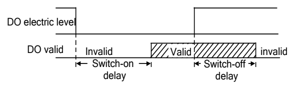
The following table lists the options of function parameters P06.01–P06.03. The same output terminal function can be repeatedly selected.

Set value	Function	Description
0	Invalid	The output terminal has no function.
1	Running	The ON signal is output when there is frequency output during running.
2	Running forward	The ON signal is output when there is frequency output during forward running.
3	Running reversely	The ON signal is output when there is frequency output during reverse running.
4	Jogging	The ON signal is output when there is frequency output during jogging.
5	Drive in fault	The ON signal is output when a drive fault occurs.
6	Frequency level detection FDT1	Refer to the descriptions for P08.32 and P08.33.
7	Frequency level detection FDT2	Refer to the descriptions for P08.34 and P08.35.
8	Frequency reached	Refer to the description for P08.36.
9	Running in zero speed	The ON signal is output when the drive output frequency and reference frequency are both zero.
10	Frequency upper limit reached	The ON signal is output when the running frequency reaches the upper limit.
11	Frequency lower limit reached	The ON signal is output when the running frequency reaches the frequency lower limit.
12	Ready to run	The ON signal is output when main circuit and control circuit powers are established, the protection functions do not act, and the drive is ready to run.
13	Pre-exciting	The ON signal is output when the drive is pre-exciting.
14	Overload pre-alarm	The ON signal is output when the pre-alarm time elapsed based on the pre-alarm threshold; for details, see descriptions for P11.08–P11.10.
15	Underload pre-alarm	The ON signal is output after the pre-alarm time elapsed based on the alarm threshold. For details, see the descriptions for P11.11–P11.12.
22	Running time reached	-
23	Modbus/Modbus TCP communication virtual terminal output	A signal is output based on the value set through Modbus/Modbus TCP communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.

Set value	Function	Description
24	PROFIBUS/CANopen/DeviceNet communication virtual terminal output	A signal is output based on the value set through PROFIBUS/CANopen communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
25	Ethernet communication virtual terminal output	A signal is output based on the value set through Ethernet communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
26	DC bus voltage established	When the bus voltage is higher than the inverter undervoltage threshold, the output is valid.
27	Z pulse output	When the encoder Z pulse is reached, the output is valid, which becomes invalid 10 seconds later.
28	In pulse superposition	When the pulse superposition terminal input function is valid, the output is valid.
30	Positioning completed	When positioning is completed, the output is valid.
34	EtherCAT/PROFINET communication virtual terminal output	A signal is output based on the value set through PROFINET communication. When the value is 1, the ON signal is output; when the value is 0, the OFF signal is output.
36	Speed/position control switchover completed	When the mode switchover is completed, the output is valid.
37	Any frequency reached	The frequency reached signal is output when the ramp reference frequency is greater than the detection value for frequency reached.
38	Hydraulic valve pressure relief output	When P73.49 (hydraulic circuit pressure relief) is enabled, the hydraulic circuit pressure relief signal is output.
39	Swash plate switching output	Outputs the swash plate switching command: 0: Switch to large displacement 1: Switch to small displacement
50	Motor OT pre-alarm	The output is valid when the detected motor temperature exceeds the preset pre-alarm threshold.
51	Stopped or running at zero speed	The drive is stopped or running at zero speed.
55	Output at hydraulic pressure reached	When the hydraulic pressure rises and exceeds the value defined by P73.78, the output becomes valid. The output remains valid until the pressure falls and drops to the value defined by P73.79, at which point the output becomes invalid.

Set value	Function	Description
63	EAI detected OT alarm	The output is valid when the EAI-detected temperature exceeds the pre-alarm threshold (with the optional I/O expansion card installed).

The related parameters are listed in the following table.

<table>
<tr><th>Function code</th><th>Name</th><th>Default</th><th>Setting range</th><th>Description</th></tr>
<tr><td>P06.01</td><td>DO1 output</td><td>1</td><td rowspan="3">0–63</td><td rowspan="3">For details, see the preceding table.</td></tr>
<tr><td>P06.02</td><td>DO2 output</td><td>38</td></tr>
<tr><td>P06.03</td><td>RO1 output</td><td>5</td></tr>
<tr><td>P06.05</td><td>Output terminal polarity selection</td><td>0x00</td><td>0x00–0x0F</td><td>The function code is used to set the output terminal polarity.
When a bit is 0, the output terminal is positive.
When a bit is 1, the output terminal is negative.<table><tr><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr><tr><td>RO1</td><td>DO2</td><td>DO1</td></tr></table></td></tr>
<tr><td>P06.06</td><td>DO1 switch-on delay</td><td>0.000s</td><td>0.000–50.000s</td><td>-</td></tr>
<tr><td>P06.07</td><td>DO1 switch-off delay</td><td rowspan="5">0.000s</td><td rowspan="5">0.000–50.000s (valid only when P06.00=1)</td><td rowspan="5">The function codes specify the delay time corresponding to the electrical level changes when the programmable output terminals switch on or switch off.


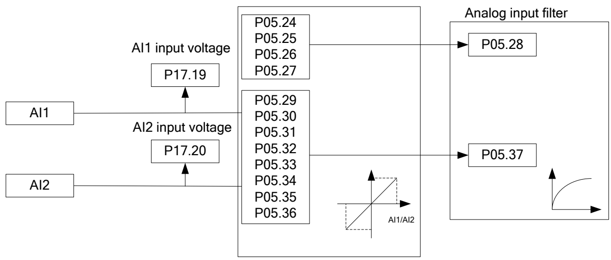
Note: P06.08 and P06.09 are valid only when P06.00=1.</td></tr>
<tr><td>P06.08</td><td>DO2 switch-on delay</td></tr>
<tr><td>P06.09</td><td>DO2 switch-off delay</td></tr>
<tr><td>P06.10</td><td>RO1 switch-on delay</td></tr>
<tr><td>P06.11</td><td>RO1 switch-off delay</td></tr>
<tr><td>P06.33</td><td>Detection value for any frequency reached</td><td>1.00Hz</td><td>0.00Hz–P00.03</td><td>-</td></tr>
<tr><td>P06.34</td><td>Detection time for any frequency reached</td><td>0.5s</td><td>0–3600.0s</td><td>-</td></tr>
</table>

Function code	Name	Default	Setting range	Description
P07.40	Output terminal state at present fault	0x0000	0x0000–0xFFFF	-
P17.13	Digital output terminal state	0x00	0x00–0x0F	Displays the present digital output terminal state of the drive. The bits correspond to RO2, RO1, and DO1 respectively.

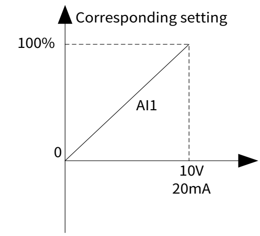
6.5.2 Analog input and output terminal functions

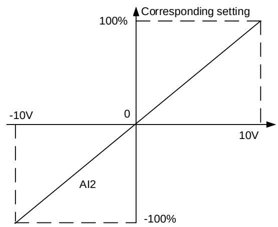
6.5.2.1 Analog input

This drive comes standard with three analog input terminals: AI1 (0–10V), AI2 (-10–10V), and AI3 (0–10V or 0–20mA), where AI3 is used only for pressure feedback in the hydraulic mode. AI1 and AI2 can be independently filtered, and the corresponding reference curve can be set by adjusting the reference values correspond to the max. value and min. values. in group P5.



Function code	Name	Default	Setting range	Description
P00.06	Setting channel of A frequency command	0	0–18	1: AI1 2: AI2
P03.11	Torque setting method	0	0–15	2: AI1 3: AI2
P03.14	Setting source of forward rotation frequency upper limit in torque control	0	0–15	1: AI1 2: AI2
P03.15	Setting source of reverse rotation frequency upper limit in torque control	0	0–15	1: AI1 2: AI2
P03.18	Setting source of electromotive torque upper limit	0	0–14	1: AI1 2: AI2

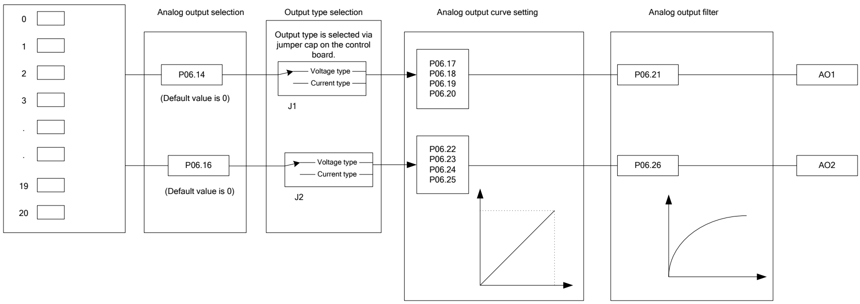
<table>
<tr><th>Function code</th><th>Name</th><th>Default</th><th>Setting range</th><th>Description</th></tr>
<tr><td>P03.19</td><td>Setting source of braking torque upper limit</td><td>0</td><td>0–14</td><td>1: AI1
2: AI2</td></tr>
<tr><td>P04.27</td><td>Voltage setting channel</td><td>0</td><td>0–16</td><td>1: AI1
2: AI2</td></tr>
<tr><td>P05.24</td><td>AI1 lower limit</td><td>0.00V</td><td>0.00V–P05.26</td><td rowspan="14">Used to define the relationship between the analog input voltage and its corresponding setting. When the analog input voltage exceeds the range from the upper limit to the lower limit, the upper limit or lower limit is used.
In different applications, 100.0% of the analog setting corresponds to different nominal values. See the description in each application section for details.
The following figures illustrate the cases of several settings:




Input filter time: Adjusts the sensitivity of the analog input. Increasing the value properly can enhance analog input anti-interference but may reduce the sensitivity of analog input.
Note: AI1 supports a 0–10V analog input, and AI2 supports a –10–+10V analog input.</td></tr>
<tr><td>P05.25</td><td>Corresponding setting of AI1 lower limit</td><td>0.0%</td><td>-300.0%–300.0%</td></tr>
<tr><td>P05.26</td><td>AI1 upper limit</td><td>10.00V</td><td>P05.24–10.00V</td></tr>
<tr><td>P05.27</td><td>Corresponding setting of AI1 upper limit</td><td>100.0%</td><td>-300.0%–300.0%</td></tr>
<tr><td>P05.28</td><td>AI1 input filter time</td><td>0.100s</td><td>0.000s–10.000s</td></tr>
<tr><td>P05.29</td><td>AI2 lower limit</td><td>-10.00V</td><td>-10.00V–P05.31</td></tr>
<tr><td>P05.30</td><td>Corresponding setting of AI2 lower limit</td><td>-100.0%</td><td>-300.0%–300.0%</td></tr>
<tr><td>P05.31</td><td>AI2 middle value 1</td><td>0.00V</td><td>P05.29–P05.33</td></tr>
<tr><td>P05.32</td><td>Corresponding setting of AI2 middle value 1</td><td>0.0%</td><td>-300.0%–300.0%</td></tr>
<tr><td>P05.33</td><td>AI2 middle value 2</td><td>0.00V</td><td>P05.31–P05.35</td></tr>
<tr><td>P05.34</td><td>Corresponding setting of AI2 middle value 2</td><td>0.0%</td><td>-300.0%–300.0%</td></tr>
<tr><td>P05.35</td><td>AI2 upper limit</td><td>10.00V</td><td>P05.33–10.00V</td></tr>
<tr><td>P05.36</td><td>Corresponding setting of AI2 upper limit</td><td>100.0%</td><td>-300.0%–300.0%</td></tr>
<tr><td>P05.37</td><td>AI2 input filter time</td><td>0.100s</td><td>0.000–10.000s</td></tr>
</table>

6.5.2.2 Analog output

The drive comes standard with two analog output terminals (0–10V/0–20mA. The output can be configured as voltage or current output via jumpers on the control board). Analog output signal can be filtered separately, and the proportional relationship can be adjusted by setting the max. value, min. value, and the percentage of their corresponding output. Analog output signal can output motor speed, output frequency, output current, motor torque and motor power at a certain proportion.



AO output relationship description:
(The min. value and max. value of the output correspond to 0.0% and 100.00% of the analog default output. The actual output voltage corresponds to the actual percentage, which can be set through function codes.) Output functions are as follows.

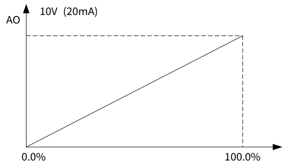
Set value	Function	Description
0	Running frequency	0–Max. output frequency
1	Set frequency	0–Max. output frequency
2	Ramp reference frequency	0–Max. output frequency
3	Rotational speed	0–Synchronous rotational speed corresponding to max. output frequency
4	Output current (relative to the drive)	0–Twice the drive rated current
5	Output current (relative to the motor)	0–Twice the motor rated current
6	Output voltage	0–1.5 times the drive rated voltage
7	Output power	0–2 times the motor rated power
8	Set torque (bipolar)	0–Twice the motor rated current. A negative value corresponds to 0.0% by default.
9	Output torque (absolute value)	0–Twice the motor rated torque (electromotive/braking)

Set value	Function	Description
10	AI1 input	0–10V/0–20mA
11	AI2 input	-10V–10V
12	EAI3 input	0–10V/0–20mA
14	Value 1 set through Modbus/Modbus TCP communication	0–1000
15	Value 2 set through Modbus/Modbus TCP communication	0–1000
16	Value 1 set through PROFIBUS/CANopen/DeviceNet communication	0–1000
17	Value 2 set through PROFIBUS/CANopen/DeviceNet communication	0–1000
18	Value 1 set through Ethernet communication	0–1000
19	Value 2 set through Ethernet communication	0–1000
21	Value 1 set through EtherCAT/PROFINET communication	0–1000. A negative value corresponds to 0.0% by default.
22	Torque current (bipolar)	0–Three times the motor rated current. A negative value corresponds to 0.0% by default.
23	Exciting current	0–Three times the motor rated current. A negative value corresponds to 0.0% by default.
24	Set frequency (bipolar)	0–Max. output frequency. A negative value corresponds to 0.0% by default.
25	Ramp reference frequency (bipolar)	0–Max. output frequency. A negative value corresponds to 0.0% by default.
26	Rotational speed (bipolar)	0–Synchronous rotational speed corresponding to max. output frequency. A negative value corresponds to 0.0% by default.

Set value	Function	Description
27	Value 2 set through EtherCAT/PROFINET communication	0–1000
30	Rotational speed	0–Twice the rated synchronous speed of the motor
31	Output torque (bipolar)	0–Twice the motor rated torque. A negative value corresponds to 0.0% by default.
32	AIAO detected temperature output	AO output temperature in the AIAO temperature detection.
34	Pressure reference (100% corresponds to the full-scale pressure value set in P73.06)	-
35	Pressure feedback (100% corresponds to the full-scale pressure value set in P73.06)	-
36	Flow reference (100% corresponds to the full-scale flow set in P73.07)	-
37	Flow feedback (100% corresponds to the full-scale flow set in P73.07)	-
38	EAI5 input	0–10V/0–20mA
39	EAI6 input	0–10V/0–20mA
40	EAI7 input	0–10V/0–20mA

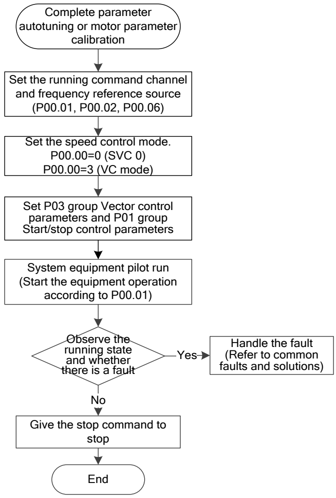
The related parameters are listed in the following table.

Function code	Name	Default	Setting range	Description
P06.14	AO1 output selection	35	0–63	0–37: For details, see the preceding table. 38–63: Reserved
P06.16	AO2 output selection	30		
P06.17	AO1 output lower limit	0.0%	-300.0%–P06.19	The function codes define the relationship between the output value and analog output. When the output value exceeds the
P06.18	AO1 output corresponding to lower limit	0.00V	0.00–10.00V	

Function code	Name	Default	Setting range	Description
P06.19	AO1 output upper limit	100.0%	P06.17–300.0%	allowed range, the output uses the lower limit or upper limit. When the analog output is current output, 1mA equals 0.5V. In different cases, the corresponding analog output of 100% of the output value is different. 
P06.20	AO1 output corresponding to upper limit	10.00V	0.00–10.00V	
P06.21	AO1 output filter time	0.000s	0.000–10.000s	
P06.22	AO2 output lower limit	0.0%	-300.0%–P06.24	
P06.23	AO2 output corresponding to lower limit	0.00V	0.00–10.00V	
P06.24	AO2 output upper limit	100.0%	P06.22–300.0%	
P06.25	AO2 output corresponding to upper limit	10.00V	0.00–10.00V	
P06.26	AO2 output filter time	0.000s	0.000–10.000s	

6.6 Speed mode commissioning

6.6.1 Commissioning flowchart



6.6.2 Speed control mode selection

The drive supports four speed control modes. You can set P00.00 to select the speed control mode based on actual conditions. Before using a vector control mode (0, 1, or 3), set the motor nameplate parameters and perform motor parameter autotuning first. For details, see section 6.2.1 Rated motor parameter settings and section 6.3.1 Motor parameter autotuning.

Function code	Name	Default	Setting range	Description
P00.00	Speed control mode	3	0–3	0: SVC 0 1: SVC 1 2: Space voltage vector control mode 3: Closed-loop vector control mode

SVC mode 0: P00.00=0

In this case, there is no need to install encoders. It is applicable to scenarios with requirements for low frequency, great torque, and high speed control accuracy. It implements precise control of speed and torque. Compared to the SVC mode 1, this mode is more suitable for medium and small power applications. For details, see Group P03—Vector control of motor 1.

Note: Compared with SVC mode 1, SVC mode 0 is more sensitive to motor parameters.

SVC mode 1: P00.00=1

In this case, there is no need to install encoders. It is applicable to scenarios that require high speed control accuracy. It can be used across all power ranges, enabling precise control of speed and torque. For details, see Group P03—Vector control of motor 1.

Space voltage vector control mode: P00.00=2

In this case, there is no need to install encoders. It can improve the control accuracy with the advantages of stable operation, valid low-frequency torque boost and current vibration suppression and the functions of slip compensation and voltage adjustment. For details, see Group P04—V/F control.

Closed-loop vector control mode: P00.00=3

In this case, encoders need to be installed. It is applicable to scenarios with high demands on speed control and current control accuracy. For details, see Group P20—Encoder functions of motor 1.

6.6.3 Vector control performance optimization

6.6.3.1 Torque upper limit

Speed control and torque control in the vector control mode are restricted by torque upper limits. When you set P03.18 (Setting source of electromotive torque upper limit) to keypad, the torque upper limit is specified by P03.20. When you set P03.19 (Setting source of braking torque upper limit) to keypad, the torque upper limit is specified by P03.21.

Function code	Name	Default	Setting range	Description
P03.18	Setting source of electromotive torque upper limit	0	0–14	0: Keypad (P03.20) 1: AI1 2: AI2 3: EAI3 4: Reserved 5: Modbus/Modbus TCP communication 6: PROFIBUS/CANopen/DeviceNet communication 7: Ethernet communication

Function code	Name	Default	Setting range	Description
				8: Reserved 9: EtherCAT/PROFINET/EtherNet IP communication 10: Reserved 11: EAI5 12: EAI6 13: EAI7 14: Reserved **Note:** 100% corresponds to the motor rated current.
P03.19	Setting source of braking torque upper limit	0	0–14	Same function as P03.18.
P03.20	Electromotive torque upper limit set through keypad	200.0%	0.0–300.0% (of the motor rated current)	Used to set torque limits.
P03.21	Braking torque upper limit set through keypad	200.0%	0.0–300.0% (of the motor rated current)	

6.6.3.2 Frequency upper limit settings in torque control

In torque control, the drive outputs torque according to the set torque command. When the set torque is greater than the load torque, the drive output frequency increases to the frequency upper limit; when the set torque is less than the load torque, the drive output frequency decreases to the frequency lower limit; when the drive output frequency is restricted, the output torque will no longer be the same as the set torque. When you set P03.14 to set the setting source of forward rotation frequency upper limit in torque control, the torque limit is specified by P03.16. When you set P03.15 to set the setting source of reverse rotation frequency upper limit in torque control, the torque limit is specified by P03.17.

Function code	Name	Default	Setting range	Description
P03.14	Setting source of forward rotation frequency upper limit in torque control	0	0–15	0: Keypad (P03.16) 1: AI1 2: AI2 3: EAI3 4: Reserved

Function code	Name	Default	Setting range	Description
				5: Multi-step setting 6: Modbus/Modbus TCP communication 7: PROFIBUS/CANopen/ DeviceNet communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET/EtherNet IP communication 11: Reserved 12: EAI5 (same as the above) 13: EAI6 (same as the above) 14: EAI7 (same as the above) 15: Reserved **Note:** 100% corresponds to the max. frequency.
P03.15	Setting source of reverse rotation frequency upper limit in torque control	0	0–12	Same function as P03.14.
P03.16	Forward rotation frequency upper limit set through keypad in torque control	50.00Hz	0.00Hz–P00.03 (Max. output frequency)	Used to set frequency upper limits. 100% corresponds to the max. frequency. P03.16 specifies the value when P03.14 = 1; while P03.17 specifies the value when P03.15 = 1.
P03.17	Reverse rotation frequency upper limit set through keypad in torque control	50.00Hz	0.00Hz–P00.03 (Max. output frequency)	

6.6.3.3 Speed loop

Take motor 1 vector control as an example.

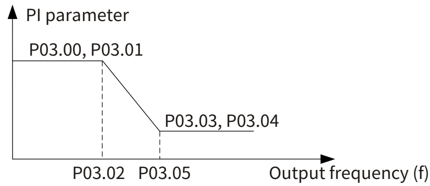
The speed loop dynamic response characteristics in vector control can be adjusted by setting the proportional coefficient and integral time of speed regulator.

The dynamic response of speed regulator can be accelerated by increasing the proportional gain or decreasing the integral time. However, too quick dynamic response of speed regulator can cause oscillations.

Recommended adjustment method: If the default settings cannot meet the requirements, adjust the settings slightly. First, increase the proportional gain to ensure that the system does not oscillate, and then reduce the integral time, so that the system responds fast with small overshoot.

Improper PI parameter settings will cause large speed overshoot.

The switchover between the low-point frequency for switching and the high-point frequency for switching indicates the linear switchover between two groups of PI parameters. See the following figure.



Function code	Name	Default	Setting range	Description
P03.00	Speed-loop proportional gain 1 of motor 1	8.0	0.0–200.0	Speed loop PI parameters are divided into the low-speed group and high-speed group. When the running frequency is less than P03.02 (Low-point frequency for speed-loop switching of motor 1), the speed loop PI parameters are P03.00 and P03.01. When the output frequency P17.01 is greater than P03.05 (High-point frequency for speed-loop switching of motor 1), the speed loop PI parameters are P03.03 and P03.04.
P03.01	Speed-loop integral time 1 of motor 1	0.200s	0.020–10.000s	
P03.02	Low-point frequency for speed-loop switching of motor 1	10.00Hz	0.00Hz–P03.05	
P03.03	Speed-loop proportional gain 2 of motor 1	8.0	0.0–200.0	
P03.04	Speed-loop integral time 2 of motor 1	0.200s	0.020–10.000s	-
P03.05	High-point frequency for speed-loop switching of motor 1	10.00Hz	P03.02–P00.03	-
P03.06	Speed-loop output filter of motor 1	0	0–8	-

6.6.3.4 Current loop

Take motor 1 vector control as an example.

In vector control mode, the current loop parameters are primarily adjusted by tuning the current loop bandwidth.

Function code	Name	Default	Setting range	Description
P03.10	Current-loop bandwidth of motor 1	400	0–2000	Smaller current-loop bandwidth indicates slower response but better current waveform.

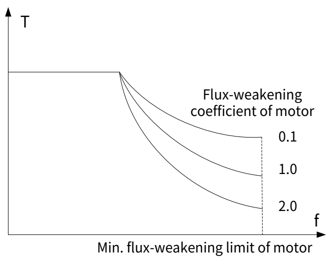
Note:

- For SM control, the current-loop parameters have a great impact on the speed control response and instantaneous current convergence, and therefore you need to increase the current-loop parameter values in scenarios such as with current divergence and motor stall.
- If the SM sounds abnormally during running, in addition to decreasing the speed-loop PI control parameters, decrease current-loop PI control parameters. Generally, small motor straight axis and cross axis inductance requires great current-loop bandwidth.

6.6.3.5 Vector control flux weakening performance optimization

When running at a speed higher than the rated speed, the motor enters the flux weakening state. The flux weakening proportional gain and integral gain are set via parameters P03.26 and P03.33. The max. drive output voltage is specified by P03.24.

If pre-exciting is performed for the motor when the drive starts up, a magnetic field is built up inside the motor to improve the torque performance during the start process. The pre-exciting time is specified by P03.25.



Function code	Name	Default	Setting range	Description
P03.24	Max. voltage limit	105.0%	0.0–120.0%	Used to set the max. drive output voltage, which is a percentage of the motor rated voltage. Set the value according to onsite conditions.

Function code	Name	Default	Setting range	Description
P03.25	Pre-exciting time	0.000s	0.000–10.000s	Pre-exciting is performed for the motor when the drive starts up. A magnetic field is built up inside the motor to improve the torque performance during the start process.
P03.26	Flux-weakening proportional gain	1000	0–8000	-
P03.33	Flux-weakening integral gain	2.0%	0.0–300.0%	-

6.6.3.6 SM start control optimization

In closed-loop vector control mode, the autotuned initial magnetic pole angle is saved to P20.10, which can be directly used on the next startup without repeated autotuning. In a scenario with an incremental encoder stalled, each time after power-on, the static autotuning of initial magnetic pole angle is performed for the first startup, but the autotuned angle can be directly used for the next startup.

Function code	Name	Default	Setting range	Description
P20.10	Initial pole angle	0.00	0.00–359.99	Relative electrical angle between encoder position and motor pole position.

In the open-loop control mode, you can select a start control method by setting P13.01.

Function code	Name	Default	Setting range	Description
P13.01	Initial pole detection method	0	0: Do not detect 1: High-frequency superposition 2: Pulse superposition	-

No detection: P13.01 = 0

The drive startup command given is a direct startup command. In this mode, set P13.02 to a great value to increase the starting torque, which causes a start reversal phenomenon with an average load carrying capacity.

High frequency superimposition: P13.01=1

If a drive startup command is given, the drive autotunes the initial pole angle by means of high-frequency current injection and then automatically starts up after the autotuning. When P13.02 is valid and the initial pole angle based direction setting is accurate, the reverse rotation problem can be mitigated or eliminated, and the load carrying capacity can be improved. In this case, you can adjust the high-frequency injection current by setting P13.13.

Pulse superposition: P13.01=2

This method is similar to that when P13.01=1. The difference is that the initial pole angle autotuning method is different. This method has higher identification accuracy with shorter time but sharper noise, but you can adjust the pulse current value by setting P13.06.

Function code	Name	Default	Setting range	Description
P13.02	Pull-in current 1	30.0%	-100.0%–100.0% (of the motor rated current)	Specifies the pole position orientation current. It is valid within the lower limit of pull-in current switch-over frequency threshold. If you need to increase the start torque, increase the value of this function parameter properly.
P13.06	Pulse current setting	10.0%	0.0–300.0% (of the motor rated voltage)	Used to set the pulse current threshold when the initial magnetic pole position is detected in the pulse mode. **Note:** When the control mode is set to SVC, the value is automatically adjusted to 80%.
P13.13	High-frequency injection current	20.0%	0.0–300.0% (of the rated drive output current)	Used to set the pulse current threshold when the initial magnetic pole position is detected in the high-frequency current injection mode.

6.6.4 Encoder-based speed detection

6.6.4.1 Encoder-based speed detection

The drive supports the speed detection by the local encoder or by encoder expansion card. The method is specified by P20.15.

Method 1 Local encoder-based speed detection

Local encoder-based speed detection applies only to rotary encoders; other encoder types are currently not supported. The measured frequency or speed can be checked using P18.00 or P76.17.

Method 2 Encoder expansion card-based speed detection

This method supports multiple detection modes. For details, refer to Appendix E.4 PG expansion card.

Function code	Name	Default	Setting range	Description
P18.00	Encoder detected frequency	0.0Hz	-999.9–3276.7Hz	-
P76.17	Encoder detected speed	0rpm	-30000–30000 rpm	-
P20.01	Encoder pulse count	1024	0–16000	Number of pulses generated when the encoder revolves for one circle.
P20.02	Encoder direction	0x000	0x000–0x111	Ones place: AB direction 0: Forward 1: Reverse Tens place: Z pulse direction (Reserved) 0: Forward 1: Reverse Hundreds place: CD/UVW pole signal direction 0: Forward 1: Reverse
P20.06	Speed ratio between motor and encoder mounting shaft	1.000	0.000–65.535	When the encoder is not installed on the motor shaft and the drive ratio is not 1, you need to set this parameter.
P20.15	Speed measurement method	2	0–1	0: PG card 1: Reserved 2: Built-in resolver

To check whether the detected speed is normal, do as follows:

Step 1 Restore to default values through the keypad.

Step 2 Set P00.03, P00.04, and motor nameplate parameters in group P02.

Step 3 Perform motor parameter autotuning. The autotuned parameters are automatically saved to related motor parameters in group P02.

Step 4 Check whether the detected speed is normal. After correctly configuring the encoder-related parameters, switch the control mode to open-loop mode (set P00.00 = 2).

When P00.10 is 20.00Hz, run the drive. Then the motor frequency is about 20Hz. Check the value of P18.00 or P76.17. If the speed is negative, the encoder is in the reverse direction, and you need to set P20.02 to 1. If the speed deviation is great, the value of P20.01 (Encoder pulse count) is set improperly.

6.6.4.2 Encoder disconnection detection

When the drive is in standby or closed-loop mode, if the number of detected resolver disconnection events exceeds the resolver disconnection detection filter count set in P03.59, the drive disables the FVC-to-SVC switching function by default and triggers an E37 fault. Related function codes:

Function code	Name	Default	Setting range	Description
P03.57	Switch from FVC to SVC mode	0x0000	0x0000–0x2111	Ones place: Selection of resolver disconnection alarm 0: Report a fault 1: Report an alarm Tens place: Switch to SVC mode selection 0: Switch to SVC0 mode 1: Switch to SVC1 mode Hundreds place: Enable switchover to SVC 0: Disable 1: Enable Thousands place: SVC to SVC 0: Disable 1: Enable 2: Enable and reset disconnection alarm code
P03.59	Resolver disconnection detection filter count	5	1–15	-

Note:

- If it is necessary to enable the FVC-to-SVC mode switching function, it is recommended to switch to SVC0 mode by setting P03.57 to 0x0001. In this scenario, if the number of detected resolver disconnection events exceeds the detection filter count set in P03.59, the drive automatically switches to SVC0 mode to continue operation, and the LED keypad displays the alarm code **A9105**.
- The switchover from FVC closed-loop mode to SVC open-loop mode upon encoder disconnection is not suitable for operating conditions where the speed is below 100rpm.
- If the **A9105** alarm code appears on the LED keypad even after verifying that the encoder cable is properly connected, increase the value of P03.59 (resolver disconnection detection filter count) appropriately.
- When the drive switches from closed-loop mode to SVC open-loop mode and the encoder cable is reconnected after the drive is stopped, the control mode will switch back to FVC closed-loop mode only after re-power on.

Some motor temperature sensors are connected to the "PT+" and "PT-" terminals on the control board via separate wires branched out from the encoder cable. Most motor temperature sensors, however, are integrated into the encoder cable. In this case, if the encoder cable is disconnected, a motor overtemperature fault (motor temperature sensor disconnection) will be triggered, causing the drive to stop. To resolve this issue, proceed as follows:

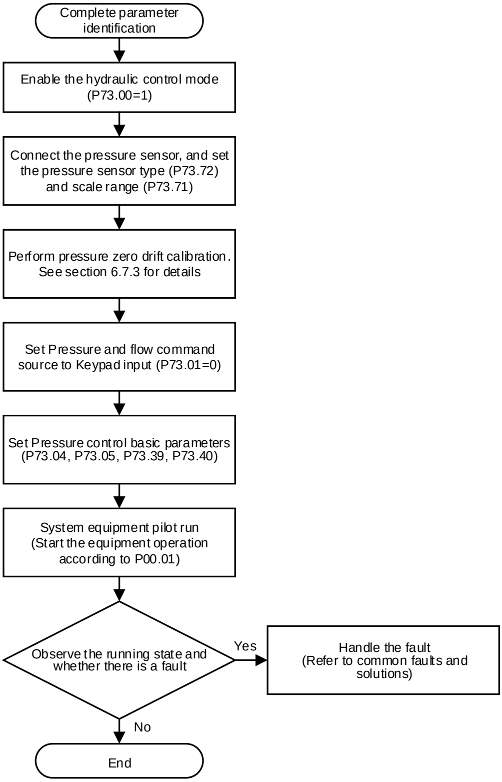
Step 1 Configure the fault selection as required. For example, set P11.31 to 624 (624 corresponds to the overtemperature fault code; for details, see P07.27 in Appendix F Function parameter list).

Step 2 Set the fault classification handling method as required. For example, set the ones place of P11.35 to 3. P11.35 (fault level processing group 1) defines the handling method for P11.31–P11.34 (fault selection 1–4). For other groups, refer to the P11 protection parameter group (P11.31–P11.50) in Appendix F Function parameter list.

When the encoder cable is disconnected, the keypad LED displays the **A9108** alarm code (motor temperature sensor disconnection), and the control mode switches from FVC closed-loop mode to SVC open-loop mode. For details of the related alarm codes, refer to section 8.2.2 Other states.

6.7 Hydraulic mode commissioning

6.7.1 Commissioning flowchart



6.7.2 Hydraulic mode selection and parameter settings

Function code	Name	Default	Setting range	Description
P73.00	Hydraulic control mode	0	0–1	0: Non-hydraulic mode 1: Hydraulic mode

When switching from non-hydraulic control mode (P73.00=0) to hydraulic control mode (P73.00=1), the settings of related parameters become invalid. Refer to the table below for details.

Function code	Name
P00.11	ACC time 1
P00.12	DEC time 1

6.7.3 Pressure feedback zero-drift calibration

Verify that the pressure sensor range and type are correctly selected before performing pressure feedback zero-drift calibration.

■ **Method 1:** Manual Adjustment

Function code	Name	Default	Setting range	Description
P75.25	Pressure feedback zero-drift calibration value	0	-5000–5000	Adjust this value so that the pressure feedback value P76.04 is 0.0bar.

Adjust the value of P75.25 so that the pressure feedback value P76.04 reads 0.

■ **Method 2:** Automatic adjustment

Function code	Name	Default	Setting range	Description
P75.24	Analog channel zero-drift autotuning	0	0–4	0: Invalid 1: AI1–AI3 zero-drift autotuning 2: AI1 zero-drift autotuning 3: AI2 zero-drift autotuning 4: AI3 zero-drift autotuning

Set P75.24 = 4 to perform AI3 (pressure feedback) zero-drift calibration. Additionally, when flow and pressure references are provided via analog inputs, P75.24 can also be used to calibrate AI1 and AI2 (zero-drift error range: the zero drift of AI1 and AI2 must be less than 0.5V).

Note: After selecting the autotuning channel, the keypad will display the channel **AI-X**. Press **RUN** to perform the zero-drift calibration autotuning. If it is successful, the LED keypad displays **PASS**. If it fails (allowable AI3 zero-drift error range: less than 0.5V or 1mA), **A9111** is displayed. In this case, check whether the pressure sensor selection or wiring is incorrect.

6.7.4 Hydraulic function parameter settings

6.7.4.1 System pressure and flow parameter setting

■ Pressure and flow command selection

Function code	Name	Default	Setting range	Description
P73.01	Pressure and flow command source selection	2	0–10	0: Keypad 1: Analog setting 1 (AI1 for pressure, AI2 for flow) 2: Analog setting 2 (AI2 for pressure, AI1 for flow) 3: Internal multi-step 4: Modbus communication 5: Profinet/CANopen/EtherCAT communication 6–8: Reserved 9: Analog setting 3 (EAI5 for pressure, EAI6 for flow) 10: Analog setting 4 (EAI6 for pressure, EAI5 for flow)
P73.02	Keypad pressure set value	0.0bar	0.0–750.0bar	When P73.01 (pressure and flow command source selection) is set to 0 (keypad), this function code is used to set the pressure reference value.
P73.03	Keypad flow set value	0.0L/min	0.0–2400.0L/min	When P73.01 (pressure and flow command source selection) is set to 0 (keypad), this function code is used to set the flow reference value.
P73.06	Full-scale value of reference pressure	175.0bar	0.0–750.0bar	The pressure reference value corresponding to 100% input. **Note:** When P73.01 (pressure and flow command source selection) is set to 1, 2, or 4, this parameter must be set according to the input range.

Function code	Name	Default	Setting range	Description
P73.07	Full-scale value of reference flow	200.0L/min	0.0–2400.0L/min	The flow reference value corresponding to 100% input. **Note:** When P73.01 (pressure and flow command source selection) is set to 1, 2, or 4, this parameter must be set according to the input range.

■ Flow and pressure settings

Function code	Name	Default	Setting range	Description
P73.04	Max. local reference pressure	250.0bar	0.0bar–P73.71	Sets the maximum reference pressure value for the system.
P73.05	Max. local output flow	250.0L/min	0.0L/min–P73.36	Sets the maximum reference output flow rate value for the system.
P73.36	Max. local output flow	250.0L/min	0.0–2400.0L/min	The maximum flow rate of the system is primarily determined by the maximum motor speed (P73.40) and the pump displacement (P07.37). This value cannot be modified.
P73.37	Pump displacement	100.0mL/r	0.0–3000.0mL/r	Pump displacement is mainly determined by the hydraulic circuit piping specifications.
P73.40	Max. motor speed	2500rpm	0–6000rpm	Sets the maximum motor speed, which corresponds to the motor speed when the flow reference is 100%.

■ Analog input

When P73.01 (pressure and flow command selection) is set to analog input, the nominal value corresponding to 100.0% analog input varies depending on the application. For details, refer to section 6.5.2.1 Analog input.

6.7.4.2 Pressure relief settings

- Reverse rotation pressure relief

The drive adopts this method by default.

Function code	Name	Default	Setting range	Description
P73.39	Min. pump speed	-300rpm	-2000rpm–P73.40	A negative value indicates the maximum reverse rotation speed during pressure relief. A larger negative value results in faster pressure relief, but may cause hydraulic pump noise. A smaller negative value results in slower pressure relief.
P73.49	Hydraulic circuit pressure relief method	0	0–1	0: Reverse rotation pressure relief 1: Hydraulic circuit pressure relief

- Hydraulic circuit pressure relief

When using this method, set P73.49 to 1. Configure the control board DO output as **38: Hydraulic valve pressure relief output.**

Function code	Name	Default	Setting range	Description
P73.51	Opening speed of hydraulic valve during pressure relief	25.0rpm	-300–300rpm	-
P73.52	Opening pressure deviation of hydraulic valve during pressure relief	30.0bar	0.0–500.0bar	When the pressure reference is less than 20bar, the pressure deviation (between the pressure feedback and the pressure reference) is compared against P73.52 and P73.53. Otherwise, it is compared against P73.54 and P73.55.
P73.53	Closing pressure deviation of hydraulic valve during pressure relief	27.0bar	0.0bar–P73.52	

Function code	Name	Default	Setting range	Description
P73.54	Low-pressure opening pressure deviation of hydraulic valve during pressure relief	10.0bar	0.0–500.0bar	When the pressure reference is less than 20bar, the pressure deviation (between the pressure feedback and the pressure reference) is compared against P73.52 and P73.53. Otherwise, it is compared against P73.54 and P73.55.
P73.55	Low-pressure closing pressure deviation of hydraulic valve during pressure relief	5.0bar	0.0bar–P73.54	
P73.56	Opening delay of hydraulic valve during pressure relief	0.000s	0.000–30.000s	-
P73.57	Closing delay of hydraulic valve during pressure relief	0.000s	0.000–30.000s	-

6.7.4.3 Base flow and low-pressure setting

Function code	Name	Default	Setting range	Description
P73.33	Base flow enabling	0	0–1	0: Disable 1: Enable
P73.34	Base flow pressure	3.0bar	0.0–500.0bar	-
P73.35	Base flow rate	3.6L/min	0.0–2400.0L/min	-

6.7.4.4 Hydraulic pressure and flow reference filter time

<table>
<tr><th>Function code</th><th>Name</th><th>Default</th><th>Setting range</th><th>Description</th></tr>
<tr><td>P73.08</td><td>Pressure command 1 rise time</td><td>0.100s</td><td rowspan="4">0.000–60.000s</td><td>-</td></tr>
<tr><td>P73.09</td><td>Pressure command 1 fall time</td><td>0.120s</td><td>-</td></tr>
<tr><td>P73.10</td><td>Rise time of low-speed flow command 1</td><td>0.060s</td><td rowspan="5">The selection of flow command rise and fall times is determined by the value set in P73.12.
When the flow reference is less than or equal to the percentage defined by P73.12 × P73.05 (maximum local output flow), the rise and fall times are set by P73.10 and P73.11.
When the flow reference is greater than the percentage, the rise and fall times are set by P73.13 and P73.14.
Note: For multi-pump systems, flow threshold is based on P76.06 (multi-pump system max flow).</td></tr>
<tr><td>P73.11</td><td>Fall time of low-speed flow command 1</td><td>0.060s</td></tr>
<tr><td>P73.12</td><td>High-speed flow threshold 1</td><td>100.0%</td><td>0.0–100.0%</td></tr>
<tr><td>P73.13</td><td>Rise time of high-speed flow command 1</td><td>0.000s</td><td rowspan="7">0.000–60.000s</td></tr>
<tr><td>P73.14</td><td>Fall time of high-speed flow command 1</td><td>0.000s</td></tr>
<tr><td>P73.15</td><td>Rising S-curve filter time of pressure command 1</td><td>0.050s</td><td>-</td></tr>
<tr><td>P73.16</td><td>Falling S-curve filter time of pressure command 1</td><td>0.050s</td><td>-</td></tr>
<tr><td>P73.17</td><td>Rising S-curve filter time of flow command 1</td><td>0.000s</td><td>-</td></tr>
<tr><td>P73.18</td><td>Falling S-curve filter time of flow command 1</td><td>0.000s</td><td>-</td></tr>
<tr><td>P73.19</td><td>Delay time of flow and pressure command 1</td><td>0.000s</td><td>Note: The pressure reference is 0 before the delay reference takes effect.</td></tr>
</table>

Function code	Name	Default	Setting range	Description
P73.20–P73.31	Flow and pressure command 2	-	-	**Note:** To switch between flow and pressure reference groups, set the DI function codes to 76–77 (injection molding machine PI signal selection terminal 1–2). When both DI signals are invalid, group 1 is selected; for any other signal combination, group 2 is selected.

6.7.5 Hydraulic pressure PID mode selection

The hydraulic pressure PI parameter groups can be selected and switched according to different application conditions. Under the default operating condition, the hydraulic pressure loop PI parameters are tuned using P74.02 and P74.03.

Multi-step PI switchover: Primarily used for different process stages of an injection molding machine. Switching between PI parameter groups requires an external signal.

High/low pressure PI switchover: Primarily used in applications with frequent pressure reference changes, where the response and overshoot characteristics of the pressure feedback are inconsistent.

Pressure build-up and pressure holding PI switchover: Primarily used in operating conditions where pressure feedback fluctuation is large during the pressure-holding phase and PI parameters need to be adjusted.

Speed-loop PI switchover: Pressure relief speed-loop PI switchover is mainly applied in applications with high requirements for pressure relief response. Speed-loop PI switchover can also be used for different process stages of injection molding machines, where switchover between PI parameter groups is performed via external command signals.

6.7.5.1 Multi-step PI switchover

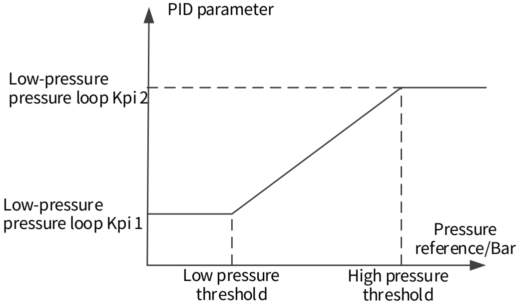
Function code	Name	Default	Setting range	Description
P74.02	Pressure-loop proportional gain 1	10.000	0.000–40.000	By default, only the first pressure-loop PID parameter group is used. **Note:** PID group selection can be switched via terminals or
P74.03	Pressure-loop integral gain 1	0.100	0.001–10.000	

Function code	Name	Default	Setting range	Description
P74.04	Pressure-loop proportional gain 2	10.000	0.000–40.000	communication. When terminal control is used, set the DI function codes to 76–77 (injection molding machine PI signal selection terminal 1–2). For selection details, refer to section 6.7.5.5 DI terminal selection.
P74.05	Pressure-loop integral gain 2	0.100	0.001–10.000	
P74.06	Pressure-loop proportional gain 3	10.000	0.000–40.000	
P74.07	Pressure-loop integral gain 3	0.100	0.001–10.000	
P74.08	Pressure-loop proportional gain 4	10.000	0.000–40.000	
P74.09	Pressure-loop integral gain 4	0.100	0.001–10.000	

6.7.5.2 High/low pressure PI switchover

Function code	Name	Default	Setting range	Description
P74.01	Pressure multi-step PI selection	0x000	0x000–0x111	Ones place: High/low pressure PI switchover selection 0: Disable 1: Enable Tens place: Pressure build-up and pressure holding PI switchover selection 0: Disable 1: Enable Hundreds place: Reserved **Note:** When modes in pressure-loop multi-step PI switchover are enabled simultaneously, the pressure build-up and pressure holding PI switchover has the highest priority.
P74.10	Low pressure threshold 1	50.0bar	0.0bar–P74.11	-

Function code	Name	Default	Setting range	Description
P74.11	High pressure threshold 1	100.0bar	0.0–500.0bar	-
P74.12	Low-pressure pressure-loop proportional gain 1	10.000	0.000–40.000	-
P74.13	Low-pressure pressure-loop integral gain 1	0.100	0.001–10.000	-
P74.12	High-pressure pressure-loop proportional gain 1	10.000	0.000–40.000	-
P74.13	High-pressure pressure-loop integral gain 1	0.100	0.001–10.000	-



When high/low pressure PI switchover is enabled:

If the pressure reference is below the low pressure threshold P74.10, use P74.12 and P74.13.

If the pressure reference is above P74.11, use P74.14 and P74.15.

If the pressure feedback is between P74.10 and P74.11, the pressure-loop PID parameters are calculated using linear interpolation between the two parameter groups.

6.7.5.3 Pressure build-up and pressure holding PI switchover

Function code	Name	Default	Setting range	Description
P74.01	Pressure multi-step PI selection	0x000	0x000–0x111	Ones place: High/low pressure PI switchover selection 0: Disable 1: Enable Tens place: Pressure build-up and pressure holding PI switchover selection 0: Disable 1: Enable Hundreds place: Reserved **Note:** When modes in pressure-loop multi-step PI switchover are enabled simultaneously, the pressure build-up and pressure holding PI switchover has the highest priority.
P74.17	Pressure feedback filter time for pressure holding judgment	0.005s	0.000–5.000s	-
P74.18	Pressure deviation threshold for pressure holding judgment	3.0bar	0.0–20.0bar	**Note:** When set to 0, PID group switching is disabled, and parameters P74.02–P74.03 are used.
P74.19	Speed threshold for pressure holding judgment	200r/min	0–1000r/min	
P74.21	Pressure-holding pressure-loop proportional gain 1	10.000	0.000–40.000	**Note:** PID group selection can be switched via terminals or communication. When terminal control is used, set the DI function codes to 76–77 (injection molding machine PI signal selection terminal 1–2). For selection details, refer to section 6.7.5.5 DI terminal selection.
P74.22	Pressure-holding pressure-loop integral gain 1	0.100	0.001–10.000	
P74.23	Pressure-holding pressure-loop proportional gain 2	10.000	0.000–40.000	
P74.24	Pressure-holding pressure-loop integral gain 2	0.100	0.001–10.000	**Note:** PID group selection can be switched via terminals

Function code	Name	Default	Setting range	Description
P74.25	Pressure-holding pressure-loop proportional gain 3	10.000	0.000–40.000	or communication. When terminal control is used, set the DI function codes to 76–77 (injection molding machine PI signal selection terminal 1–2). For selection details, refer to section 6.7.5.5 DI terminal selection.
P74.26	Pressure-holding pressure-loop integral time 3	0.100	0.001–10.000	

6.7.5.4 Speed-loop PI switchover

- Pressure relief speed-loop PI switchover

Function code	Name	Default	Setting range	Description
P74.00	Enabling speed-loop multi-step PI	0x00	0x00–0x11	Ones place: Pressure relief speed-loop switchover selection 0: Disable 1: Enable Tens place: Hydraulic mode speed-loop switchover selection 0: Disable 1: Enable **Note:** When P74.18 or P74.19 is set to 0, pressure relief speed-loop PI parameter switching is disabled.
P74.29	Pressure relief speed-loop proportional gain 1	8.0	0.0–200.0	**Note:** To switch between flow and pressure reference groups, set the function codes to 76–77 (injection molding machine PI signal selection terminal 1–2). When both DI signals are invalid, group 1 is selected; for any other signal combination, group 2 is selected.
P74.30	Pressure relief speed-loop integral time 1	0.200	0.020–10.000	
P74.31	Pressure relief speed-loop proportional gain 2	8.0	0.0–200.0	**Note:** To switch between flow and pressure reference groups, set the function codes to 76–77 (injection molding machine PI signal selection terminal 1–2). When both DI signals are invalid, group 1 is selected; for any other signal combination, group 2 is selected.
P74.32	Pressure relief speed-loop integral time 2	0.200	0.020–10.000	

- Speed-loop PI switchover

Switching of speed-loop PI parameter groups (valid only in hydraulic mode; disabled in non-hydraulic mode) is controlled via DI function code settings 76–77 (injection molding machine PI signal selection terminal 1–2). When both DI signals are invalid, group 1 is selected; for any other signal combination, group 2 is selected.

Function code	Name	Default	Setting range	Description
P23.00	Group 2 speed-loop proportional gain 1	8.0	0.0–200.0	-
P23.01	Group 2 speed-loop integral time 1	0.200s	0.000–10.000s	-
P23.02	Low-point frequency for switching	10.00Hz	0.00Hz–P23.05	-
P23.03	Group 2 speed-loop proportional gain 2	8.0	0.0–200.0	-
P23.04	Group 2 speed-loop integral time 2	0.200s	0.000–10.000s	-
P23.05	High-point frequency for switching	10.00	P03.02–P00.03 (Hz)	-
P23.06	Speed-loop output filter	0	0–8	-
P23.07	Electromotive slip compensation coefficient of vector control	100%	50–200%	-
P23.08	Braking slip compensation coefficient of vector control	100%	50–200%	-
P23.10	Group 2 current-loop bandwidth	400	0–2000	-
P23.11	Group 2 speed-loop differential gain	0.00	0.00–10.00	-
P23.12	Hidden	0	0–0	-
P23.13	Group 2 speed-loop overshoot suppression gain	100	0–700	-

6.7.5.5 DI terminal selection

- Selecting the PID group mode via two DI terminals

When pressure multi-step PID is disabled (P74.01 = 0), the first PID parameter group is used by default. The PID parameters are selected according to the combination of the input terminals, as shown below:

DI1 (76# PID terminal 1)	DI2 (77# PID terminal 2)	PID group
Invalid	Invalid	PID group 1
Invalid	Valid	PID group 2
Valid	Invalid	PID group 3
Valid	Valid	PID group 4

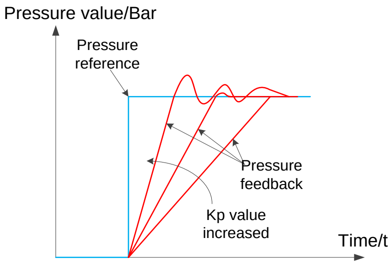
6.7.6 Pressure holding stability commissioning

A larger proportional gain (Kp) and integral gain (Ki) result in a faster system response. However, an excessively fast response may cause overshoot, leading to oscillation and instability of the system.

Conversely, smaller proportional gain (Kp) and integral gain (Ki) result in a slower response. An excessively slow response may lead to reduced efficiency and unstable product quality.

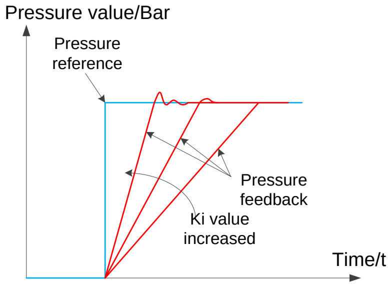
■ Hydraulic pressure PID proportional gain

The larger the proportional gain, the faster the pressure response. However, an excessively large proportional gain may cause system oscillation; conversely, a smaller proportional gain results in a slower pressure response. See the figure below.



■ Hydraulic pressure PID integral gain

A larger integral gain results in a faster pressure response but increases the risk of overshoot; if the gain is too high, it may cause system oscillation. Conversely, a smaller gain results in a slower response; if the gain is too low, it may lead to pressure instability. See the figure below.

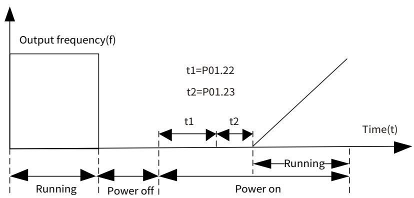


If significant pressure holding fluctuations are observed during commissioning, enhance the low-speed speed loop response to improve pressure stability. Specifically, appropriately increase P3.00 and P3.01. Adjust these values moderately; otherwise, motor oscillation may occur.

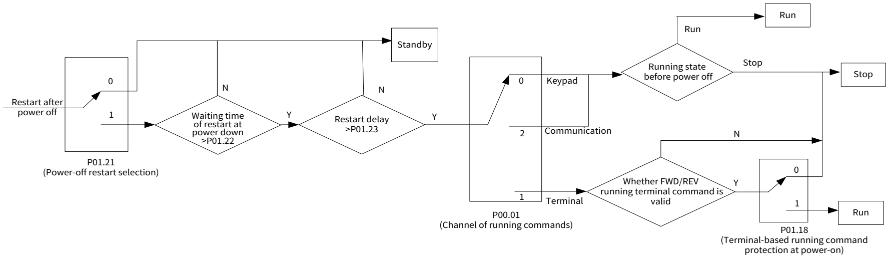
6.7.7 Power-off restart

For injection molding machines or applications where a digital input terminal is used to enable drive operation, if P01.21 is set to 1, the drive memorizes the operating status at the time of a power-off. If the drive is running before power-off, the drive automatically runs with a wait time specified by P01.22 at the next power-on when start conditions are met.

When terminals are used as the command running channel, you need to set P01.18 to 2. The following figure shows the wait time for restart after power-off.



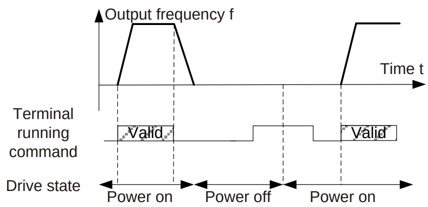
The following figure shows the logic flow:



Function code	Name	Default	Setting range	Description
P01.21	Power-off restart selection	0	0–1	0: Disable 1: Enable
P01.22	Wait time for power-on restart	1.0s	0.0–3600.0s	Valid when P01.21 is 1. The function code indicates the wait time before the automatic running of the drive that is re-powered on.
P01.23	Start delay time	0.0s	0.0–600.0s	After a drive running command is given, the drive is in standby state and restarts with the delay defined by P01.23.
P01.18	Terminal-based running command protection at power-on	0	0–2	0: The terminal-based running command is invalid at power-on 1: The terminal-based running command condition is valid at power-on 2: The terminal-based running command is valid at power-on **Note:** ● Valid only when P01.21 is set to 0. ● During software/firmware upgrade or commissioning, it is recommended to set this parameter to 0.

Terminal-based running command is invalid at power-on: P01.18= 0

Though the command running terminal is considered valid during power-on, the drive does not run and it keeps the protection state until the terminal is disabled and then enabled.



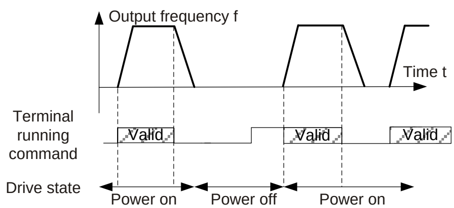
Terminal-based running command condition is valid at power-on: P01.18=1

If the running command is considered valid during power-on, the drive is started automatically after the initialization.

Note: When P01.18 is set to 1, the drive will automatically start upon re-power on only if the reference frequency is greater than the jogging frequency setting (P08.06) (applicable to software version V6.03 and above).

Terminal-based running command is valid at power-on: P01.18=2

If the command running terminal is considered as valid during power-on, the drive is started automatically after the initialization.



Note: When P01.18 is set to 2, the drive automatically starts after re-power on (software version V6.04 or later).

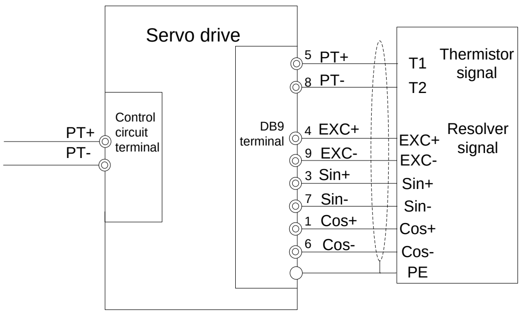
6.7.8 Pressure sensor disconnection detection

The drive uses AI3 as the pressure feedback signal. Under the default parameter settings, if the pressure sensor is disconnected, a fault is immediately generated (LED keypad displays **E94**) and the drive stops.

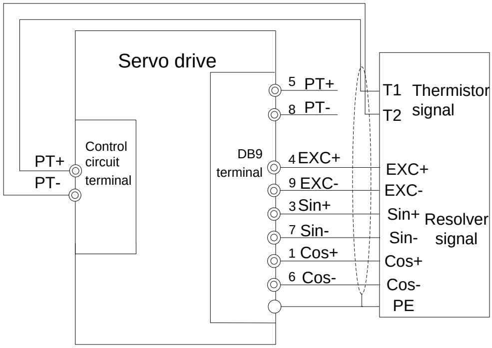
Function code	Name	Default	Setting range	Description
P73.73	Pressure sensor disconnection action	0	0–2	0: Report a fault and stop 1: Alarm and switch to speed mode 2: Reserved
P73.74	Running frequency selection when switching from pressure mode to speed mode	0	0–2	0: Run at the frequency corresponding to base flow 1: Run at the frequency set by P73.75 2: Reserved
P73.75	Speed setting for pressure–speed mode switching	1500rpm	0rpm–P73.40	-

6.7.9 Motor temperature detection

The MH860C series drive features an integrated temperature sampling module that supports three types of sensors: KTY84, PT1000, and PTC130. Connections can be made via the DB9 terminal or the control circuit terminals. When using IMS20B series motors and encoder cables, it is not necessary to connect the external temperature sensor wires from the encoder cable to terminals PT+ and PT-. See the wiring diagram below.



Temperature sensor wiring via the DB9 terminal



Temperature sensor wiring via the control circuit terminals

Complete the wiring per the diagram above. Set P73.68 to match type of sensor connected. Set P73.69 and P73.70 to define the motor overheat protection and pre-alarm thresholds. Related function codes:

Function code	Name	Default	Setting range	Description
P73.68	Motor temperature sensor type	4	0–7	0: No temperature sensor 1: Reserved 2: PT1000 (single resistor, approximately 1.1kΩ at 25°C) 3: PT1000 (three resistors, approximately 3.2kΩ at 25°C) 4: KTY84-130 (single resistor, approximately 0.6kΩ at 25°C) 5: KTY84-130 (three resistors, approximately 1.8kΩ at 25°C) 6: PTC130 (single resistor) 7: PTC130 (three resistors)
P73.69	Detected motor OT protection threshold	130°C	0–150°C	-0–150°C
P73.70	Detected motor OT pre-alarm threshold	90°C	0–150°C	0–150°C

6.8 Multi-pump flow combining commissioning

For the hydraulic control of large-tonnage injection molding machines, single-pump systems cannot meet flow requirements due to limitations in hydraulic pump displacement or motor power. Therefore, the outlets of multiple single-pump systems must be connected in parallel to achieve a large flow by combining the flows. Under split-flow control, each loop independently manages flow and pressure. In contrast, under combined flow control, a master drive regulates pressure and total system flow. The remaining drives perform single-loop flow control according to the flow command from the master drive. The total system output is the sum of the output flows of all individual pumps.

6.8.1 Multi-pump mode

Once the flow combining type of each node (single-pump system) is set to multi-pump, the nodes operate exclusively in combined flow control mode. The master node is responsible for receiving the pressure reference, flow reference, and operation enable signal from the external control system, as well as the pressure sensor signal from the system oil outlet. It performs control of the pressure and total system flow. The slave nodes receive the flow command transmitted via CAN communication and execute speed control.

Figure 6-1 Multi-pump system

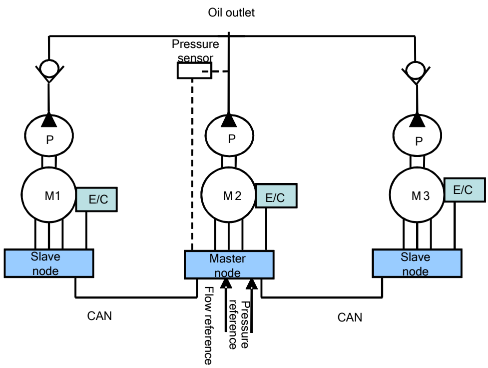
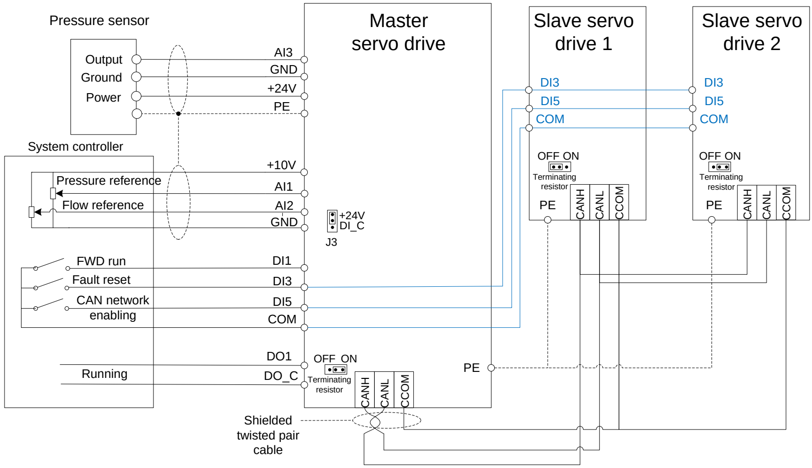


Figure 6-2 Multi-pump systematic wiring diagram



■ Master parameter settings

Function code	Name	Setting range	Description
P00.01	Channel of running commands	0–2	1: Terminal
P05.01	Function of DI1	0–95	1: Forward running
P05.03	Function of DI3	0–95	7: Fault reset
P05.05	Function of DI5	0–95	82: CAN master/slave network enable
P73.01	Pressure and flow command source selection	0–10	Set this parameter according to the source of the master command. In the example above (analog input), set the value to 1 or 2.
P73.04	Max. local reference pressure	0.0bar–P73.71	Set according to master requirements.
P73.05	Max. local output flow	0.0L/min–P73.36	Set according to master requirements.
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid 1: CAN master/slave 2: CANopen communication	Set to 1.

Function code	Name	Setting range	Description
P75.02	Local CAN master/slave address	0–15	Set to 0 (0 indicates the master).
P75.03	Multi-pump slave node count	0–15	Set according to the number of slave nodes. In the example shown above (2 slaves), set the value to 2.
P75.04	Multi-pump flow combining type	0–4	Set based on the multi-pump flow combining type. In the example above, set to 2 (multi-pump)
P75.08	Multi-pump flow cut-in threshold	0.0–100.0%	The cut-in ratio is based on the local pump's maximum output flow (P73.05). **Note:** When P75.05 is set to 0, the slave pump follows the master pump.
P75.09	Multi-pump flow cut-in hysteresis upper limit	0.0–100.0%	
P75.10	Multi-pump flow cut-in hysteresis lower limit	0.0%–P75.09	

■ Slave parameter setting

Function code	Name	Setting range	Description
P05.03	Function of DI3	0–95	7: Fault reset
P05.05	Function of DI5	0–95	82: CAN master/slave network enable
P73.04	Max. local reference pressure	0.0bar–P73.71	Set according to slave requirements.
P73.05	Max. local output flow	0.0L/min–P73.36	Set according to slave requirements.
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid 1: CAN master/slave 2: CANopen communication	Set to 1.
P75.02	Local CAN master/slave address	0–15	Set to 1 (1 indicates slave 1).

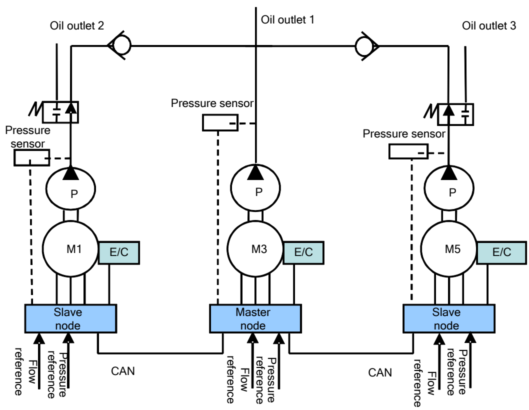
Function code	Name	Setting range	Description
P75.04	Multi-pump flow combining type	0–4	Set based on the multi-pump flow combining type. In the example above, set to 2 (multi-pump)

Note: For detailed descriptions of relevant parameters, refer to Appendix F Function parameter list.

6.8.2 Hybrid mode

The system supports two control modes: combined-flow control and split-flow control. The control mode of each node is switched via digital DI input signals. In split-flow control, each node operates as an independent single-loop hydraulic system, performing its own flow and pressure control. In combined-flow control, the operation is identical to the multi-pump mode. The master node performs pressure control and total system flow control. The slave nodes simply receive the flow command transmitted via CAN communication and perform speed control.

Figure 6-3 Hybrid mode system



■ Master parameter settings

Function code	Name	Setting range	Description
P00.01	Channel of running commands	0–2	1: Terminal
P05.01	Function of DI1	0–95	1: Forward running
P05.03	Function of DI3	0–95	7: Fault reset
P05.05	Function of DI5	0–95	82: CAN master/slave network enable
P73.01	Pressure and flow command source selection	0–10	Set according to the master command source.
P73.04	Max. local reference pressure	0.0bar–P73.71	Set according to master requirements.
P73.05	Max. local output flow	0.0L/min–P73.36	Set according to master requirements.
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid 1: CAN master/slave 2: CANopen communication	Set to 1.
P75.02	Local CAN master/slave address	0–15	Set to 0 (0 indicates the master).
P75.03	Multi-pump slave node count	0–15	Set according to the number of slave nodes. In the example shown above (2 slaves), set the value to 2.
P75.04	Multi-pump flow combining type	0–4	Set according to the multi-pump flow combining type. In the example shown above, set the value to 1 (hybrid).
P75.08	Multi-pump flow cut-in threshold	0.0–100.0%	The cut-in ratio is based on the local pump's maximum output flow (P73.05).
P75.09	Multi-pump flow cut-in hysteresis upper limit	0.0–100.0%	
P75.10	Multi-pump flow cut-in hysteresis lower limit	0.0%–P75.09	

- Slave parameter setting

Function code	Name	Setting range	Description
P00.01	Channel of running commands	0–2	1: Terminal **Note:** This function is invalid when the slave is in combined flow control mode.
P05.01	Function of DI1	0–95	1: Forward running **Note:** This function is invalid when the slave is in combined flow control mode.
P05.03	Function of DI3	0–95	7: Fault reset
P05.04	Function of DI4	0–95	73: Flow splitting/combining selection
P05.05	Function of DI5	0–95	82: CAN master/slave network enable
P73.04	Max. local reference pressure	0.0bar–P73.71	Set according to slave requirements.
P73.05	Max. local output flow	0.0L/min–P73.36	Set according to slave requirements.
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid 1: CAN master/slave 2: CANopen communication	Set to 1.
P75.02	Local CAN master/slave address	0–15	Set to 1 (1 indicates slave 1).
P75.04	Multi-pump flow combining type	0–4	Set according to the multi-pump flow combining type. In the example shown above, set the value to 1 (hybrid).

Note: For detailed descriptions of relevant parameters, refer to Appendix F Function parameter list.

6.8.3 Communication with two modes

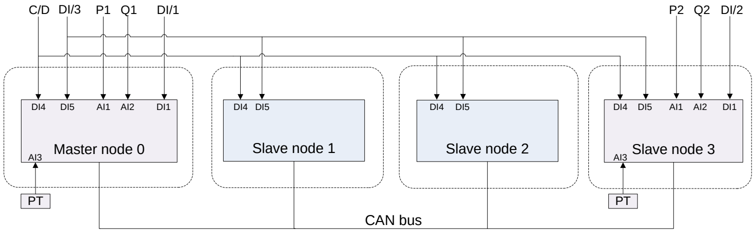
In this mode, there is one master node (single-pump system), and multiple slave nodes (single-pump systems). The flow-splitting/combining selection terminals are used to configure which slave nodes combine flow with the master node. There are two types of slave node splitting and combining configurations.

Flow splitting/combining selection	CAN slave node address selection
Low	Multi-pump slave flow splitting and combining 1
High	Multi-pump slave flow splitting and combining 2

P75.11 (multi-pump slave flow splitting and combining 1) and P75.12 (multi-pump slave flow splitting and combining 2): used to select a slave node with the flow combined with the master node. A total of 15 slave nodes can be set. The value 1 of a bit indicates combining flow with the master node, while the value 0 indicates splitting flow and independent oil pump control. Set bit 0 to 1 for the master node to combine flow with slave nodes; set bit 0 to 0 for the master node to operate independently.

CAN slave node address Hexadecimal range: 0x0000–0xffff Decimal range: 0–65535															
16-bit integer, each bit corresponding to a node															
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Slave node No. 15	Slave node No. 14	Slave node No. 13	Slave node No. 12	Slave node No. 11	Slave node No. 10	Slave node No. 9	Slave node No. 8	Slave node No. 7	Slave node No. 6	Slave node No. 5	Slave node No. 4	Slave node No. 3	Slave node No. 2	Slave node No. 1	Slave node No. 0

Figure 6-4 Wiring diagram for communication with two modes



PT: Pressure sensor   P1–P2: Pressure command   Q1–Q2: Flow command

DI/1–DI/2: Drive enabling   C/D: Flow splitting/combining selection   DI/3: CAN network enabling

Example: The hydraulic system has four pumps, with the addresses set to 0, 1, 2, and 3. The following two operating configurations are available:

Using slave flow splitting and combining 1 (P75.11 = 0x0007)

Master node 0 combines flow with slave nodes 1 and 2. Slave node 3 operates in split flow mode and is switched to operate independently.

Using slave flow splitting and combining 2 (P75.12 = 0x000f)

The four nodes combine the flow.

- Master parameter settings

Function code	Name	Setting range	Description
P05.01	Function of DI1	0–95	1: Forward running
P05.04	Function of DI4	0–95	73: Flow splitting/combining selection
P05.05	Function of DI5	0–95	82: CAN master/slave network enable
P73.01	Pressure and flow command source selection	0–10	Set according to the master command source.
P73.04	Max. local reference pressure	0.0bar–P73.71	Set according to master requirements.
P73.05	Max. local output flow	0.0L/min–P73.36	Set according to master requirements.
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid	Set to 1.

Function code	Name	Setting range	Description
		1: CAN master/slave 2: CANopen communication	
P75.02	Local CAN master/slave address	0–15	Set to 0 (0 indicates the master).
P75.03	Multi-pump slave node count	0–15	Set according to the number of slave nodes. In the example shown above (3 slaves), set the value to 3.
P75.04	Multi-pump flow combining type	0–4	Set according to the multi-pump flow combining type. In the example shown above, set to 3 (communication with two modes).
P75.08	Multi-pump flow cut-in threshold	0.0–100.0%	The cut-in ratio is based on the local pump's maximum output flow (P73.05).
P75.09	Multi-pump flow cut-in hysteresis upper limit	0.0–100.0%	
P75.10	Multi-pump flow cut-in hysteresis lower limit	0.0%–P75.09	
P75.11	Multi-pump slave flow splitting and combining 1	0x0000–0xFFFF	0x0007
P75.12	Multi-pump slave flow splitting and combining 2	0x0000–0xFFFF	0x000F

■ Slave parameter setting

Function code	Name	Setting range	Description
P05.01	Function of DI1	0–95	1: Forward running **Note:** This function is invalid when the slave is in combined flow control mode.
P05.04	Function of DI4	0–95	Set to 73: flow splitting/combining selection.

Function code	Name	Setting range	Description
P05.05	Function of DI5	0–95	82: CAN master/slave network enable
P73.04	Max. local reference pressure	0.0bar–P73.71	Set according to slave requirements.
P73.05	Max. local output flow	0.0L/min–P73.36	Set according to slave requirements.
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid 1: CAN master/slave 2: CANopen communication	Set to 1.
P75.02	Local CAN master/slave address	0–15	Set to 1 (1 indicates slave 1).
P75.04	Multi-pump flow combining type	0–4	Set according to the multi-pump flow combining type. In the example shown above, set to 3 (communication with two modes).
P75.11	Multi-pump slave flow splitting and combining 1	0x0000–0xFFFF	0x0007
P75.12	Multi-pump slave flow splitting and combining 2	0x0000–0xFFFF	0x000F

Note: For detailed descriptions of relevant parameters, refer to Appendix F Function parameter list.

6.8.4 Communication with four modes

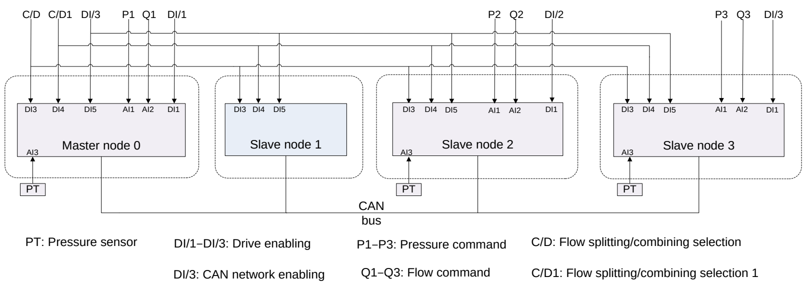
In the communication with four modes, there is one master node (single-pump system), and multiple slave nodes (single-pump systems). The flow-splitting/combining selection (or selection 1) terminal is used to configure which slave nodes combine flow with the master node. There are two types of slave node splitting and combining configurations.

Flow splitting/combining selection	Flow splitting/combining selection 1	CAN slave node address selection
Low	Low	Multi-pump slave flow splitting and combining 1
Low	High	Multi-pump slave flow splitting and combining 2
High	Low	Multi-pump slave flow splitting and combining 3
High	High	Multi-pump slave flow splitting and combining 4

P75.11, P35.12, P75.13, P35.14 (multi-pump slave flow splitting and combining 1, 2, 3, and 4): Used to configure which slave nodes combine flow with the master node, supporting settings for up to 15 slave nodes. A bit value of 1 indicates combining flow with the master node, while a bit value of 0 indicates splitting flow and independent hydraulic pump control. Set bit 0 to 1 for the master node to combine flow with slave nodes; set bit 0 to 0 for the master node to operate independently.

CAN slave node address Hexadecimal range: 0x0000–0xffff Decimal range: 0–65535															
16-bit integer, each bit corresponding to a node															
Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Slave node No. 15	Slave node No. 14	Slave node No. 13	Slave node No. 12	Slave node No. 11	Slave node No. 10	Slave node No. 9	Slave node No. 8	Slave node No. 7	Slave node No. 6	Slave node No. 5	Slave node No. 4	Slave node No. 3	Slave node No. 2	Slave node No. 1	Slave node No. 0

Figure 6-5 Wiring diagram for communication with four modes



Example: The hydraulic system has four oil pumps, with the addresses set to 0, 1, 2, and 3. The following four operating configurations are available:

Using multi-pump slave flow splitting and combining 1 (P75.11 = 0x0003)

Master node 0 combines flow with slave node 1. Slave node 2 and 3 operates in split flow mode and are switched to operate independently .

Using multi-pump slave flow splitting and combining 2 (P75.12 = 0x0007)

Master node 0 combines flow with slave nodes 1 and 2. Slave node 3 operates in split flow mode and is switched to operate independently.

Using slave flow splitting and combining 3 (P75.13 = 0x000b)

Master node 0 combines flow with slave nodes 1 and 3. Slave node 2 operates in split flow mode and is switched to operate independently.

Using slave flow splitting and combining 4 (P75.14 = 0x000f)

The four nodes combine the flow.

■ Master and slave parameter settings

The communication with 4 modes is the same as the communication with 2 modes. Compared with the communication with 2 modes, the communication with 4 modes provides one additional DI input terminal (73: flow splitting/combining selection 1), enabling two additional configurations for slave flow splitting and combining: P75.13 (multi-pump slave flow splitting and combining 3) and P75.14 (multi-pump slave flow splitting and combining 4).

6.8.5 Other parameter settings

Function code	Name	Setting range	Description
P75.05	Local CAN network enabling	0–1	Set to 1 to enable the CAN master/slave communication network. **Note:** This function is consistent with DI terminal 82: CAN M/S enabling.
P75.06	Local CAN baud rate	0–5	Default: 4: 500Kbps **Note:** Master and slave settings must be consistent.
P75.07	Local CAN timeout time	0.0–60.0s	-

Function code	Name	Setting range	Description
P75.23	Master action selection on multi-pump slave fault	0x00–0x11 Ones place: Slave offline 0: Report an alarm 1: Report a fault Tens place: Slave fault 0: Report an alarm 1: Report a fault	Default: 0x11 **Note:** When the combining pumps do not have check valves, the master action must be set to 0x11.
P75.16	Multi-pump speed gain	0.1–3000.0	**Note:** When the master pump flow cut-in threshold (P75.08) is set to 0.0% (i.e., slave pumps follow the master pump): If there are two pumps in total, set the value to 200.0 for each drive. If there are three pumps in total, set the value to 300.0 for each drive.

6.9 Monitoring parameters

Monitoring parameters mainly fall in groups P07, P17, P18, and P29, which are used to view and analyze the drive control and use status. The monitored content is listed in the following.

Group	Type	Monitored content
P07	HMI	Drive information, module temperature, run time, power usage, fault history, and software version.
P17	Basic status viewing	● Frequency information ● Current information ● Voltage information ● Torque and power information ● Input terminal information ● Output terminal information ● Control word (CW) and status word (SW) information

Group	Type	Monitored content
P18	Status viewing in closed-loop control	● Encoder-based speed detection information ● Pulse reference based speed detection information ● Encoder position information ● Pulse reference position information
P19	Expansion card status viewing	● Expansion card information ● IO card input terminal information ● IO card output terminal information ● Communication card CWs and SWs
P76	Electro-hydraulic status monitoring	● Flow and pressure reference information ● Pressure feedback information ● Motor temperature information ● PID switching status information ● Multi-pump status information

6.9.1 HMI

Function code	Name	Default	Setting range	Description
P07.11	Rectifier bridge module temperature	0.0°C	-20.0–120.0°C	-
P07.12	Inverter module temperature	0.0°C	-20.0–120.0°C	-
P07.13	Control board software version	Version depended	1.00–655.35	-
P07.14	Accumulative operating time	0h	0–65535h	-
P07.15	Drive electricity consumption MSB	0kkWh	0–65535kkWh	Displays the electricity consumption of the drive. Drive electricity consumption = P07.16 + P07.15 * 1000
P07.16	Drive electricity consumption LSB	0kWh	0.0–999.9kWh	
P07.18	Drive rated power	Model depended	0.4–3000.0kW	-
P07.19	Drive rated voltage	Model depended	50–1200V	-
P07.20	Drive rated current	Model depended	0.1–6000.0A	-

Function code	Name	Default	Setting range	Description
P07.27	Type of present fault	0	0–700	0: No fault 1: Inverter unit U-phase protection (E1) 2: Inverter unit V-phase protection (E2) 3: Inverter unit W-phase protection (E3) 4: Overcurrent during ACC (E4) 5: Overcurrent during DEC (E5) 6: Overcurrent during constant speed running (E6) 7: Overvoltage during ACC (E7) 8: Overvoltage during DEC (E8) 9: Overvoltage during constant speed running (E9) 10: DC bus undervoltage (E10) For details about fault information, see section 8.2 Faults and solutions.
P07.28	Last fault type	0		
P07.29	2nd-last fault type	0		
P07.30	3rd-last fault type	0		
P07.31	4th-last fault type	0		
P07.32	5th-last fault type	0		
P07.33	Running frequency at present fault	0.00Hz	0.00Hz–P00.03	-
P07.34	Ramp reference frequency at present fault	0.00Hz	0.00Hz–P00.03	-
P07.35	Output voltage at present fault	0V	0–1200V	-
P07.36	Output current at present fault	0.0A	0.0–6300.0A	-
P07.37	Bus voltage at present fault	0.0V	0.0–2000.0V	-
P07.38	Max. temperature at present fault	0.0°C	-20.0–120.0°C	-
P07.39	Input terminal state at present fault	0x0000	0x0000–0xFFFF	-
P07.40	Output terminal state at present fault	0x0000	0x0000–0xFFFF	-
P07.41	Pressure feedback value at present fault	0.0bar	0.0–500.0bar	

Function code	Name	Default	Setting range	Description
P07.42	Running frequency at last fault	0.00Hz	0.00Hz–P00.03	
P07.43	Ramp reference frequency at last fault Reference frequency	0.00Hz	0.00Hz–P00.03	-
P07.44	Output voltage at last fault	0V	0–1200V	-
P07.45	Output current at last fault	0.0A	0.0–6300.0A	-
P07.46	Bus voltage at last fault	0.0V	0.0–2000.0V	-
P07.47	Temperature at last fault	0.0°C	-20.0–120.0°C	-
P07.48	Input terminal state at last fault	0x0000	0x0000–0xFFFF	-
P07.49	Output terminal state at last fault	0x0000	0x0000–0xFFFF	-
P07.50	Pressure feedback value at last fault	0.0bar	0.0–500.0bar	
P07.51	Running frequency at 2nd-last fault	0.00Hz	0.00Hz–P00.03	-
P07.52	Ramp reference frequency at 2nd-last fault	0.00Hz	0.00Hz–P00.03	-
P07.53	Output voltage at 2nd-last fault	0V	0–1200V	-
P07.54	Output current at 2nd-last fault	0.0A	0.0–6300.0A	-
P07.55	Bus voltage at 2nd-last fault	0.0V	0.0–2000.0V	-
P07.56	Temperature at 2nd-last fault	0.0°C	-20.0–120.0°C	-
P07.57	Input terminal state at 2nd-last fault	0x0000	0x0000–0xFFFF	-

Function code	Name	Default	Setting range	Description
P07.58	Output terminal state at 2nd-last fault	0x0000	0x0000–0xFFFF	-
P07.59	Pressure feedback value at 2nd-last fault	0.0bar	0.0–500.0bar	

6.9.2 Basic status viewing

6.9.2.1 Basic status viewing

Function code	Name	Default	Setting range	Description
P17.12	Digital input terminal state	0x00	0x00–0x3F	Displays the present digital input terminal state of the drive. The bits correspond to DI5, DI4, DI3, DI2, and DI1 respectively.
P17.13	Digital output terminal state	0x00	0x00–0x0F	Displays the present digital output terminal state of the drive. The bits correspond to RO2, RO1, and DO1 respectively.
P17.40	Motor control mode	0x000	0x000–0x123	Ones place: Control mode 0: Vector 0 1: Vector 1 2: V/F control 3: Closed-loop vector control Tens place: Control state 0: Speed control 1. Torque control 2: Position control Hundreds place: Motor number 0: Motor 1 1: Reserved **Note:** The control state of the tens place represents the control state during operation.

6.9.2.2 Frequency related information

Function code	Name	Default	Setting range	Description
P17.00	Set frequency	0.00Hz	0.00Hz–P00.03	Displays the present set frequency of the drive.
P17.01	Output frequency	0.00Hz	0.00Hz–P00.03	Displays the present output frequency of the drive.
P17.02	Ramp reference frequency	0.00Hz	0.00Hz–P00.03	Displays the present ramp reference frequency of the drive.
P17.05	Motor speed	0rpm	0–65535rpm	Displays the present motor speed.
P17.10	Estimated motor frequency	0.00Hz	0.00Hz–P00.03	Displays the estimated motor rotor frequency under the open-loop vector condition.
P17.16	Linear speed	0	0–65535	-
P17.43	Forward rotation frequency upper limit in torque control	0.00Hz	0.00Hz–P00.03	-
P17.44	Reverse rotation frequency upper limit in torque control	0.00Hz	0.00Hz–P00.03	-
P17.49	A source frequency reference	0.00Hz	0.00Hz–P00.03	-

6.9.2.3 Voltage related information

Function code	Name	Default	Setting range	Description
P17.03	Output voltage	0V	0–1200V	Displays the present output voltage of the drive.
P17.11	DC bus voltage	0.0V	0.0–2000.0V	Displays the present DC bus voltage of the drive.
P17.19	AI1 input voltage	0.00V	0.00–10.00V	Displays the AI1 input signal.
P17.20	AI2 input voltage	0.00V	-10.00–10.00V	Displays the AI2 input signal.
P17.21	AI3 input voltage	0.00V	-10.00–10.00V	Displays the AI3 input signal.

6.9.2.4 Current related information

Function code	Name	Default	Setting range	Description
P17.04	Output current	0.0A	0.0–5000.0A	Displays the valid value of the present output current.
P17.06	Torque current	0.0A	-3000.0–3000.0A	Displays the present torque current of the drive.
P17.07	Exciting current	0.0A	-3000.0–3000.0A	Displays the present exciting current of the drive.
P17.33	Exciting current reference	0.0A	-3000.0–3000.0A	Displays the exciting current reference value under the vector control mode.
P17.34	Torque current reference	0.0A	-3000.0–3000.0A	Displays the torque current reference value under the vector control mode.
P17.35	AC incoming current	0.0A	0.0–5000.0A	Displays the valid value of incoming current on AC input side.

6.9.2.5 Torque and power related information

Function code	Name	Default	Setting range	Description
P17.08	Motor power	0.0%	-300.0–300.0% (of the motor rated power)	Displays the present motor power. 100% corresponds to the motor rated power. A positive value indicates the motoring state while a negative value indicates the generating state.
P17.09	Motor output torque	0.0%	-250.0–250.0%	Displays the present output torque of the drive. 100% corresponds to the motor rated torque. During forward running, the positive value is the motoring state while the negative value is generating state. During reverse running, the positive value is the generating state while the negative value is the motoring state.

Function code	Name	Default	Setting range	Description
P17.15	Torque reference value	0.0%	-300.0–300.0% (of the motor rated current)	Indicates the percentage of the rated torque of the present motor, displaying the torque reference.
P17.25	Motor power factor	1.00	-1.00–1.00	Displays the power factor of the present motor.
P17.36	Output torque	0.0N・m	-3000.0–3000.0 N・m	Displays the output torque value. During forward running, the positive value is the motoring state while the negative value is generating state. During reverse running, the positive value is the generating state while the negative value is the motoring state.
P17.41	Electromotive torque upper limit	0.0%	0.0–300.0% (of the motor rated current)	-
P17.42	Braking torque upper limit	0.0%	0.0–300.0% (of the motor rated current)	-
P17.45	Inertia compensation torque	0.0%	-100.0–100.0%	-
P17.46	Friction compensation torque	0.0%	-100.0–100.0%	-

6.9.3 Status viewing in closed-loop control

Function code	Name	Default	Setting range	Description
P18.00	Encoder detected frequency	0.0Hz	-999.9–3276.7Hz	Indicates the actual-measured encoder frequency. The value of forward running is positive; the value of reverse running is negative.
P18.01	Encoder position count value	0	0–65535	Encoder count value, quadruple frequency.
P18.02	Encoder Z pulse count value	0	0–65535	Corresponding count value of encoder Z pulse.
P18.14	PG card pulse feedback count MSB	0	0–65535	Indicates the encoder pulse count value. The count value is accumulated only if the drive is powered on.
P18.15	PG card pulse feedback count LSB	0	0–65535	Indicates the encoder pulse count value. The count value is accumulated only if the drive is powered on.

6.9.4 Expansion card status viewing

<table>
<tr><th>Function code</th><th>Name</th><th>Default</th><th>Setting range</th><th>Description</th></tr>
<tr><td>P19.00</td><td>Expansion card type of card slot 1</td><td rowspan="2">0</td><td rowspan="2">0–100</td><td rowspan="2">0: No card
1: Reserved
2: I/O card
3: Incremental PG card
4: Incremental PG card with UVW
5: Ethernet communication card
6: DP communication card
7–8: Reserved
9: CANopen communication card
10: Reserved
Refer to Appendix F Function parameter list (P19.01) for expansion card types.</td></tr>
<tr><td>P19.01</td><td>Expansion card type of card slot 2</td></tr>
</table>

Function code	Name	Default	Setting range	Description
P19.03	Software version of expansion card in slot 1	0.00	0.00–655.35	-
P19.04	Software version of expansion card in slot 2	0.00	0.00–655.35	-
P19.06	Terminal input state of I/O card	0x0000	0x0000–0xFFFF	-
P19.07	Terminal output state of I/O card	0x0000	0x0000–0xFFFF	-
P76.17	Encoder detected speed	0rpm	30000–30000rpm	-

6.9.5 Electro-hydraulic status monitoring

6.9.5.1 Basic status viewing

Function code	Name	Default	Setting range	Description
P76.00	Local flow set value	0.0L/min	0.0–2400.0L/min	-
P76.01	Local flow command value	0.0L/min	-2400.0–2400.0L/min	-
P76.02	Local pressure set value	0.0bar	0.0–750.0bar	-
P76.03	Local pressure command value	0.0bar	0.0–750.0bar	-
P76.04	Local pressure feedback value	0.0bar	0.0–750.0bar	-
P76.07	Present PID step	0	0–3	-
P76.08	Present internal multi-step reference	1	1–8	-
P76.13	Motor temperature	0°C	-40–150°C	-
P76.14	AI1 input voltage	0.00V	0.00–10.00V	-
P76.15	AI2 input voltage	0.00V	-10.00–10.00V	-
P76.16	AI3 input voltage	0.00 V	0.00–10.00V	-
P76.27	DC bus voltage utilization	0.0%	0.0–150.0%	-

Function code	Name	Default	Setting range	Description
P76.29	Electro-hydraulic alarm code	0	0–10000	-
P76.31	AI3 AD sampling value	0	0–4095	-
P76.32	Pressure feedback value after zero-drift calibration	0	0–65535	-
P76.38	AD sampling value from AI1 zero drift detection	0	0–1000	-
P76.39	AD sampling error value from AI2 zero drift detection	0	-1000–1000	-
P76.40	AD sampling error value from AI3 zero drift detection	0	-1000–1000	-

6.9.5.2 Electro-hydraulic multi-pump information

Function code	Name	Default	Setting range	Description
P76.05	Multi-pump system maximum pressure	0.0bar	0.0–750.0bar	-
P76.06	Multi-pump system maximum flow	0.0L/min	0.0–2400.0L/min	-
P76.09	Flow combining type	0	0–3	-
P76.10	Multi-pump communication state	0	0–15	-
P76.11	CAN communication sent count	0	0–65535	-
P76.12	CAN communication receive count	0	0–65535	-
P76.28	CAN slave online state in M/S mode	0x0000	0x0000–0xFFFF	-

7 Communication

7.1 Standard communication interface

The drive is equipped with RS485/CANopen communication as standard. The communication interface and terminal definitions are as follows.

Table 7-1 Standard communication terminals

Interface type	Network signal	Signal description	Description
IO terminal	485+ 485-	RS485 communication	External RS485 communication terminal, supporting the Modbus communication protocol.
	CANH CANL	CAN communication	External CAN communication terminal, supporting CANopen protocol.

7.2 Modbus networking

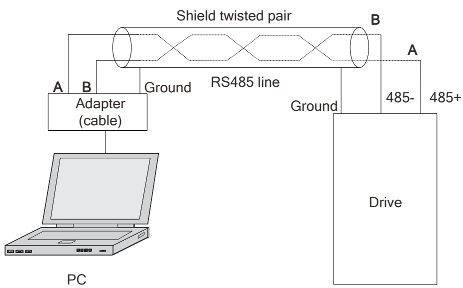
A Modbus network is a control network with one master and multiple slaves, that is, on one Modbus network, there is only one device serving as the master, and other devices are the slaves. The master can communicate with any single slave or with all slaves. For individual commands, a slave needs to return a response. For broadcast information, the slaves do not need to return responses.

Generally, a PC, industrial control device, or programmable logic controller (PLC) functions as the master, while drives function as slaves.

7.2.1 Network topology

7.2.1.1 Application to one drive

Figure 7-1 Application to one drive



7.2.1.2 Application to multiple drives

In practical multi-drive applications, daisy chain and star topologies are commonly used. 120Ω terminal resistors must be connected at both ends of the bus, as shown in Figure 7-2.

Figure 7-2 Daisy chain connection

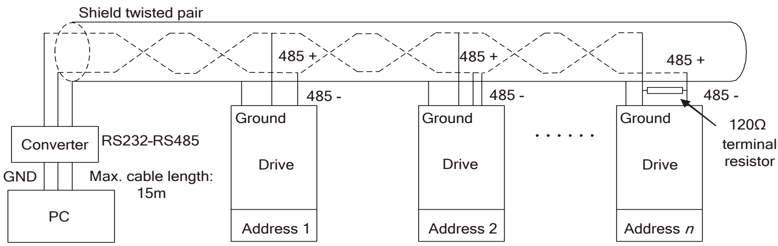
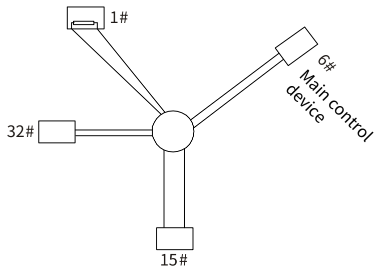


Figure 7-3 shows the star connection. When this connection mode is adopted, terminal resistors must be installed on the two devices farthest apart on the line (devices #1 and #15).

Figure 7-3 Star connection



Use shielded cables, if possible, in multi-device connection. The baud rates, data bit check settings, and other basic parameters of all the devices on the RS485 line must be set consistently, and addresses cannot be duplicated.

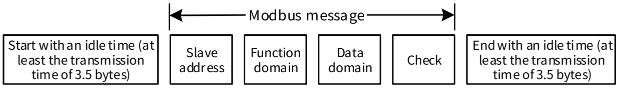
7.2.2 RTU mode

7.2.2.1 RTU communication frame structure

When a controller is set to use the RTU communication mode on a Modbus network, every byte (including 8 bits) in the message includes 2 hexadecimal characters (each includes 4 bits). Compared with the ASCII mode, the RTU mode achieves transmission of more data at the same baud rate.

In RTU mode, the transmission of a new frame always starts from an idle time (the transmission time of 3.5 bytes). On a network where the transmission rate is calculated based on the baud rate, the transmission time of 3.5 bytes can be easily obtained. After the idle time ends, the data domains are transmitted in the following sequence: slave address, command code, data, and CRC check character. Each byte transmitted in each domain includes 2 hexadecimal characters (0–9, A–F). The network devices constantly monitor the communication bus. When the first domain (the address information) is received, each device verifies the byte. After the last byte is transmitted, a similar transmission interval (the transmission time of 3.5 bytes) is used to indicate that the transmission of the frame ends. Then, the transmission of a new frame starts.

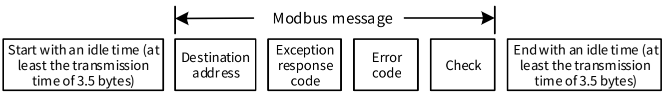
RTU data frame format



The information of a frame must be transmitted in a continuous data flow. If there is an interval greater than the transmission time of 1.5 bytes before the transmission of the entire frame is complete, the receiving device deletes the incomplete information, and mistakes the subsequent byte for the address domain of a new frame. Similarly, if the transmission interval between two frames is shorter than the transmission time of 3.5 bytes, the receiving device mistakes it for the data of the last frame. The CRC check value is incorrect due to the disorder of the frames, and thus a communication fault occurs.

If the slave detects a communication fault or read/write failure due to another cause, an error frame is replied.

RTU data frame format



The following table describes the standard structure of an RTU frame.

START (frame header)	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR (slave address domain)	Communication address: 0–247 (decimal system; 0 is the broadcast address)
CMD (function domain)	03H: Read slave parameter; 06H: Write slave parameter
Data domain DATA (N-1)...DATA(0)	Data of 2*N bytes Main content of the communication as well as the core of data exchanging
CRC CHK LSB	Detection value: CRC verification value (16 bits)
CRC CHK MSB	
END (frame tail)	T1-T2-T3-T4 (transmission time of 3.5 bytes)

7.2.2.2 RTU communication frame error check methods

During the transmission of data, errors may occur due to various factors. Without error check, the data receiving device cannot identify data errors and may make an incorrect response. The incorrect response may cause severe problems. Therefore, the data must be checked.

The error check of a frame includes two parts, namely, bit check on individual bytes (that is, odd/even check using the check bit in the character frame), and whole data check (CRC check).

7.2.2.3 Bit check on individual bytes (odd/even check)

You can select the bit check mode as required, or choose not to perform the check, which will affect the check bit setting of each byte.

Definition of even check: Before the data is transmitted, an even check bit is added to indicate whether the number of "1" in the to-be-transmitted data is odd or even. If it is even, the check bit is set to "0"; if it is odd, the check bit is set to "1".

Definition of odd check: Before the data is transmitted, an odd check bit is added to indicate whether the number of "1" in the to-be-transmitted data is odd or even. If it is odd, the check bit is set to "0"; if it is even, the check bit is set to "1".

For example, the data bits to be sent are "11001110", including five "1". If the even check is applied, the even check bit is set to "1"; if the odd check is applied, the odd check bit is set to "0". During the transmission of the data, the odd/even check bit is calculated and placed in the check bit of the frame. The receiving device performs the odd/even check after receiving the data. If it finds that the odd/even parity of the data is inconsistent with the preset information, it determines that a communication error occurs.

7.2.2.4 Cyclic redundancy check (CRC)

A frame in the RTU format includes an error detection domain based on the CRC calculation. The CRC domain checks all the content of the frame. The CRC field consists of two bytes, including 16 binary bits. It is calculated by the transmitter and added to the frame. The receiver calculates the CRC of the received frame, and compares the result with the value in the received CRC domain. If the two CRC values are not equal to each other, errors occur in the transmission.

The CRC calculation is initialized with 0xFFFF. Then, a CRC routine is invoked to process a minimum of 6 contiguous bytes in the frame based on the value in the current register. CRC is valid only for the 8-bit data in each character. It is invalid for the start, stop, and parity bits.

During the CRC generation process, each 8-bit character is individually XORed with the register content. The result is shifted towards the Least Significant Bit (LSB), with the Most

Significant Bit (MSB) filled with 0. Then, LSB is checked. If LSB is 1, the register is XORed with the preset value. If LSB is 0, no operation is performed. This process is repeated 8 times. After the last bit (8th bit) is detected and processed, the XOR operation is performed on the next 8-bit byte and the current content in the register. The final values in the register are the CRC values obtained after operations are performed on all the bytes in the frame.

The calculation adopts the international standard CRC check rule. You can refer to the related standard CRC algorithm to compile the CRC calculation program as required.

The following example is a simple CRC calculation function for your reference (using the C programming language):

```
unsigned int crc_cal_value（unsigned char*data_value,unsigned char data_length）
{
    int i;
    unsigned int crc_value=0xffff;
    while（data_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）;
}
```

In ladder logic, CKSM uses the table look-up method to calculate the CRC value according to the content in the frame. The program of this method is simple, and the calculation is fast, but the ROM space occupied is large. Use this program with caution in scenarios where there are space occupation requirements on programs.

7.2.3 RTU command code

7.2.3.1 Command code 03H, reading *N* words (continuously up to 16 words)

The command code 03H is used by the master to read data from the drive. The count of data to be read depends on the "data count" in the command. A maximum of 16 pieces of data can be read. The parameter addresses to be read must be continuous. Each piece of data occupies 2 bytes, that is, one word. The command format is presented using the hexadecimal system (a number followed by "H" indicates a hexadecimal value). One hexadecimal value occupies one byte.

The 03H command is used to read information including the parameters and running status of the drive.

For example, if the master reads two contiguous pieces of data (that is, to read content from the data addresses 0004H and 0005H) from the drive whose address is 01H, the frame structures are described in the following.

RTU master command (from the master to the drive)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR (address)	01H
CMD (command code)	03H
Start address MSB	00H
Start address LSB	04H
Data count MSB	00H
Data count LSB	02H
CRC LSB	85H
CRC MSB	CAH
End	T1-T2-T3-T4 (transmission time of 3.5 bytes)

"T1-T2-T3-T4 (transmission time of 3.5 bytes)" in "START" and "END" indicates that the RS485 communication needs to be idle for at least the transmission time of 3.5 bytes. An idle time is required to distinguish one message from another to ensure that the two messages are not regarded as one.

ADDR=01H means the command message is sent to the drive with the address of 01H and ADDR occupies one byte.

CMD=03H means the command message is sent to read data from the drive and CMD occupies one byte.

"Start address" means the address from which data reading starts. "Start address" occupies two bytes, with the MSB on the left and LSB on the right.

"Data count" indicates the count of data to be read (unit: word). "Start address" is "0004H" and "Data count" is "0002H", which indicates reading data from the addresses 0004H and 0005H.

CRC occupies two bytes with the MSB on the left and LSB on the right.

RTU slave response (from the drive to the master)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	01H
CMD	03H
Number of bytes	04H
Address 0004H data MSB	13H
Address 0004H data LSB	88H
Address 0005H data MSB	00H
Address 0005H data LSB	00H
CRC LSB	7EH
CRC MSB	9DH
End	T1-T2-T3-T4 (transmission time of 3.5 bytes)

The definition of the response information is described as follows:

"ADDR" is "01H", indicating that the command is sent from the drive whose address is 01H. "ADDR" occupies one byte.

"CMD" is "03H", indicating that the message is a drive response to the 03H command from the master for reading data. "CMD" occupies one byte.

"Number of bytes" indicates the number of bytes between a byte (not included) and the CRC byte (not included). The value "04" indicates that there are four bytes of data between "Number of bytes" and "CRC LSB", that is, "Address 0004H data MSB", "Address 0004H data LSB", "Address 0005H data MSB", and "Address 0005H data LSB".

A record of data contains two bytes, with the MSB on the left and LSB on the right. From the response, the data in 0004H is 1388H, and that in 0005H is 0000H.

CRC occupies two bytes with the MSB on the left and LSB on the right.

7.2.3.2 Command code: 06H, writing a word

This command is used by the master to write data to the drive. One command can be used to write only one piece of data. It is used to modify the parameters and running mode of the drive.

For example, write 5000 (1388H) into address 0004H of the drive with the slave address 02H.

RTU master command (from the master to the drive)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	06H
Write data address MSB	00H
Write data address LSB	04H
Data content MSB	13H
Data content LSB	88H
CRC LSB	C5H
CRC MSB	6EH
End	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU slave response (from the drive to the master)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	06H
Write data address MSB	00H
Write data address LSB	04H
Data content MSB	13H
Data content LSB	88H
CRC LSB	C5H
CRC MSB	6EH
End	T1-T2-T3-T4 (transmission time of 3.5 bytes)

7.2.3.3 Command code: 10H, continuous writing

The command code 10H is used by the master to write data to the drive. The quantity of data to be written is determined by "Data count", and a maximum of 16 pieces of data can be written.

For example: Write 5000 (1388H) and 50 (0032H) to 0004H and 0005H of the drive (as the slave) whose address is 02H.

RTU master command (from the master to the drive)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	10H
Write data address MSB	00H
Write data address LSB	04H
Data count MSB	00H

Data count LSB	02H
Number of bytes	04H
MSB of data to be written to 0004H	13H
LSB of data to be written to 0004H	88H
MSB of data to be written to 0005H	00H
LSB of data to be written to 0005H	32H
CRC LSB	C5H
CRC MSB	6EH
End	T1-T2-T3-T4 (transmission time of 3.5 bytes)

RTU slave response (from the drive to the master)

START	T1-T2-T3-T4 (transmission time of 3.5 bytes)
ADDR	02H
CMD	10H
Write data address MSB	00H
Write data address LSB	04H
Data count MSB	00H
Data count LSB	02H
CRC LSB	C5H
CRC MSB	6EH
End	T1-T2-T3-T4 (transmission time of 3.5 bytes)

7.2.4 Data address definition

This section describes the address definition of communication data. The addresses are used for controlling the running, obtaining the state information, and setting related function parameters of the drive.

7.2.4.1 Function code address format rules

The address of a function code consists of two bytes, with the MSB on the left and LSB on the right. The MSB ranges from 00 to ffH, and the LSB also ranges from 00 to ffH. The MSB is the hexadecimal form of the group number before the dot mark, and LSB is that of the number behind the dot mark. Take P05.06 as an example: The group number is 05, that is, the MSB of the parameter address is the hexadecimal form of 05; and the number behind the dot mark is 02, that is, the LSB is the hexadecimal form of 02. Therefore, the function code address is 0506H in the hexadecimal form. For P10.01, the parameter address is 0A01H.

Note:

- The parameters in the P99 group are set by the manufacturer and cannot be read or modified. Some parameters cannot be modified when the drive is running; some cannot be modified regardless of the drive status. Pay attention to the setting range, unit, and description of a parameter when modifying it.
- The service life of the Electrically Erasable Programmable Read-Only Memory (EEPROM) may be reduced if it is frequently used for storage. Some function codes do not need to be stored during communication. The application requirements can be met by modifying the value of the on-chip RAM, that is, modifying the MSB of the corresponding function code address from 0 to 1. For example, if P00.07 is not to be stored in the EEPROM, you need only to modify the value of the RAM, that is, set the address to 8007H. The address can be used only for writing data to the on-chip RAM, and it is invalid when used for reading data.

7.2.4.2 Address description of other Modbus functions

In addition to modifying the parameters of the drive, the master can also control the drive, such as starting and stopping the drive, and monitoring the running status of the drive. The following table lists other function parameters.

Table 7-2 Addresses of other function parameters

Function	Address definition	Data description	R/W
Communication-based control command	2000H	0001H: Run forward	R/W
		0002H: Run reversely	
		0003H: Jog forward	
		0004H: Jog reversely	
		0005H: Stop	
		0006H: Coast to stop	
		0004H: Fault reset	
		0008H: Stop jogging	
Communication-based setting address	2001H	Communication-based frequency setting (0–Fmax; unit: 0.01Hz)	R/W
	2004H	Torque setting (-3000–3000, in which 1000 corresponds to 100.0% of the motor rated current)	R/W
	2005H	Upper limit setting of forward running frequency (0–Fmax; unit: 0.01Hz)	R/W
	2006H	Upper limit setting of reverse running frequency (0–Fmax; unit: 0.01Hz)	R/W
	2007H	Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)	R/W

Function	Address definition	Data description	R/W
Communication-based setting address	2008H	Upper limit of the braking torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)	R/W
	2009H	Special control command word: Bit1–Bit0: Reserved. Bit2: =1 Enable speed/torque control switchover =0: Disable speed/torque control switchover Bit3: Reserved Bit4: =1: Enable pre-excitation =0: Disable pre-excitation Bit5: =1: Enable DC braking =0: Disable DC braking	R/W
	2013H	The pressure reference in hydraulic mode (range: 0–1000, where 1000 corresponds to 100.0% of P73.06).	R/W
	2014H	The flow reference in hydraulic mode (range: 0–1000, where 1000 corresponds to 100.0% of P73.07).	R/W
	200AH	Virtual input terminal command (range: 0x000–0x3FF) Corresponding to the local terminals: EI8/EI7/EI6/EI5/Reserved/DI5/DI4/DI3/DI2/DI1	R/W
	200BH	Virtual output terminal command (range: 0x00–0x0F) Corresponding to the local terminals: Reserved/RO1/DO2/DO1	R/W
	200CH	Voltage setting (used for V/F separation) (0–1000, in which 1000 corresponds to 100.0% of the motor rated voltage)	R/W
	200DH	AO setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%)	R/W
	200EH	AO setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%)	R/W

Function	Address definition	Data description	R/W
Drive SW 1	2100H	0001H: Forward running 0002H: Reverse running 0003H: Drive stopped 0004H: Drive in fault 0005H: Drive in POFF state 0006H: Drive in pre-exciting state	R
Drive SW 2	2101H	Bit0: =0: Not ready to run =1: Ready to run Bit2–Bit1: Reserved Bit3: Reserved Bit4: =0: No pre-alarm upon overload =1: Pre-alarm upon overload Bit6–Bit5: =0: Keypad-based control =1: Terminal-based control =2: Communication-based control Bit7: Reserved Bit8: =0: Speed control =1: Torque control Bit9: =0: Non position control =1: Position control Bit11–Bit10: =00: Vector 0 =01: Vector 1 =10: Closed-loop vector =11: Space voltage vector	R
Drive fault code	2102H	For details, see section 8.2 Faults and solutions.	R
Drive identification code	2103H	MH860C-----0x2900	R
Running frequency	3000H	0–Fmax (Unit: 0.01Hz)	R
Set frequency	3001H	0–Fmax (Unit: 0.01Hz)	R
Bus voltage	3002H	0.0–2000.0V (Unit: 0.1V)	R
Output voltage	3003H	0–1200V (Unit: 1V)	R
Output current	3004H	0.0–3000.0A (Unit: 0.1A)	R
Rotational speed	3005H	0–65535 (Unit: 1 RPM)	R

Function	Address definition	Data description	R/W
Output power	3006H	-300.0%–300.0% (Unit: 0.1%)	R
Output torque	3007H	-250.0–250.0% (Unit: 0.1%)	R
Closed-loop setting	3008H	-100.0–100.0% (Unit: 0.1%)	R
Closed-loop feedback	3009H	-100.0–100.0% (Unit: 0.1%)	R
Input I/O status	300AH	00–3F Corresponding to the local terminals: Reserved/DI5/DI4/DI3/DI2/DI1	R
Output I/O status	300BH	00–0F Corresponding to the local terminals: Reserved/RO1/DO2/DO1	R
Analog input 1	300CH	0.00–10.00V (Unit: 0.01V)	R
Analog input 2	300DH	0.00–10.00V (Unit: 0.01V)	R
Expansion card analog input 3	300EH	-10.00–10.00V (Unit: 0.01V)	R
Torque setting	3015H	-300.0%–300.0% (Unit: 0.1%)	R
Drive identification code	3016H	-	R
Fault code	5000H	-	R

The Read/Write (R/W) characteristics indicate whether a function code can be read and written. For example, "Communication-based control command" can be written; therefore, the command code 06H is used to control the drive. The R characteristic indicates that a function code can only be read, and W indicates that a function code can only be written.

Note: Some parameters in the preceding table are valid only after they are enabled. For example, for the running or stop operation, you must set the channel of running commands (P00.01) to communication, and set the communication channel of running commands (P00.02) to Modbus.

The following table describes the encoding rules of device codes (corresponding to the identification code 2103H of the drive).

8 MSBs	Meaning	8 LSBs	Meaning
0x29	Electro-hydraulic servo drive	0x00	MH860C drive

7.2.5 Fieldbus scale

In practical applications, communication data is represented in the hexadecimal form, but hexadecimal values cannot represent decimals. You can multiply a non-integer by a multiple to obtain an integer, in which the multiple is considered as a fieldbus scale.

The fieldbus scale depends on the number of decimal places in the value specified in "Setting range" or "Default". If there are n (for example, 1) decimal places in the value, the fieldbus scale m (then m=10) is the result of 10 to the power of n. For example:

Function code	Name	Description	Setting range	Default
P01.20	Wake-up-from-sleep delay	0.0–3600.0s (valid when the ones place of P01.19 is 2)	0.00–3600.0s	0.0s

The value specified in "Setting range" or "Default" contains one decimal place, and therefore the fieldbus scale is 10. If the value received by the master is 50, "Wakeup delay" of the drive is 5.0 (5.0=50/10).

To set "Wakeup delay" to 5.0s through Modbus communication, you need first to multiply 5.0 by 10 according to the scale to obtain an integer 50, that is, 32H in the hexadecimal form. Then, send the write command:

01	06	01 14	00 32	49 E7
Drive address	Write command	Parameter address	Parameter data	CRC

After receiving the command, the drive converts 50 into 5.0 based on the fieldbus scale, and then sets "Wakeup delay" to 5.0s.

For another example, after the host controller sends the "Wakeup delay" parameter read command, the master receives the following response from the drive:

01	03	02	00 32	39 91
Drive address	Read command	2-byte data	Parameter data	CRC

The parameter data is 0032H, that is, 50, and therefore 5.0 is obtained based on the fieldbus scale (50/10=5.0). Then, the master confirms that the wakeup delay is 5.0s.

7.2.6 Error message response

Error message responses are sent from the drive to the master. The following table lists the codes and definitions of the error message responses.

Code	Name	Meaning
01H	Invalid command	The command code received from the host controller is not allowed to be executed. The possible causes are as follows: ● The function code is applicable only to new devices and is not implemented on this device. ● The slave is in faulty state when processing this request.
02H	Invalid data Address	For the drive, the data address in the request of the host controller is not allowed. In particular, the combination of the register address and the number of the to-be-sent bytes is invalid.
03H	Invalid data value	The received data domain contains a value that is not allowed. The value indicates the error in the remaining structure in the combined request. **Note:** It does not mean that the data item submitted for storage in the register includes a value unexpected by the program.
04H	Operation failure	The parameter is set to an invalid value in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Incorrect password	The password entered in the password verification address is different from that specified by P07.00.
06H	Incorrect data frame	The data frame sent from the host controller is incorrect in the length, or in the RTU format, the value of the CRC check bit is inconsistent with the CRC value calculated by the downstream device.
07H	Parameter read-only	The parameter to be modified in the write operation of the host controller is a read-only parameter.
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the host controller cannot be modified during the running of the drive.
09H	Password protection	If the host controller does not provide the correct password to unlock the system to perform a read or write operation, the error of "system being locked" is reported.

7.2.7 Read/Write operation examples

For the formats of the read and write commands, see section 7.2.2 RTU mode and section 7.2.3 RTU command code.

7.2.7.1 Example of read command 03H

Example 1: Read SW 1 of the drive whose address is 01H. According to Table 7-2, the parameter address for drive SW 1 is 2100H.

The read command transmitted to the drive is:

01	03	21 00	00 01	8E 36
Drive address	Read command	Parameter address	Data quantity	CRC

Assume that the following response is returned:

01	03	02	00 03	F8 45
Drive address	Read command	Number of bytes	Data content	CRC

The data returned by the drive is 0003H. According to the table, this indicates that the drive is in the stopped state.

Example 2: View information about the drive whose address is 03H, including "Type of present fault" (P07.27) to "Type of 5th-last fault" (P07.32) of which the parameter addresses are 071BH to 0720H (contiguous 6 parameter addresses starting from 071BH).

The command transmitted to the drive is as follows:

03	03	07 1B	00 06	B5 59
Drive address	Read command	Start address	6 parameters in total	CRC

Assume that the following response is returned:

03	03	0C	00 13	00 13	00 13	00 13	00 13	00 13	5F D2
Drive address	Read command	Number of bytes	Present fault type	Last fault type	2nd-last fault type	3rd-last fault type	4th-last fault type	5th-last fault type	CRC

According to the returned data, all the fault types are 0013H, that is, 19 in the decimal form, which means the current detection fault (E19).

7.2.7.2 Example of write command 06H

Example 1: Set the drive whose address is 03H to be forward running. According to Table 7-2, the address of "Communication-based control command" is 2000H, and 0001 indicates forward running.

Function	Address definition	Data description	R/W
Communication-based control command	2000H	0001H: Run forward	R/W
		0002H: Run reversely	
		0003H: Jog forward	
		0004H: Jog reversely	
		0005H: Stop	
		0006H: Coast to stop	
		0004H: Fault reset	
		0008H: Stop jogging	

The command transmitted from the master is as follows:

03	06	20 00	00 01	42 28
Drive address	Write command	Parameter address	Forward running	CRC

If the operation is successful, the following response (same as the command transmitted from the master) is returned:

03	06	20 00	00 01	42 28
Drive address	Write command	Parameter address	Forward running	CRC

Example 2: Set the max. output frequency to 100Hz for the drive with the address of 03H.

Function code	Name	Description	Setting range	Default	Modify
P00.03	Max. output frequency	P00.04–400Hz	100.00–400.00Hz	50.00Hz	◎

According to the number of decimal places, the fieldbus scale of the "Max. output frequency" (P00.03) is 100. Multiply 100Hz by 100. The value 10000 is obtained, and it is 2710H in the hexadecimal form.

The command transmitted from the master is as follows:

03	06	00 03	27 10	62 14
Drive address	Write command	Parameter address	Parameter data	CRC

If the operation is successful, the following response (same as the command transmitted from the master) is returned:

03	06	00 03	27 10	62 14
Drive address	Write command	Parameter address	Parameter data	CRC

Note: In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

7.2.7.3 Example of continuous writing command 10H

Example 1: Set the drive whose address is 01H to be forward running at the frequency of 10Hz. According to Table 7-2, the address of "Communication-based control command" is 2000H, 0001 indicates forward running. The address of "Communication-based frequency setting" is 2001H. 10Hz is 03E8H in the hexadecimal form. See the following table.

Function	Address definition	Data description	R/W
Communication-based control command	2000H	0001H: Run forward	R/W
		0002H: Run reversely	
		0003H: Jog forward	
		0004H: Jog reversely	
		0005H: Stop	
		0006H: Coast to stop	
		0004H: Fault reset	
		0008H: Stop jogging	
Communication-based setting address	2001H	Communication-based frequency setting (0–Fmax; unit: 0.01Hz)	R/W

In the actual operation, set P00.01 to 2 and P00.06 to 8.

The command transmitted from the master is as follows:

01	10	20 00	00 02	04	00 01	03 E8	3B 10
Drive address	Continuous write command	Parameter address	Parameter quantity	Number of bytes	Froward running	10 Hz	CRC

If the operation is successful, the following response is returned:

01	10	20 00	00 02	4A 08
Drive address	Continuous write command	Parameter address	Parameter quantity	CRC

Example 2: Set the acceleration time of the drive whose address is 01H to 10s, and the deceleration time to 20s.

Function code	Name	Description	Default	Modify
P00.11	ACC time 1	Setting range of P00.11 and P00.12: 0.0–3600.0s	Model depended	○
P00.12	DEC time 1		Model depended	○

The address of P00.11 is 000B. An acceleration time of 10s corresponds to 0064H in the hexadecimal form, and a deceleration time of 20s corresponds to 00C8H in the hexadecimal form.

The command transmitted from the master is as follows:

01	10	00 0B	00 02	04	00 64	00 C8	F2 55
Drive address	Continuous write command	Parameter address	Parameter quantity	Number of bytes	10s	20s	CRC

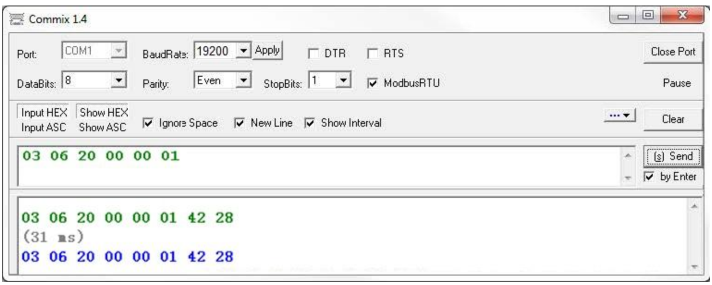
If the operation is successful, the following response is returned:

01	10	00 0B	00 02	30 0A
Drive address	Continuous write command	Parameter address	Parameter quantity	CRC

Note: In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

7.2.7.4 Example of Modbus communication commissioning

In the following example, a PC is used as the master, an RS232-RS485 converter is used for signal conversion, and the PC serial port used by the converter is COM1 (an RS232 port). The host controller commissioning software is the serial port commissioning assistant Commix, which can be downloaded from the Internet. Download a version that can automatically execute the CRC check function. The following figure shows the interface of Commix.



First, set the serial port to **COM1**. Then, set the baud rate consistently with P14.01. The data bits, check bits, and stop bits must be set consistently with P14.02. If the RTU mode is selected, you need to select the hexadecimal form Input HEX. To set the software to automatically execute the CRC function, you need to select **ModbusRTU** ☑ ModbusRTU, select **CRC16 (MODBU SRTU)**, and set the start byte to **1**. After the auto CRC check function is enabled, do not enter CRC information in commands. Otherwise, command errors may occur due to repeated CRC check.

The commissioning command to set the drive whose address is 03H to run forward is as follows:

03	06	20 00	00 01	42 28
Drive address	Write command	Parameter address	Forward running	CRC

Note:

- Set the address (P14.00) of the drive to 03.
- Set "Channel of running commands" (P00.01) to "Communication", and set "Communication channel of running commands" (P00.02) to the Modbus channel.
- Click **Send**. If the line configuration and settings are correct, a response from the drive is received.

7.2.8 Common communication faults

Common communication faults include the following:

- No response is returned.
- The drive returns an exception response.

Possible causes of no response include the following:

- The serial port is set incorrectly. For example, the converter uses the serial port COM1, but COM2 is selected for the communication.
- The settings of the baud rates, data bits, end bits, and check bits are inconsistent with those set on the drive.
- The positive pole (+) and negative pole (-) of the RS485 bus are connected reversely.
- The RS485 matching resistor on the drive's terminal board is set incorrectly.

7.2.9 Related parameters

Function code	Name	Description	Default	Modify
P14.00	Local communication address	1–247	1	◎
P14.01	Communication baud rate setting	0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps	4	◎
P14.02	Data bit check setting	0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU	1	◎
P14.03	Communication response delay	0–200ms	5	○
P14.04	Communication timeout time	0.0: Invalid; 0.1–60.0s	0.0s	○
P14.05	Transmission error processing	0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0	○
P14.06	Communication processing action	0x00–0x11 LED ones place: 0: Respond to write operations 1: Not respond to write operations Tens place: Communication password protection 0: Communication password protection is invalid. 1: Communication password protection is valid.	0x00	○

7.3 CANopen bus networking

7.3.1 Overview

CANopen supports two mechanisms for reading and writing the drive's process data: Process Data Objects (PDO) and Service Data Objects (SDO) for reading or writing manufacturer-defined object dictionary.

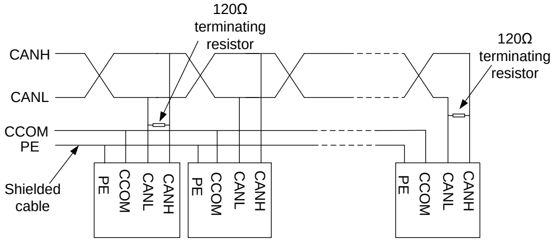
Supported functions:

- CAN 2.0A protocol.
- CANopen DS301.
- CANopen services (PDO: supports 4 pairs of PDO services [PDO1–PDO4 TX, PDO1–PDO4 RX], PDO1 is used for reading and writing drive parameters, while PDO2–PDO4 are used for real-time control and acquiring actual drive values; SDO: SDO information uses "client/server" mode, used to configure slave nodes and access the object dictionary of each node).
- Emergency service.
- Node guarding (NMT node guarding).
- Heartbeat message (heartbeat producer).
- NMT (network management: supports NMT module control, NMT broadcast address, NMT error control, and boot-up).
- SYNC (1–240).
- Asynchronous transmission 254 and 255.
- Inhibit time.
- Event timer.
- Manufacturer-defined object dictionary, allowing control and reading of real-time drive values via SDO.

7.3.2 Electrical connection

Use shielded cables for the bus. It is recommended to connect the PE of all devices together. When there are only two devices for CAN master/slave communication, both devices shall be connected to terminal resistors. When there are more than two devices, the devices at both ends of the bus shall be connected to terminal resistors. The terminal resistor can be selected using the jumper cap on the control board. Figure 7-4 shows the electrical wiring.

Figure 7-4 Electrical wiring diagram



7.3.3 Communication

7.3.3.1 Message format

CAN2.0A messages are used to transmit data between the master and bus nodes through data frames.

Figure 7-5 Message structure

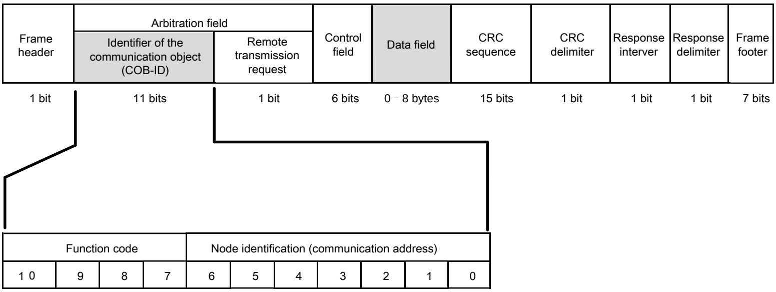


Table 7-3 COB-IDs of communication objects

Communication object	Function code (binary)	COB-ID (hexadecimal)
NMT	0	0x00
SYNC	1	0x80
EMERGENCY	1	0x81–0xFF
PDO1 Tx	11	0x181–0x1FF
PDO1 Rx	100	0x201–0x27F
PDO2 Tx	101	0x281–0x2FF
PDO2 Rx	110	0x301–0x37F
PDO3 Tx	111	0x381–0x3FF
PDO3 Rx	1000	0x401–0x47F
PDO4 Tx	1001	0x481–0x4FF

Communication object	Function code (binary)	COB-ID (hexadecimal)
PDO4 Rx	1010	0x501–0x57F
SDO Tx	1011	0x581–0x5FF
SDO Rx	1100	0x601–0x67F
Node guarding	1110	0x701–0x77F

COB-IDs vary according to communication address, but for the same type of command, the COB-IDs are within a certain range.

Note: The commands described in this manual are all data frames if it is not specified that they are remote frames.

7.3.3.2 CANopen state transition

The start sequence defined in the CANopen communication protocol is supported. The following figure shows the NMT state transition diagram.

Figure 7-6 NMT state transition

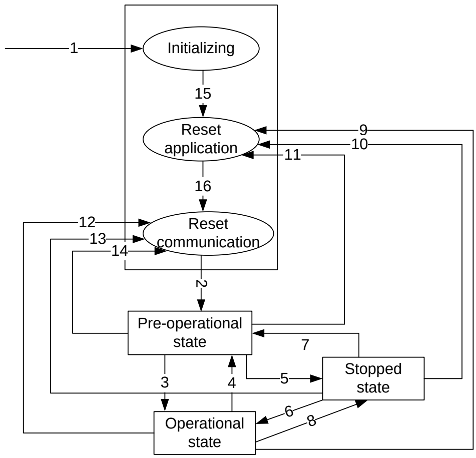


Table 7-4 NMT state transition

State transition	Required triggering event
1	Automatic initialization after power-on
2	Automatic change after initialization
3, 6	Command of the NMT master for starting a remote node
4, 7	Command of the NMT master for entering the pre-operational state
5, 8	Command of the NMT master for entering the stopped state

State transition	Required triggering event
9, 10, 11	Command of the NMT master for resetting a remote node
12, 13, 14	Command of the NMT master for resetting a remote node communication parameter

Different services are supported in different states, as described in Table 7-5.

Table 7-5 Services supported in various NMT states

Services	Pre-operation state	Operation state	Stopped state
PDOs	No	Yes	No
SDOs	Yes	Yes	No
Synchronization (SYNC) message	Yes	Yes	No
Emergency (EMCY) message	Yes	Yes	No
Network management	Yes	Yes	No
Error control	Yes	Yes	Yes

7.3.3.3 Network management (NMT) command

This function is used by the master to control the NMT states of slave nodes.

- **Command**

Master → Slave

COB-ID	Byte0	Byte1
0x000	Command specifier (CS)	Node-ID (node ID)

- **Description**

The command COB-ID is fixed to 0x00. If Node-ID is set to 0, the command is broadcast to all CANopen slaves, and each slave must execute the NMT command. Table 7-6 describes the function of each CS.

Table 7-6 Function of each CS

NMT CS	NMT service (control action)
0x01	Starts a slave device.
0x02	Stops a slave device.
0x80	Enables a slave to enter the pre-operational state.
0x81	Resets a slave.
0x82	Resets communication of a node.

- **Example**

For example, to set the drive with Node-ID 3 to the pre-operational state, the command is as follows:

COB-ID	Byte0	Byte1
0x000	0x80	0x03

As another example, to start all nodes in the CANopen network, the command is as follows:

COB-ID	Byte0	Byte1
0x000	0x01	0x00

7.3.3.4 Node guarding (NMT Node Guarding)

By using the node protection service, the NMT master node can detect the current state of each node.

- **Command**

Request: Master (remote frame) → slave

COB-ID	No data
0x700+Node-ID	-

Response: slave → master

COB-ID	Byte0 (state value)
0x700+Node-ID	Bit 7: Toggle bit; Bits 0–Bit 6: State

- **Description**

The MSB (bit 7) of Byte0 (state value) in the response command is the toggle bit, that is, the value of bit 7 is alternated between 0 and 1 each time the slave transmits a response frame to distinguish frames. Bits 0 to 6 indicate the state of the slaves. Table 7-7 describes the state values and their corresponding states.

Table 7-7 Node guarding state values

State value (Byte0: Bits 0–6)	State
0x00	Initializing
0x04	Stopped
0x05	Operational
0x7F	Pre-operational

- **Example**

For example, the command for the master to check the state of slave 3 is as follows:

Master (remote frame) → slave

COB-ID	No data
0x703	-

Upon receiving the node guarding command from the master, the slave sends the following command:

COB-ID	Byte0 (state value)
0x703	0x85

In the command, bit 7 of Byte0 is 1, and the state value is 0×05, indicating that slave 3 is in the operational state. If receiving another node guarding command, the slave will respond with a value of 0x05, because Bit 7 of Byte 0 must toggle to 0.

7.3.3.5 Heartbeat message (Heartbeat Producer)

In some cases, the master requires that a slave automatically transmit a heartbeat message at regular intervals, so that it can learn the state of the slave in real time. The interval parameter (data length: 16 bits; unit: ms) is defined in the object dictionary 0x1017. If the interval is set to 0, the slave does not transmit heartbeat messages. By default, the producer heartbeat time is 0.

- **Command**

Slave → Master

COB-ID	Byte0
0x700+Node-ID	State value

- **Description**

The heartbeat messages are in the same format as the node guarding response frames. The difference is that the toggle bit does not alternate in heartbeat messages (it is always 0). Table 7-7 describes the state values.

- **Example**

For example, if slave 3 is in the operational state and the interval parameter in 0x1017 is set to 100, slave 3 transmits a heartbeat message every 100ms.

COB-ID	Byte0
0x703	0x05

SDOs can be used to disable heartbeat messages, transmitting 2B 17 10 00 00 00 00 00 (setting the interval to 0).

Note: Node guarding and heartbeat messages cannot be used simultaneously.

7.3.3.6 NMT boot-up message

Upon completion of initialization (boot-up), a boot-up message is transmitted.

- **Command**

Slave → Master

COB-ID	Byte0
0x700+Node-ID	0x00

- **Example**

For example, for a node with Node-ID 3, the boot-up message transmitted after initialization is as follows:

COB-ID	Byte0
0x703	0x00

7.3.3.7 Synchronization object (SYNC)

Generally, SYNC signals are transmitted by the CANopen master cyclically. A SYNC signal does not contain any data and is used mainly to request synchronous PDO Tx of the slave node to transmit process data. 0x1005 in the object dictionary defines COB-IDs of the objects that receive SYNC messages, and they are set to 0x80 in the CANopen pre-defined connection set. For PDO Tx, the transmission types of 1 to 240 indicate synchronous transmission.

- **Command**

Master → Slave

COB-ID	No data
0x80	-

7.3.3.8 Emergency object (EMCY)

This message is transmitted when an internal error occurs in the drive, or when an error is cleared.

- **Command**

Slave → Master

<table>
<tr><th>COB-ID</th><th>Byte0</th><th>Byte1</th><th>Byte2</th><th>Byte3</th><th>Byte4</th><th>Byte5</th><th>Byte6</th><th>Byte7</th></tr>
<tr><td rowspan="2">0x80+Node-ID</td><td colspan="2">Emergency error code</td><td rowspan="2">Error register</td><td colspan="5">Drive error code</td></tr>
<tr><td>LSB</td><td>MSB</td><td>Bit7–0</td><td>Bit15–8</td><td>Reserved</td><td>Reserved</td><td>Reserved</td></tr>
</table>

- **Description**

An emergency error code is two bytes. Byte0 is the LSB, and Byte1 is the MSB. A drive error code is five bytes. Byte3 is the LSB, and Byte7 is the MSB.

An emergency error code indicates the type of the current error, as described in Table 7-8. The error register stores the type of the current error. You can determine the error type indicated by the current emergency message according to the value stored in the register. Table 7-9 describes the bit definitions of the error register. Refer to the drive manual for details on drive error codes.

Table 7-8 Common emergency error codes and descriptions

Emergency error code (hex)	Code function description
00xx	Error reset or no error
10xx	Generic Error
20xx	Current
21xx	Current, device input side
22xx	Current, inside the device
23xx	Current, device input side
30xx	Voltage
31xx	Mains voltage
32xx	Voltage inside the device
40xx	Temperature
50xx	Device hardware
60xx	Device software
61xx	Internal software
70xx	Additional modules
80xx	Monitoring
81xx	Communication
8110	CAN overrun
8120	Error Passive
8130	Life Guard Error or Heartbeat Error
8140	Recovered from Bus-Off

Emergency error code (hex)	Code function description
82xx	Protocol Error
8210	PDO not processed Due to length error
8220	Length exceed
90xx	External error
F0xx	Additional functions
FFxx	Device specific

Table 7-9 Definition of error register bits

Error register bit (Bit)	Error type
0	Generic error or no error
1	Current error
2	Voltage error
3	Temperature error
4	Communication error
5	Device description error
6	Reserved (=0)
7	Manufacturer-defined error

- **Example**

For example, if the "inverter unit U-phase protection (OUT1)" fault occurs on the slave drive whose node ID is 3, and the fault type is 1 (that is, the drive error code is 1), the communication card transmits the following emergency message.

COB-ID	Emergency error code		Error register	Drive error code				
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x83	0x00	0x30	0x04	0x01	0x00	0x00	0x00	0x00

As indicated by the message, the emergency error code is 0x3000, which signifies a voltage error. The error register is 0x04, that is, bit 2 is "1", indicating a voltage error. The device error code is 0x0000000001, where code 1 corresponds to the "inverter unit U-phase protection (OUT1)" fault.

After the fault is reset, the following emergency message is transmitted to notify the master that the slave is no longer faulty.

COB-ID	Emergency error code		Error register	Drive error code				
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x83	0x00	0x00	0x00	0x00	0x00	0x00	0x00	0x00

7.3.3.9 Service data object (SDO)

SDOs are mainly used to transmit non-time-critical data. By using SDOs, the master can read data from and write data to the object dictionary of a device.

- **Command**

Request: master → slave

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x600+NodeID	Request code	Object index		Sub-index	Request data			
		LSB	MSB		Bit7–0	Bit15–8	Bit23–16	Bit31–24

Response: slave → master

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x580+NodeID	Response code	Object index		Sub-index	Response data			
		LSB	MSB		Bit7–0	Bit15–8	Bit23–16	Bit31–24

- **Description**

An object index is two bytes. Byte1 is the LSB, and Byte2 is the MSB. For information about the object indexes and subindexes, see Appendix H CANopen object dictionary. Request codes include request codes for reading and those for writing.

Request codes for writing vary according to the character length of items in the object dictionary, and the request code for reading is 0×40. See Table 7-10.

Response codes indicating successful reading vary according to the character length of items in the object dictionary, and the response code indicating successful writing is 0×60. The response codes indicating reading failure and writing failure are both 0x80. See Table 7-12.

Table 7-11 SDO request codes and data

Request code type	Request code	Command description	Request data			
			Byte4	Byte5	Byte6	Byte7
Write	0x23	Writes 4-byte data	Bit7-0	Bit15-8	Bit23-16	Bit31-24
	0x2B	Writes 2-byte data	Bit7-0	Bit15-8	-	-
	0x2F	Writes 1-byte data	Bit7-0	-	-	-
Read	0x40	Reads data	-	-	-	-

Table 7-12 SDO response codes and data

<table>
<tr><th rowspan="2">Response code type</th><th rowspan="2">Response code</th><th rowspan="2">Command description</th><th colspan="4">Response data</th></tr>
<tr><th>Byte4</th><th>Byte5</th><th>Byte6</th><th>Byte7</th></tr>
<tr><td rowspan="3">Read</td><td>0x43</td><td>Reads 4-byte data</td><td>Bit7-0</td><td>Bit15-8</td><td>Bit23-16</td><td>Bit31-24</td></tr>
<tr><td>0x4B</td><td>Reads 2-byte data</td><td>Bit7-0</td><td>Bit15-8</td><td>-</td><td>-</td></tr>
<tr><td>0x4F</td><td>Reads 1-byte data</td><td>Bit7-0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Write</td><td>0x60</td><td>Writing succeeds</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">Read/write</td><td rowspan="2">0x80</td><td rowspan="2">Reading/writing fails</td><td colspan="4">Abort code</td></tr>
<tr><td>Bit7-0</td><td>Bit15-8</td><td>Bit23-16</td><td>Bit31-24</td></tr>
</table>

Note: The symbol "-" in Table 7-13 and Table 7-12 indicates that the byte is reserved and provides no function.

Table 7-14 describes the abort codes.

Table 7-14 Abort code

Abort code (hex)	Code function description
05030000	Toggle bit not alternated
05040000	SDO protocol timeout
05040001	Invalid or unknown client/server
05040002	Invalid block size
05040003	Invalid sequence number
05040004	CRC error
05040005	Out of memory
06010000	No access to the object
06010001	Attempts to read a write-only object
06010002	Attempts to write information to a read-only object
06020000	Object cannot be found in the object dictionary
06040041	Object cannot be mapped to PDO
06040042	Number and length of the object to be mapped exceeds the PDO length
06040043	General parameter incompatibility
06040047	General internal incompatibility of the device
06060000	Object access failure caused by hardware error
06070010	Data type not matched; service parameter length not matched
06090011	Subindex cannot be found in the object dictionary
06090030	Parameter value range exceeded
06090031	Written parameter value too high
06090032	Written parameter value too low
06090036	Max. value less than Min. value

Abort code (hex)	Code function description
08000000	General error
08000020	Data failed to be transmitted or stored in the application
08000021	Data failed to be transmitted or stored in the application due to local control
08000022	Data failed to be transmitted or stored in the application due to the current state of the device
08000023	Error occurs dynamically on the object dictionary or object dictionary cannot be found

- **Example**

For example, slave 3 reads data from and writes data to the object whose index is 0x1801 and subindex is 03. (The object whose index is 0x1801 and subindex is 03 indicates the inhibit time of PDO2 Tx. For more information, see Appendix H CANopen object dictionary.)

Write operation example: To modify the inhibit time of PDO2 Tx to 1000ms, the master transmits the following write operation command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x2B	0x01	0x18	0x03	0xe8	0x03	0x00	0x00

After receiving the command transmitted by the master, the slave transmits the following command response if the modification is successful.

COB-ID	Response code	Object index		Sub-index	Response data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x60	0x01	0x18	0x03	0x00	0x00	0x00	0x00

Read operation example: To read the inhibit time of PDO2 Tx, the master transmits the following read operation command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x01	0x18	0x03	0x00	0x00	0x00	0x00

After receiving the command transmitted by the master, the slave transmits the following response if the current inhibit time of PDO2 Tx is 1000ms.

COB-ID	Response code	Object index		Sub-index	Response data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x43	0x01	0x18	0x03	0xe8	0x03	0x00	0x00

Read/write error example: The master transmits the following read command to read an object (whose index is 0x6000 and subindex is 0x00) that cannot be found.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x00	0x60	0x00	0x00	0x00	0x00	0x00

Since the object does not exist, the slave transmits a read/write error response as follows:

COB-ID	Response code	Object index		Sub-index	Response data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x80	0x00	0x60	0x00	0x00	0x00	0x02	0x06

The error code in the response is 0x06020000, indicating that "Object cannot be found in the object dictionary".

7.3.4 Process data object (PDO)

Four PDO Tx commands (whose indexes are 0x1800 to 0x1803) and four PDO Rx commands (whose indexes are 0x1400 to 0x1403) are available. PDO Rx is a PDO command transmitted by the master to a slave, that is, it is a master command. PDO Tx is a PDO command transmitted by a slave to the master.

The CW, SW, set value, and return value of each PDO are all defined with a "manufacturer-defined object dictionary". In this way, the process data of a drive can be monitored not only through PDOs but also through SDOs. For more information, see section 7.3.5 Monitoring process data through SDO commands. Each PDO command is labeled with "manufacturer-defined object dictionary" in the format of 0xXXXX.HH, where XXXX indicates an index, HH indicates a subindex, and both of them are hexadecimal.

7.3.4.1 Triggering mode of PDO Tx

Each PDO Tx is defined with a transmission type, inhibit time, and event timer. The corresponding subindex of the transmission type is 0x02, that of the inhibit time is 0x03, and that of the event timer is 0x05. Therefore, the object dictionary index corresponding to PDO2 Tx is 0x1801, and the subindex is 0x02. The same principle applies to other PDO Tx commands. Refer to Appendix H CANopen object dictionary for more details. Both the inhibit time and event timer units are milliseconds.

Synchronous triggering

When the transmission type is set to 1 to 240, PDO Tx is synchronous transmission. For example, if you set the transmission type of PDO2 Tx to n ($1 \leqslant n \leqslant 240$), a slave transmits the PDO2 Tx once for every n SYNC objects received. The same principle applies to other PDO Txs.

Asynchronous triggering (254)

When the event timer is not zero, a slave transmits the PDO Tx periodically. For example, if the event timer of PDO2 Tx is set to 200, the slave transmits the PDO2 Tx at the interval of 200ms. When the event timer is zero, the slave transmits the PDO Tx once the corresponding PDO Tx data changes. However, the transmission interval is subject to the inhibit time. A PDO Tx message can be transmitted only once within the inhibit time, which effectively reduces the bus load. When the inhibit time is set to a period shorter than 50ms, 50ms is used as the inhibit time.

Asynchronous triggering (255)

When the event timer is not zero, a slave transmits the PDO Tx periodically. For example, if the event timer of PDO2 Tx is set to 200, the slave transmits the PDO2 Tx at the interval of 200ms. When the event timer is zero, the slave transmits the PDO Tx once the corresponding PDO Rx command is received. For example, after receiving a PDO2 Rx command, the slave transmits a PDO2 Tx.

Table 7-15 Triggering modes supported

Trigger mode	Transmission type (decimal)	Event triggering	PDO1 TX	PDO2 TX	PDO3 TX	PDO4 TX
Synchronous	1–240	-	Unavailable	Available	Available	Available
Asynchronous	254	Event timer	Unavailable	Available	Available	Available
		Inhibit time	Unavailable	Available	Available	Available
	255	Event timer=0	Available	Available	Available	Available
		Event timer	Unavailable	Available	Available	Available
		Inhibit time	Available	Available	Available	Available

Table 7-16 PDO Tx default values

	PDO1 TX	PDO2 TX	PDO3 TX	PDO4 TX
Transmission type	255	254	254	254
Event timer (ms)	0	0	0	0
Inhibit time (ms)	500	500	500	500

Refer to section 7.3.3.9 Service data object (SDO) for commands on setting the triggering type of PDO Tx.

7.3.4.2 PDO1

PDO1 is used to read and write parameters of the drive. The function of PDO1 is similar to that of an SDO. SDOs are used to read and write objects of an object dictionary, and PDO1 is used to read and write parameters of the drive.

Note: PDO1 Tx supports only the transmission type of asynchronous transmission 255. Do not set it to other transmission types, and do not try to set the event timer to periodically transmit PDO1 Tx to the master.

- **PDO1 Rx**
- **Command**

Request: master → slave

<table>
<tr><th>COB-ID</th><th>Byte0</th><th>Byte1</th><th>Byte2</th><th>Byte3</th><th>Byte4</th><th>Byte5</th></tr>
<tr><td rowspan="2">0x200+Node-ID</td><td colspan="2">Request code</td><td colspan="2">Parameter address</td><td colspan="2">Request data</td></tr>
<tr><td colspan="2">0x2100.00</td><td colspan="2">0x2100.01</td><td colspan="2">0x2100.02</td></tr>
</table>

- **Description**

A request code is two bytes. Byte0 is the LSB, and Byte1 is the MSB. The manufacturer defines the index 0x2100 and subindex 0x00 for the request codes. Table 7-17 describes the functions of the request codes.

Table 7-17 Request code

Request code	Function
0	No task
1	Reading a parameter value
2	Modifying a parameter value [modifying the value only on RAM]
4	Modifying a parameter value [modifying the value on both RAM and EEPROM] (reserved)

A parameter address is two bytes. Byte2 is the LSB, and Byte3 is the MSB. It indicates the address of the parameter to be read or modified.

Parameter address representation rules: The MSB is the hexadecimal form of the number before the decimal point, and the LSB is that of the number after the decimal point. Take P73.01 as an example, the number before the decimal point is 73, that is, the MSB of the parameter address is 0x49; the number after the decimal point is 01, that is, the LSB is 0×01. Therefore, the function code address is 0×4901.

Table 7-18 MH860C series drive parameter addresses

Function code	Name	Description	Setting range	Default	Modify
P73.01	Pressure and flow command source selection	0: Keypad 1: Analog setting 1 (AI1 for pressure, AI2 for flow) 2: Analog setting 2 (AI2 for pressure, AI1 for flow) 3: Internal multi-step 4: Modbus communication 5: Profinet/CANopen/EtherCAT communication 6–8: Reserved 9: Analog setting 3 (EAI5 for pressure, EAI6 for flow) 10: Analog setting 4 (EAI6 for pressure, EAI5 for flow)	0–10	2	◎

The request data is two bytes. Byte4 is the LSB, and Byte5 is the MSB. It indicates the data to be modified. When the command is transmitted for reading data, the request data is not used.

Note: The PDO1 Rx data domain must be six bytes. Otherwise, an emergency message will be generated.

- **PDO1 Tx**
- **Command**

Response: slave → master

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x180+Node-ID	Response code		Error code		Response data		0x00	0x00
	0x2000.00		0x2000.01		0x2000.02		-	-

- **Description**

Byte6 and Byte7 are reserved and both are 0x00.

A response code is two bytes. Byte0 is the LSB, and Byte1 is the MSB. Table 7-19 describes the functions of the response codes.

Table 7-19 Response code

Response code	Function
0	No response
1	Reading or writing succeeds
3	A reading or writing error occurs. Table 7-20 describes the error codes.

Response data is four bytes. Byte4 is the LSB, and Byte7 is the MSB. When a write command is responded, the response data is the data to be modified; and when a read command is responded, the response data is the data to be read.

An error code is two bytes. Byte2 is the LSB, and Byte3 is the MSB. Error codes are valid only when the response code is 3. An error code indicates the reason why it fails to respond to PDO1 Rx. Table 7-20 Error code describes the definitions of the error codes.

Table 7-20 Error code

Code	Name	Meaning
00H	No error	-
01H	Invalid command	The operation corresponding to the request code is not allowed to be executed. The possible causes are as follows: ● The function code is applicable only to new devices and is not implemented on this device. ● The slave is in the faulty state when processing this request.
02H	Invalid data address	For a slave device, the data address in the request of the master is not allowed. In particular, the combination of the register address and the number of the to-be-transmitted bytes is invalid.
03H	Invalid data value	The received data field contains a value that is not allowed. The value indicates the error in the remaining structure in the combined request. **Note:** It does not mean that the data item submitted for storage in the register includes a value unexpected by the program.
04H	Operation failure	The parameter is set to an invalid value in the write operation. For example, a function input terminal cannot be set repeatedly.
05H	Incorrect password	The password entered in the password verification address is different from that set by the user.
06H	Incorrect data frame	Occurs when the data frame sent from the host controller is incorrect in the length, or when in the RTU format, the value of the CRC check bit is inconsistent with the CRC value calculated by the downstream device.
07H	Parameter read-only	The parameter to be modified in the write operation of the master is a read-only parameter.

Code	Name	Meaning
08H	Parameter cannot be modified in running	The parameter to be modified in the write operation of the master cannot be modified during the running of the drive.
09H	Password protection	If the master does not provide the correct password to unlock the system to perform a read or write operation, the error of "system being locked" is reported.

- **Example of PDO1**

The drive slave address is 3. Assume that you want to set the function code P15.13 of the drive to 1.

Command analysis: The parameter address of P15.13 is 0×0F0D. According to the protocol, the request code of PDO1 Rx is 0×02, the parameter address is 0x0F0D, and the request data is 0x01; therefore, PDO1 Rx transmitted by the master is as follows.

COB-ID	Request code		Parameter address		Request data	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5
0x203	0x02	0x00	0x0D	0x0F	0x01	0x00

If the drive parameter is successfully modified, the drive responds with the following PDO1 Tx:

COB-ID	Response code		Error code		Response data		-	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x183	0x01	0x00	0x00	0x00	0x01	0x00	0x00	0x00

7.3.4.3 PDO2

- **PDO2 Rx**

PDO2 Rx is used to modify CWs and real-time process data (setting 1, setting 2, and setting 3) of a drive. A CW is used to control the start and stop of a drive, and settings are used to control the real-time running values of the drive, such as set frequency.

- **Command**

Master → Slave

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x300+Node-ID	CW		Setting 1		Setting 2		Setting 3	
	0x2101.00		0x2100.03		0x2100.04		0x2100.05	

- **Description**

A CW is two bytes. Byte0 is the LSB, and Byte1 is the MSB. See section 7.5.1 CW description for MH860C CW details.

The function of each setting value can be configured via the drive function codes. Refer to the relevant drive manual for the specific configuration methods. Setting 1, setting 2, and setting 3 correspond to received PZD2, received PZD3, and received PZD4, respectively. To set the function of setting 1 to "Set frequency", you need only to set "Received PZD2" to "1: Set frequency". The same principle applies to other settings. When multiple settings are enabled, the failure to set one setting (for example, the set value exceeds the setting range) does not affect the setting of other settings.

- **Example**

Assume that the drive slave address is 3. The goal is to control the running of the drive through CANopen communication and set the running frequency to 50Hz through CANopen communication.

Command analysis: First, set the drive start mode and frequency reference mode to CANopen communication (P00.01=2, P00.02=1, P00.06=9). In this example, use Setting 2 to set the running frequency (P15.03=1, that is, set Received PZD3 to "1: Set frequency").

When a CW is 0×01, it indicates that the drive is to be run. To set the frequency to 50.00Hz, set Setting 2 to 5000, that is, 0x1388.

The PDO2 Rx command transmitted by the master is as follows.

COB-ID	CW		Setting 1		Setting 2		Setting 3	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x303	0x01	0x00	0x00	0x00	0x88	0x13	0x00	0x00

- **PDO2 Tx**

PDO2 Tx is a response transmitted by a drive to the master. It contains a SW and real-time process data (Returned value 1, returned value 2, and returned value 3). A SW is used to report the state of the drive, and returned values are used to transmit the real-time running values of drive, such as running frequency.

The default transmission type of PDO2 Tx is 254; therefore, PDO2 Tx is transmitted once a SW or returned value changes.

- **Response**

Slave → Master

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x280+NODEID	SW		Returned value 1		Returned value 2		Returned value 3	
	0x2001.00		0x2000.03		0x2000.04		0x2000.05	

- **Description**

A SW is two bytes. Byte0 is the LSB, and Byte1 is the MSB. Refer to section 7.5.2 SW description for the definitions of the MH860C drive SW.

The function of each returned value can be set through the corresponding function code of the drive. The setting method is the same as that for "received PZD" in PROFIBUS communication. For details, see the drive operation manual. Returned value 1, returned value 2, and returned value 3 correspond to sent PZD2, sent PZD3, and sent PZD4, respectively. To set the function of returned value 1 to "Running frequency", simply set "sent PZD2" to "1: Running frequency". The same principle applies to other returned values. Multiple returned values can be enabled simultaneously.

- **Example**

Assume that the drive slave address is 3. The drive is running, and the running frequency is 50.00Hz. Returned value 1 is set to "Running frequency", returned value 2 is set to "Output voltage", and returned value 3 is set to no function.

Command analysis: You need to set returned value 1 to the running frequency of the drive (P15.13=1), returned value 2 to the output voltage of the drive (P15.14=4), and returned value 3 to invalid (P15.15=0) first.

The drive is running and the bus voltage has been established; therefore, the SW is 0x0101. The running frequency is 50.00 Hz; therefore, the returned value 1 is 5000, that is, 0x1388. If the output voltage is 380V, returned value 2 is 0x017C.

The PDO2 Tx command transmitted by the drive is as follows.

COB-ID	SW		Returned value 1		Returned value 2		Returned value 3	
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x283	0x01	0x01	0x88	0x13	0x7C	0x01	0x00	0x00

7.3.4.4 PDO3–PDO4

- **PDO3 Rx and PDO4 Rx**

PDO3 Rx and PDO4 Rx are used to modify the real-time process data of a drive, such as set frequency.

- **PDO3 Rx command**

Master → Slave

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x400+NODEID	Setting 4		Setting 5		Setting 6		Setting 7	
	0x2100.06		0x2100.07		0x2100.08		0x2100.09	

- **PDO4 Rx command**

Master → Slave

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x500+NODEID	Setting 8		Setting 9		Setting 10		Setting 11	
	0x2100.0a		0x2100.0b		0x2100.0c		0x2100.0d	

- **Description**

The application methods for PDO3 Rx and PDO4 Rx are the same as those for PDO2 Rx.

7.3.4.5 PDO3 Tx and PDO4 Tx

PDO3 Tx and PDO4 Tx are used by the drive to transmit real-time process data to the master, such as running frequency.

The default transmission type of PDO3 Tx and PDO4 Tx is 254; therefore, PDO3 Tx or PDO4 Tx is transmitted once a returned value in the same command changes.

- **PDO3 Tx command**

Slave → Master

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x380+NODEID	Returned value 4		Returned value 5		Returned value 6		Returned value 7	
	0x2000.06		0x2000.07		0x2000.08		0x2000.09	

- **PDO4 Tx command**

Slave → Master

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x480+NODEID	Returned value 8		Returned value 9		Returned value 10		Returned value 11	
	0x2000.0a		0x2000.0b		0x2000.0c		0x2000.0d	

- **Description**

The application methods for PDO3 Tx and PDO4 Tx are the same as those for the returned values of PDO2 Tx.

7.3.5 Monitoring process data through SDO commands

In addition to PDO, you can also use SDO to monitor the drive's process data. The monitoring mode can be selected as required. SDOs can be used to read objects in the manufacturer-defined object dictionary to monitor the drive.

For the definition and application of the CWs, SWs, set values, and returned values in the manufacturer-defined object dictionary, see section 7.3.4 Process data object (PDO). For

SDO, see section 7.3.3.9 Service data object (SDO) for usage instructions. Do not try to use SDOs to read and write drive parameters.

Table 7-21 and Table 7-22 describe the manufacturer-defined object dictionary.

Table 7-21 Manufacturer-defined object dictionary – control objects

Index (hex)	Subindex (hex)	Function	Access	Data length	Description
2100	0	Request code (do not use)	RW	2 bytes	-
	1	Parameter address (do not use)	RW	2 bytes	-
	2	Request data (do not use)	RW	2 bytes	-
	3	Setting 1	RW	2 bytes	Received PZD2
	4	Setting 2	RW	2 bytes	Received PZD3
	5	Setting 3	RW	2 bytes	Received PZD4
	6	Setting 4	RW	2 bytes	Received PZD5
	7	Setting 5	RW	2 bytes	Received PZD6
	8	Setting 6	RW	2 bytes	Received PZD7
	9	Setting 7	RW	2 bytes	Received PZD8
	A	Setting 8	RW	2 bytes	Received PZD9
	B	Setting 9	RW	2 bytes	Received PZD10
	C	Setting 10	RW	2 bytes	Received PZD11
	D	Setting 11	RW	2 bytes	Received PZD12
	E	Reserved	RW	2 bytes	-
	F	Reserved	RW	2 bytes	-
2101	0	CW	RW	2 bytes	-

Table 7-22 Manufacturer-defined object dictionary – status objects

Index (hex)	Subindex (hex)	Function	Access	Data length	Description
2000	0	Response code (do not use)	RO	2 bytes	-
	1	Error code (do not use)	RO	2 bytes	-
	2	Response data (do not use)	RO	2 bytes	-
	3	Returned value 1	RO	2 bytes	Sent PZD2
	4	Returned value 2	RO	2 bytes	Sent PZD3

Index (hex)	Subindex (hex)	Function	Access	Data length	Description
2000	5	Returned value 3	RO	2 bytes	Sent PZD4
	6	Returned value 4	RO	2 bytes	Sent PZD5
	7	Returned value 5	RO	2 bytes	Sent PZD6
	8	Returned value 6	RO	2 bytes	Sent PZD7
	9	Returned value 7	RO	2 bytes	Sent PZD8
	A	Returned value 8	RO	2 bytes	Sent PZD9
	B	Returned value 9	RO	2 bytes	Sent PZD10
	C	Returned value 10	RO	2 bytes	Sent PZD11
	D	Returned value 11	RO	2 bytes	Sent PZD12
	E	Reserved	RO	2 bytes	-
	F	Reserved	RO	2 bytes	-
2001	0	SW	RO	2 bytes	-

- **Example**

Example 1: To run the drive whose address is 3 forward, the master transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x2B	0x01	0x21	0x00	0x01	0x00	0x00	0x00

Example 2: Assume that the address of the slave drive is 3, and the function of setting 1 is defined as "Set frequency". To set the frequency to 50.00Hz (that is, setting 1=0x1388), the master transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x2B	0x00	0x21	0x03	0x88	0x13	0x00	0x00

Example 3: To read the running state of the drive whose address is 3, the master transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x01	0x20	0x00	0x00	0x00	0x00	0x00

If the drive is running forward, the following SDO response is returned to the master.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x4B	0x01	0x20	0x00	0x01	0x01	0x00	0x00

Example 4: Assume that the address of the slave drive is 3, and the function of setting 1 is defined as "Set frequency". The master transmits the following SDO command.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x603	0x40	0x00	0x20	0x03	0x00	0x00	0x00	0x00

If the running frequency of the drive is 50.00Hz, the following SDO command is returned to the master.

COB-ID	Request code	Object index		Sub-index	Request data			
	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x583	0x4B	0x00	0x20	0x03	0x88	0x13	0x00	0x00

7.3.6 Baud rate and communication address setting

7.3.6.1 Baud rate setting

Note: After setting the CANopen baud rate and communication address, you need to restart the drive for the settings to take effect.

The CANopen baud rate is set via drive function code P15.27. For function code addresses, refer to Appendix F Function parameter list. Table 7-23 describes the values of the function parameter and their corresponding baud rates.

Table 7-23 Baud rate selection

Function parameter value	Baud rate (bps)
1	800k
2	500k
3	250k
4	125k
5	100k

7.3.6.2 Communication address setting

The CANopen communication address is set through the function parameter P15.01.

7.3.7 Function codes related to sent and received PZD

Note: To enable CANopen communication, set P75.00 to 2 (CANopen communication) and select the relevant CANopen channel. The CANopen communication timeout time is configured via function code P15.26.

Table 7-24 Received PZD

Function code	Name	Description	Default	Modify
P15.02–P15.12	Received PZD2–Received PZD12	For details, refer to Appendix F Function parameter list.	0	○

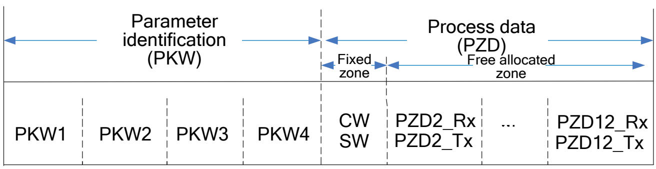
Table 7-25 Sent PZD

Function code	Name	Description	Default	Modify
P15.13–P15.23	Sent PZD2–Sent PZD12	For details, refer to Appendix F Function parameter list.	0	○

7.4 PKW communication description

The bus system allows fast data exchange between the master and the drive. For drives, data is always read and written in the master/slave mode. The drives always function as slaves, and one address is clearly defined for each slave. Periodic transmission messages use 16 words (16 bit) transmission, with the structure shown in the following figure.

Table 7-26 Message format



Parameter zone:

PKW1—Parameter identification

PKW2—Array index

PKW3—Parameter value 1

PKW4—Parameter value 2

Process data:

CW—Control word (see section 7.5.1 CW description)

SW—Status word (see section 7.5.2 SW description)

PZD—Process data (see section 7.5.3–7.5.5)

PKW zone (parameter identification marks PKW1–value zone): PKW zone describes treatment of parameter identification interface, PKW interface is a mechanism which determine parameters transmission between two communication partners, such as reading and writing parameter values. In the periodic communication, the PKW zone consists of four 16-bit words. The following table lists the definition of each word.

Table 7-27 PKW data definition

First word PKW 1 (16 bits)		
Bit 15–Bit 00	Task or response identification flag	0–7
Second word PKW2 (16 bit)		
Bit 15–Bit 00	Basic parameter address	0–65535
Third word PKW3 (16 bits)		
Bit 15–Bit 00	Value (most significant word) of a parameter or error code of the returned value	00
Fourth word PKW4 (16 bits)		
Bit 15–Bit 00	Value (least significant word) of a parameter	0–65535

Note: If cyclic read/write operations are required for relevant function parameters, it is recommended to use the PZD process data exchange function.

Task request and response: When transmitting data to a slave, the master uses a request number, and the slave uses a response number to accept or reject the request.

Table 7-28 Definitions of the task identification flag PKW1

Request (master → slave)		**Response signal**	
Request	**Function**	**Acceptance**	**Rejection**
0	No task	0	-
1	Requesting the value of a parameter	1 or 2	3
2	Modifying a parameter value (one word) [modifying the value only on RAM]	1	3 or 4
3	Modifying a parameter value (two words) [modifying the value only on RAM]	2	3 or 4
4	Modifying a parameter value (one word) [modifying the value on both RAM and EEPROM]	1	3 or 4
5	Modifying a parameter value (two words) [modifying the value on both RAM and EEPROM]	2	3 or 4

Table 7-29 Definitions of the task identification flag PKW1

Response No. (slave → master)	
Response No.	**Function**
0	No response
1	Transmitting the value of a parameter (one word)
2	Transmitting the value of a parameter (two words)
3	The task cannot be executed and one of the following error codes is returned: 1: Invalid command 2: Invalid data address 3: Invalid data value 4: Operation failure 5: Incorrect password 6: Incorrect data frame 7: Parameter read only 8: Parameter cannot be modified in running 9: Password protection 10: Function code mapping operation failure
4	Reserved

7.4.1 PKW read/write operation examples

Example 1: Reading the value of a parameter

You can set PKW1 to 1 and PKW2 to 0A to read a frequency set through keypad (the address of the frequency set through keypad is 10), and the value is returned in PKW4. The following data is in hexadecimal format.

Request: master → slave

PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
00	01	00	0A	00	00	00	00	xx	xx	xx	xx	xx	xx	...	xx	xx

Response: slave → master

PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
00	01	00	0A	00	00	13	88	xx	xx	xx	xx	xx	xx	...	xx	xx

Example 2: Modifying the value of a parameter (on both RAM and EEPROM)

You can set PKW1 to 4 and PKW2 to 0A to modify a frequency set through keypad (the address of the frequency set through keypad is 10). The value to be modified 1388H (50.00) is in PKW4.

Request: master → slave

PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
00	04	00	0A	00	00	13	88	xx	xx	xx	xx	xx	xx	...	xx	xx

Response: slave → master

PKW1		PKW2		PKW3		PKW4		CW		PZD2		PZD3		...	PZD12	
00	01	00	0A	00	00	13	88	xx	xx	xx	xx	xx	xx	...	xx	xx

7.5 PZD communication description

In CANopen/PROFIBUS and PROFINET/EtherNet IP, P15.43 provides CWs and SWs defined in decimal and bits. P14.48 is used to select the PZD mapping to function code channels. The following table lists the function code descriptions.

Function code	Name	Description	Default	Modify
P14.48	Channel selection for mapping between PZDs and function codes	Setting range: 0x00–0x12 Ones place: Channel for mapping function codes to PZDs 0: Reserved 1: Group P15 2: Group P16 Tens place: Save function at power-off 0: Disable 1: Enable	0x12	○
P15.43	Communication CW and SW representation formats	Setting range: 0–1 0: In decimal format 1: In binary format	1	◎

7.5.1 CW description

The CW has two representation formats: decimal and binary, which can be selected via function code P15.43. Table 7-30 and Table 7-31 describe the CWs for the MH860C series servo drive.

Table 7-30 MH860C CWs in decimal

Bit	Name	Value (EDC)	Description
0–7	Communication-based control command	1	Run forward
		2	Run reversely
		3	Jog forward
		4	Jog reversely
		5	Stop
		6	Coast to stop
		7	Fault reset
		8	Stop jogging
		9	Emergency stop
8	WIRTE ENABLE	1	Read and write enable (PKW1–PKW4)
9–10	Motor group setting	0	Reserved
		1	Reserved
11	Control mode switchover selection	1	Enable the switchover between torque control/speed control
		0	No switchover
12	ELECTRIC CONSUMPTION CLEAR	1	Enable clearing electricity consumption
		0	Disable clearing electricity consumption
13	PRE-EXCIATION	1	Enable pre-excitation
		0	Disable pre-excitation
14	DC BRAKE	1	Enable DC braking
		0	Disable DC braking
15	HEARTBEAT REF	1	Enable heartbeat
		0	Disable heartbeat

Table 7-31 MH860C CW binary representation

Bit	Name	Description	Priority
0	Enable running	0: Decelerate to stop 1= Enable running	1
1	Reserved		
2	Fault reset	0: None 1: Fault reset	3
3	Coast to stop	0: None 1: Coast to stop	4
4	Enable jogging	0: Decelerate to stop 1: Enable jogging	5
5	Reserved		
6	Reserved		
7	Reserved		
8	Enable read and write (PKW1–4)	0: Disable 1: Enable	/
9	Reserved		

Bit	Name	Description	Priority
10	Decelerate to stop in emergency manner	0: No 1: Decelerate to stop in emergency manner	0: Top priority
11–15	Reserved		

7.5.2 SW description

The SW has two representation formats: decimal and binary, which can be selected via function code P15.43. Table 7-32 and Table 7-33 describe the SWs for the MH860C series servo drive.

Table 7-32 MH860C series SW decimal representation

Bit	Name	Value	Description
0–7	Run status byte	1	Running forward
		2	Running reversely
		3	Drive in stopped state
		4	Drive in fault
		5	Drive in POFF state
8	Bus voltage established	1	Ready to run
		0	Not ready to run
9–10	Motor group feedback	0(0x00)	Feedback from motor 1
		1(0x01)	Feedback from motor 2
11	Motor type feedback	1	Synchronous motor (SM)
		0	Asynchronous motor (AM)
12	Overload pre-alarm feedback	1	Overload pre-alarm
		0	No overload pre-alarm
13–14	RUN/STOP MODE	0(0x00)	Keypad-based control
		1(0x01)	Terminal-based control
		2(0x10)	Communication-based control
		3(0x11)	Reserved
15	HEARTBEAT FEEDBACK	1	Heartbeat feedback
		0	No heartbeat feedback

Table 7-33 MH860C series SW binary representation

Bit	Name	Description	Priority
0	Forward running	0: None 1: Running forward	1
1	Reserved		
2	Stop	0: None 1: Drive in stopped state	3
3	Fault	0: None 1: Drive in fault	4
4	POFF	0: None 1: Drive in POFF state	5

Bit	Name	Description	Priority
5	Reserved		
6	Ready to run	0: None 1: Drive ready to run	0: Top priority
7–15	Reserved		

7.5.3 Short description of CANopen/PROFIBUS DP communication PZD

Received parameters:

Function code	Name	Description
P15.02	Received PZD2	0: Disable 1: Set frequency (0–Fmax, unit: 0.01Hz) 2–3: Reserved 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 9: Virtual input terminal command. Range: 0x000–0x3FF 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (used when V/F separation is implemented) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: Position reference MSB (signed) 15: Position reference LSB (unsigned) 16: Position feedback MSB (signed) 17: Position feedback LSB (unsigned)
P15.03	Received PZD3	
P15.04	Received PZD4	
P15.05	Received PZD5	
P15.06	Received PZD6	
P15.07	Received PZD7	
P15.08	Received PZD8	
P15.09	Received PZD9	
P15.10	Received PZD10	
P15.11	Received PZD11	
P15.12	Received PZD12	

Function code	Name	Description
P15.12	Received PZD12	18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59) 20: Flow setting (0.0–2400.0L/min, unit: 0.1L/min) 21: Pressure setting (0.0–250.0bar, unit: 0.1bar) 22: Hydraulic CW (Bit 0–2: Multi-step PID 0–3; Bit 3: 0: Flow splitting, 1: Flow combining; Bit 4–16: Reserved) 23: Hydraulic control mode (0 indicates that hydraulic control is invalid, and 1 indicates that hydraulic control is valid) 24: Speed reference (Non-hydraulic mode, -100.0–100.0%; 100.0% corresponds to P73.40 (Max. motor speed), -100.0% corresponds to negative P73.40) 25–27: Reserved 28: EAO3 output setting 29: EAO4 output setting 30–31: Reserved

When "1: Set frequency (0–Fmax, unit: 0.01Hz)" is selected, P00.06 (setting channel of A frequency command) must be set to PROFIBUS/CANopen/DeviceNet communication.

Function code	Name	Description	Set value
P00.06	Setting channel of A frequency command	9: PROFIBUS/CANopen/DeviceNet communication	9

When "24: Speed reference" is selected, P00.06 (setting channel of A frequency command) must be set to communication speed (corresponding to received PZD #24).

Function code	Name	Description	Set value
P00.06	Setting channel of A frequency command	4: Communication speed (corresponding to received PZD #24).	4

When selecting "12: AO1 output setting 1 (-1000–1000, 1000 corresponds to 100.0%)" and "13: AO2 output setting 2 (-1000–1000, 1000 corresponds to 100.0%)", they must be used in conjunction with function codes P06.14 and P06.16.

Function code	Name	Description	Set value
P06.14	AO1 output selection	16: Value 1 set through PROFIBUS/CANopen/DeviceNet communication 17: Value 2 set through PROFIBUS/CANopen/DeviceNet communication	16 or 17
P06.16	AO2 output selection	16: Value 1 set through PROFIBUS/CANopen/DeviceNet communication 17: Value 2 set through PROFIBUS/CANopen/DeviceNet communication	16 or 17

When selecting "19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59)", it must be used in conjunction with function codes P14.48–P14.59.

Function code	Name	Description	Set value
P14.48	Channel selection for mapping between PZDs and function codes	Setting range: 0x00–0x12 Ones place: Channel for mapping function codes to PZDs 0: Reserved 1: Group P15 2: Group P16 Tens place: Save function at power-off 0: Disable 1: Enable	0x11
P14.49	Mapped function code of received PZD2	Setting range: 0x0000–0xFFFF Set the function code address to be mapped. For example, if the parameter to be mapped is P73.05, set it to 0x4905.	0x0000
P14.50	Mapped function code of received PZD3	Setting range: 0x0000–0xFFFF	0x0000
P14.51	Mapped function code of received PZD4	Setting range: 0x0000–0xFFFF	0x0000
P14.52	Mapped function code of received PZD5	Setting range: 0x0000–0xFFFF	0x0000
P14.53	Mapped function code of received PZD6	Setting range: 0x0000–0xFFFF	0x0000
P14.54	Mapped function code of received PZD7	Setting range: 0x0000–0xFFFF	0x0000
P14.55	Mapped function code of received PZD8	Setting range: 0x0000–0xFFFF	0x0000

Function code	Name	Description	Set value
P14.56	Mapped function code of received PZD9	Setting range: 0x0000–0xFFFF	0x0000
P14.57	Mapped function code of received PZD10	Setting range: 0x0000–0xFFFF	0x0000
P14.58	Mapped function code of received PZD11	Setting range: 0x0000–0xFFFF	0x0000
P14.59	Mapped function code of received PZD12	Setting range: 0x0000–0xFFFF	0x0000

When selecting "20: Flow setting (0.0–2400.0L/min, unit: 0.1L/min)", "21: Pressure setting (0.0–250.0bar, unit: 0.1bar)", and "22: Hydraulic CW (Bit 0–2: Multi-step PID 0–3; Bit 3: 0: Flow splitting, 1: Flow combining; Bit 4–16: Reserved)", they must be used in conjunction with function code P73.01.

Function code	Name	Description	Set value
P73.01	Pressure and flow command source selection	5: Profinet/CANopen/EtherCAT communication	5

Sent parameters:

Function code	Name	Description
P15.13	Sent PZD2	Setting range: 0–32 0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotation speed of running (×1, rpm) 9: Linear speed of running (×1, m/s) 10: Ramp reference frequency
P15.14	Sent PZD3	
P15.15	Sent PZD4	
P15.16	Sent PZD5	
P15.17	Sent PZD6	
P15.18	Sent PZD7	
P15.19	Sent PZD8	
P15.20	Sent PZD9	
P15.21	Sent PZD10	
P15.22	Sent PZD11	
P15.23	Sent PZD12	

Function code	Name	Description
P15.23	Sent PZD12	11: Fault code 12: AI1 input (×100, V) 13: AI2 input (×100, V) 14: Pressure feedback value (×10， bar) 15: Hydraulic SW 16: Terminal input state 17: Terminal output state 18–19: Reserved 20: Speed reference (×1, RPM, signed) 21: Position reference MSB (signed) 22: Position reference LSB (unsigned) 23: Position feedback MSB (signed) 24: Position feedback LSB (unsigned) 25: SW 2 (same as P18.23) 26: Hydraulic mode speed feedback (×10, RPM) 27: MSB of PG card pulse feedback count 28: LSB of PG card pulse feedback count 29: EAI5 input (×100, V) 30: EAI6 input (×100, V) 31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70)

When "15: Hydraulic SW 2" is selected, the bit information is described as follows.

Bit	Name	Value	State/Description
0	Hydraulic control mode	0	Non-hydraulic mode
		1	Hydraulic mode
1–3	Multi-step PID selection	0	PID group 1
		1	PID group 2
		2	PID group 3
		3	PID group 4
4	Flow splitting/combining status	0	Local flow splitting
		1	Local flow combining
5	Hydraulic circuit pressure relief status	0	No hydraulic circuit pressure relief signal output
		1	Hydraulic circuit pressure relief signal output
6	Swash plate switching output	0	Switch to large displacement
		1	Switch to small displacement

Bit	Name	Value	State/Description
7	Hydraulic pressure reached	0	Hydraulic pressure set value not reached
		1	Hydraulic pressure set value reached
8	Pressure holding status	0	No pressure holding
		1	Pressure holding status
9–10	Pressure relief status	0	No pressure relief
		1	Reverse rotation pressure relief
		2	Hydraulic circuit pressure relief
11–16	Reserved	-	-

When "25: SW 2 (same as P18.23)" is selected, the bit information is described as follows.

Bit	Name	Value	State/Description
0	Ready to run	0	Not ready to run
		1	Ready to run
1–2	Motor group	0x00	Motor 1
		0x01	Motor 2
3	Motor type	0	AM
		1	SM
4	Overload pre-alarm	0	No overload pre-alarm
		1	Overload pre-alarm
5–6	Control mode	00	Keypad-based control
		01	Terminal-based control
		10	Communication-based control
		11	Reserved
7	Reserved		
8	Speed/Torque control	0	Speed control
		1	Torque control
9	Position control	0	Non-position control
		1	Position control
10–11	Control mode	00	Sensorless vector control (SVC) mode 0
		01	Sensorless vector control (SVC) mode 1
		10	VF control
		11	Closed-loop vector control mode
12–15	Reserved		

When selecting "31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70)", it must be used in conjunction with function codes P14.48 and P14.60–P14.70.

Function code	Name	Description	Set value
P14.48	Channel selection for mapping between PZDs and function codes	Setting range: 0x00–0x12 Ones place: Channel for mapping function codes to PZDs 0: Reserved 1: Group P15 2: Group P16 Tens place: Save function at power-off 0: Disable 1: Enable	0x11
P14.60	Mapped function code of sent PZD2	Setting range: 0x0000–0xFFFF Set the function code address to be mapped. For example, if the parameter to be mapped is P75.04, set it to 0x4B04.	0x0000
P14.61	Mapped function code of sent PZD3	Setting range: 0x0000–0xFFFF	0x0000
P14.62	Mapped function code of sent PZD4	Setting range: 0x0000–0xFFFF	0x0000
P14.63	Mapped function code of sent PZD5	Setting range: 0x0000–0xFFFF	0x0000
P14.64	Mapped function code of sent PZD6	Setting range: 0x0000–0xFFFF	0x0000
P14.65	Mapped function code of sent PZD7	Setting range: 0x0000–0xFFFF	0x0000
P14.66	Mapped function code of sent PZD8	Setting range: 0x0000–0xFFFF	0x0000
P14.67	Mapped function code of sent PZD9	Setting range: 0x0000–0xFFFF	0x0000
P14.68	Mapped function code of sent PZD10	Setting range: 0x0000–0xFFFF	0x0000
P14.69	Mapped function code of sent PZD11	Setting range: 0x0000–0xFFFF	0x0000
P14.70	Mapped function code of sent PZD12	Setting range: 0x0000–0xFFFF	0x0000

7.5.4 Short description of PROFINET/EtherNet IP/EtherCAT communication PZD

Received parameters:

Function code	Name	Description
P16.32	Received PZD2	0: Invalid 1: Set frequency (0–Fmax, unit: 0.01Hz) 2–3: Reserved 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 9: Virtual input terminal command. Range: 0x000–0x3FF 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (used when V/F separation is implemented) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%) 14: Position reference MSB (signed) 15: Position reference LSB (unsigned) 16: Position feedback MSB (signed) 17: Position feedback LSB (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59) 20: Flow setting (0.0–2400.0L/min, unit: 0.1L/min) 21: Pressure setting (0.0–250.0bar, unit: 0.1bar) 22: Hydraulic CW (Bit 0–2: Multi-step PID 0–3; Bit 3: 0:
P16.33	Received PZD3	
P16.34	Received PZD4	
P16.35	Received PZD5	
P16.36	Received PZD6	
P16.37	Received PZD7	
P16.38	Received PZD8	
P16.39	Received PZD9	
P16.40	Received PZD10	
P16.41	Received PZD11	
P16.42	Received PZD12	

Function code	Name	Description
P16.42	Received PZD12	Flow splitting, 1: Flow combining; Bit 4–16: Reserved) 23: Hydraulic control mode (0 indicates that hydraulic control is invalid, and 1 indicates that hydraulic control is valid) 24: Speed reference (Non-hydraulic mode, -100.0–100.0%; 100.0% corresponds to P73.40 (Max. motor speed), -100.0% corresponds to negative P73.40) 25–27: Reserved 28: EAO3 output setting 29: EAO4 output setting 30–31: Reserved

The usage of some received PZD parameters is similar to the description in section 7.5.3 Short description of CANopen/PROFIBUS DP communication PZD.

Sent parameters:

Function code	Name	Description
P16.43	Sent PZD2	Setting range: 0–32 0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotation speed of running (×1, rpm) 9: Linear speed of running (×1, m/s) 10: Ramp reference frequency 11: Fault code 12: AI1 input (×100, V) 13: AI2 input (×100, V) 14: Pressure feedback value (×10， bar) 15: Hydraulic SW 16: Terminal input state
P16.44	Sent PZD3	
P16.45	Sent PZD4	
P16.46	Sent PZD5	
P16.47	Sent PZD6	
P16.48	Sent PZD7	
P16.49	Sent PZD8	
P16.50	Sent PZD9	
P16.51	Sent PZD10	
P16.52	Sent PZD11	
P16.53	Sent PZD12	

Function code	Name	Description
P16.53	Sent PZD12	17: Terminal output state 18–19: Reserved 20: Speed reference (×1, RPM, signed) 21: Position reference MSB (signed) 22: Position reference LSB (unsigned) 23: Position feedback MSB (signed) 24: Position feedback LSB (unsigned) 25: SW 2 (same as P18.23) 26: Hydraulic mode speed feedback (×10 RPM, signed) 27: MSB of PG card pulse feedback count 28: LSB of PG card pulse feedback count 29: EAI5 input (×100, V) 30: EAI6 input (×100, V) 31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70) 32: EAI7 input (×100, V)

The usage of some sent PZD parameters is similar to the description in section 7.5.3 Short description of CANopen/PROFIBUS DP communication PZD.

7.5.5 PZD data exchange monitoring

In CANopen/PROFIBUS and PROFINET/EtherNet IP, it is possible to display the interaction between the communication card and the drive in P19.15 and P19.16 by setting P14.47, which facilitates commissioning.

Function code	Name	Description	Set value
P14.47	PZD display selection	Setting range: 0x00–0xCC Ones place: Received PZD 0–1: P19.15 displays CW 2–C: P19.15 displays PZD2–PZD12 sequentially Tens place: Sent PZD 0–1: P19.16 displays SW 2–C: P19.16 displays PZD2–PZD12 sequentially	00

When the ones place of P14.47 is set to 0–1, P19.15 specifies the CW that the PROFIBUS-DP/CANopen/PROFINET/EtherCAT card sends to the drive during communication.

When the ones place of P14.47 is set to 2–0xC, P19.15 specifies the PZD2–PZD12 sequentially that the PROFIBUS-DP/CANopen/PROFINET card sends to the drive during communication.

When the tens place of P14.47 is set to 0–1, P19.16 specifies the SW that the drive returns to the PROFIBUS-DP/CANopen/PROFINET/EtherCAT card during communication.

When the tens place of P14.47 is set to 2–0xC, P19.16 specifies the PZD2–PZD12 sequentially that the drive sends to the PROFIBUS-DP/CANopen/PROFINET card during communication.

Function code	Name	Description	Set value
P19.15	Drive communication CW	Display range: 0x0000–0xFFFF	-
P19.16	Drive communication SW	Display range: 0x0000–0xFFFF	-

8 Fault handling

8.1 Fault indication and reset

When the TRIP indicator is lit, it indicates that the drive is in an abnormal state, and the keypad display will show a fault code. Once a fault occurs, the protection function activates, the servo drive stops output, and the motor stops running. For details on the causes and common solutions corresponding to the fault codes, refer to section 8.2 Faults and solutions. The function codes from P07.27 to P07.32 record the types of the last six faults. The function codes P07.33–P07.41, P07.42–P07.50, and P07.51–P07.59 record the running data of the drive at the last three faults. If the fault cause cannot be located, contact our local office for technical support. There are three methods to reset drive faults:

Method 1 Press the STOP/RST key on the keypad.

Method 2 Set the corresponding parameter in P05.01–P05.05 to 7 for fault reset.

Method 3 Cut off the drive power supply.

After faults are removed, the motor can be started again.

8.2 Faults and solutions

When a fault occurs, handle the fault as follows:

Step 1 Check whether keypad display is improper. If yes, contact the local INVT office.

Step 2 If no, check the function codes in P07 group to determine the real state when the fault occurred.

Step 3 See the following table for a detailed solution and check for exceptions.

Step 4 Troubleshoot the fault or seek assistance from professionals.

Step 5 After confirming that the fault is cleared, reset the fault and start operation.

8.2.1 Common faults and solutions

<table>
<tr><th>Code</th><th>Fault type</th><th>Possible cause</th><th>Solution</th></tr>
<tr><td>E01</td><td>[1] Inverter unit U-phase protection</td><td rowspan="3">● ACC/DEC is too fast.
● The IGBT module is damaged.
● Misoperation is caused by interference.
● Drive wires are poorly connected.
● To-ground short circuit occurred.
● Sparks have occurred inside due to poor use environment conditions.</td><td rowspan="3">● Increase ACC/DEC time.
● Change the inverter unit.
● The device and system have been grounded reliably.
● Check for loose drive wires.
● Check for abnormal motor wiring and motor-to-ground short-circuit.
● Remove the dust or oil stain inside the drive regularly.</td></tr>
<tr><td>E02</td><td>[2] Inverter unit V-phase protection</td></tr>
<tr><td>E03</td><td>[3] Inverter unit W-phase protection</td></tr>
<tr><td>E04</td><td>[4] Overcurrent during ACC</td><td rowspan="3">● ACC/DEC is too fast.
● The voltage of the grid is too low.
● The drive power rating is insufficient.
● Load transient or exception occurred.
● To-ground short circuit or output phase loss occurred.
● 3PH output current imbalance.
● There are strong external interference sources (contactor switchover or improper grounding).
● Overcurrent stalling protection disabled.</td><td rowspan="3">● Increase ACC/DEC time.
● Increase grid input voltage.
● Select a drive with higher power rating.
● Check the motor for stalling or short circuits (short-to-ground or phase-to-phase), and load device exceptions.
● Check for abnormal drive 3PH output voltage and motor 3PH resistance imbalance.
● Check for strong interference (whether motor cable far away from contactor and system grounded reliably).
● Check the settings of related function codes.</td></tr>
<tr><td>E05</td><td>[5] Overcurrent during DEC</td></tr>
<tr><td>E06</td><td>[6] Overcurrent during constant speed running</td></tr>
<tr><td>E07</td><td>[7] Overvoltage during ACC</td><td rowspan="3">● ACC/DEC time is too short.
● Abnormal input voltage.
● The motor starts during rotating.
● Load energy regeneration too high.
● Lack of braking units.
● Dynamic braking is disabled.</td><td rowspan="3">● Increase ACC/DEC time.
● Check the input voltage.
● Use the speed tracking start function.
● Add dynamic braking devices or regenerative units.
● Set dynamic braking function parameters.</td></tr>
<tr><td>E08</td><td>[8] Overvoltage during DEC</td></tr>
<tr><td>E09</td><td>[9] Overvoltage during constant speed running</td></tr>
</table>

Code	Fault type	Possible cause	Solution
E10	[10] DC bus undervoltage	● The voltage of the grid is too low. ● Overvoltage stall protection disabled. ● Abnormal bus voltage display. ● Abnormal pre-charge contactor closing.	● Increase grid input voltage. ● Check the related function code settings. ● Contact the manufacturer. ● Contact the manufacturer.
E11	[11] Motor overload	● Grid voltage is too low. ● The motor rated current is set incorrectly. ● Motor stalling has occurred or load sudden change is too great.	● Increase grid input voltage. ● Reset the motor rated current in the motor parameter group. ● Check the load and adjust the torque boost.
E12	[12] The drive is overloaded.	● ACC is too fast. ● The motor is restarted during rotating. ● Grid voltage is too low. ● Load is too heavy. ● The drive power rating is insufficient.	● Increase ACC time. ● Avoid restart upon stop or enable speed tracking start. ● Increase grid input voltage. ● Select a drive with larger power. ● Select a proper motor.
E13	[13] Phase loss on input side	● Phase loss or violent fluctuation occurred on inputs RST. ● Input-side screws are loose.	● Check whether the input power is normal and input cables are loose. ● Set P11.00 to disable the fault.
E14	[14] Phase loss on output side	● Output cables are damaged or to-ground short circuit has occurred. ● Output phase loss (U, V, W) or severe three-phase load unbalance	● Check for loose or damaged output cables. ● Check for sharp load fluctuation and motor 3PH resistance imbalance.
E15	[15] Rectifier module overheating	● The air duct is blocked or the fan is damaged. ● Ambient temperature is too high. ● Long-time overload running.	● Ventilate the air duct or replace the fan. ● Keep good ventilation to lower ambient temperature. ● Select a drive with larger power.
E16	[16] Inverter module overheating		
E17	[17] External fault	● DI terminal external fault input signal acted.	● Check whether external device input is normal.

Code	Fault type	Possible cause	Solution
E18	[18] RS485 communication fault	● Incorrect baud rate. ● Communication line fault. ● Incorrect communication address. ● Communication suffers from strong interference.	● Set a proper baud rate. ● Check the communication port wiring. ● Set the communication address correctly. ● You are recommended to use shielded cables to improve anti-interference.
E19	[19] Current detection fault	● Abnormal motor cable or motor insulation. ● Poor contact of the connector of control board. ● Hall cable in poor contact. ● Hall component or current sampling optocoupler damaged.	● Remove motor cables to check. ● Check the connector and re-plug. ● Check the Hall cable connector. ● Contact the manufacturer.
E20	[20] Motor autotuning fault	● Motor capacity does not match the drive capacity. This fault may occur if the capacity difference exceeds five power classes. ● Motors parameters are set improperly. ● Autotuned parameter settings deviate sharply from the standard ones. ● Autotuning timeout. ● Pulse current setting is too high.	● Change the drive model, or adopt V/F mode for control ● Set the motor type and nameplate parameters correctly. ● Check motor wiring, motor type, and parameter settings. ● Disconnect the load from the motor and carry out autotuning again. ● Check whether the frequency upper limit is greater than 2/3 of the rated frequency. ● Decrease the pulse current setting properly.
E20	[20] Motor autotuning fault		
E21	[21] EEPROM operation fault	● Control parameter reading/writing error. ● EEPROM damaged.	● Press STOP/RST to reset. ● Replace the main control board.
E23	[23] Braking unit fault	● Braking circuit fault or braking IGBT damage. ● External braking resistor with low resistance.	● Check the braking unit and replace the braking IGBT. ● Increase the braking resistance.

Code	Fault type	Possible cause	Solution
E24	[24] Running time reached	● Actual running time of the drive is longer than internally set running time.	● Contact the manufacturer and adjust the set running time.
E25	[25] Electronic overload	● The drive reports an overload pre-alarm according to the setting. ● The resolver encoder polarity is opposite to the UVW output.	● Check whether the overload pre-alarm point is set properly. ● Adjust the ones place of P20.02, and re-perform the initial pole angle autotuning.
E26	[26] Keypad communication fault	● Keypad cable connected improperly or disconnected. ● Keypad cable too long, causing strong interference. ● Keypad or mainboard communication circuit error.	● Check the keypad cable and re-plug to determine whether a fault occurs. ● Check for and remove the external interference source. ● Replace the hardware and seek maintenance services.
E26	[26] Keypad communication fault		
E27	[27] Parameter upload error	● Keypad cable connected improperly or disconnected. ● Keypad cable too long, causing strong interference. ● Keypad or mainboard communication circuit error.	● Check the keypad cable and re-plug to determine whether a fault occurs. ● Check for and remove the external interference source. ● Replace the hardware and seek maintenance services.
E28	[28] Parameter download error	● Keypad cable connected improperly or disconnected. ● Keypad cable too long, causing strong interference. ● Keypad data storage error.	● Check for and remove the external interference source. ● Replace the hardware and seek maintenance services. ● Back up the data in the keypad again, and check whether the version of the original control board software of parameter copy is the same as the version of the control board software to be downloaded.

Code	Fault type	Possible cause	Solution
E29	[29] PROFIBUS card communication timeout fault	● There is no data transmission between the communication card and the host controller (or PLC).	● Check whether the communication card wiring is loose or dropped.
E30	[30] Ethernet card communication timeout fault	● There is no data transmission between the communication card and the host controller.	● Check whether the communication card wiring is loose or dropped
E31	[31] CANopen card communication timeout fault	● There is no data transmission between the communication card and the host controller (or PLC).	● Check whether the communication card wiring is loose or dropped.
E32	[32] To-ground short-circuit fault 1	● The output of the drive is short circuited to the ground. ● Current detection circuit fault ● Actual motor power setup deviates sharply from the drive power.	● Check whether the motor is short circuited to the ground and wiring is normal. ● Check whether the motor wiring is normal. ● Replace the hall component. ● Replace the main control board. ● Reset the motor parameters properly.
E33	[33] To-ground short-circuit fault 2		
E34	[34] Speed deviation fault	● The load is too heavy or stalled.	● Check for overload, increase speed deviation detection time, or prolong ACC/DEC time. ● Check motor parameter settings and re-perform motor parameter autotuning. ● Check whether speed loop control parameters are set properly.

Code	Fault type	Possible cause	Solution
E35	[35] Mal-adjustment fault	● Load exception occurred. ● SM parameters are set incorrectly. ● Autotuned motor parameters are inaccurate. ● The drive is not connected to the motor. ● Flux weakening application.	● Check for overload or stalling. ● Check motor parameter and counter EMF settings. ● Check whether control parameters are set correctly. ● Re-perform motor parameter autotuning. ● Increase mal-adjustment detection time. ● Adjust flux weakening coefficient and current loop parameters.
E36	[36] Underload fault	● The drive reports an underload pre-alarm according to the setting.	● Check the load and underload pre-alarm thresholds.
E37	[37] Encoder disconnection fault	● Incorrect encoder line sequence, or signal wires poorly connected. ● The encoder signal is interfered. ● Encoder is damaged.	● Check whether the encoder wiring is normal, and route the encoder cable separately from the power cable. ● Use a shielded cable for the encoder cable, and ensure the shield layer is grounded reliably. Ensure the system is grounded reliably. ● Replace the encoder with a new one.
E38	[38] Encoder reversal fault	● The encoder speed signal is opposite to the motor running direction.	● Reset the encoder direction.
E39	[39] Encoder Z pulse disconnection fault	● Z signal disconnection	● Check the wiring of Z signal and perform the wiring again.
E55	[55] Duplicate expansion card type	● The two inserted expansion cards are of the same type.	● You should not insert two cards of the same type. Check the type of expansion card, and remove one card after power-off.
E56	[56] Encoder UVW loss fault	● No level change detected in UVW signals.	● Check the UVW wiring. ● Check whether the encoder is damaged.

Code	Fault type	Possible cause	Solution
E57	[57] PROFINET card communication timeout fault	● There is no data transmission between the communication card and the host controller (or PLC).	● Check whether the communication card wiring is loose or dropped.
E58	[58] CAN master/slave card communication timeout fault	● There is no data transmission between the CAN master and slave communication cards.	
E59	[59] Motor overtemperature fault	● Motor overtemperature input terminal is valid. ● The temperature detection resistance is abnormal. ● Prolonged motor overload or abnormal heat dissipation.	● Check the wiring of the motor overtemperature input terminal (terminal function 57). ● Check whether the temperature sensor is normal. ● Check the motor and perform maintenance.
E60	[60] Failure to identify the expansion card in slot 1	● There is data transmission in the interface of card slot 1, but it cannot identify the card type.	● Check whether the expansion card at this slot is supported. ● Secure the expansion card interface after power-off, and check whether the fault persists at next power-on. ● Check whether the card slot is damaged. If yes, use another card slot after power-off.
E61	[61] Failure to identify the expansion card in slot 2	● There is data transmission in the interface of card slot 2, but it cannot identify the card type.	● Check whether the expansion card at this slot is supported. ● Secure the expansion card interface after power-off, and check whether the fault persists at next power-on. ● Check whether the card slot is damaged. If yes, use another card slot after power-off.
E62	[62] Failure to identify the expansion card in slot 3	● There is data transmission in the interface of card slot 3, but it cannot identify the card type.	
E63	[63] Communication timeout of expansion card in card slot 1	● There is no data transmission in the interface of card slot 1.	
E64	[64] Communication timeout of expansion card in card slot 2	● There is no data transmission in the interface of card slot 2.	

Code	Fault type	Possible cause	Solution
E66	[66] EtherCAT card communication timeout fault	● There is no data transmission between the communication card and the host controller (or PLC).	● Check whether the communication card wiring is loose or dropped.
E69	[69] CAN slave fault in master/slave synchronization	● Fault occurred in one of the CAN slave drives.	● Detect the CAN slave drive and analyze the corresponding fault cause.
E92	[92] AI1 disconnection	● AI1 wiring disconnected. ● AI1 input too low.	● Connect a 5V or 10mA power source to check whether the input is normal. ● Check the wiring or replace the cables.
E93	[93] AI2 disconnection	● AI2 wiring disconnected. ● AI2 input too low.	
E94	[94] AI3 disconnection	● Pressure sensor signal wires are connected incorrectly or not securely. ● The pressure feedback value is less than the disconnection detection threshold.	● Check the wiring of pressure feedback to control board terminals AI3, +24V and GND. ● Check whether the AD sampling value of AI3 exceeds the AI3 disconnection detection threshold in standby mode.
E95	[95] EtherNet/IP communication timeout	● There is no data transmission between the communication card and the host controller (or PLC).	● Check whether the communication card wiring is loose or dropped.
E96	[96] No upgrade bootloader	● Upgrade bootloader missing.	● Contact the manufacturer.
E97	[97] EAI3 disconnection	● I/O expansion card EAI3 wiring is disconnected. ● I/O expansion card EAI3 input is too low.	● Connect a 5V or 10mA power source to check whether the input is normal. ● Check the wiring or replace the cables.
E98	[98] EAI5 disconnection	● I/O expansion card EAI5 wiring is disconnected. ● I/O expansion card EAI5 input is too low.	
E99	[99] EAI6 disconnection	● I/O expansion card EAI6 wiring is disconnected. ● I/O expansion card EAI6 input is too low.	
E100	[100] EAI7 disconnection	● I/O expansion card EAI7 wiring is disconnected. ● I/O expansion card EAI7 input is too low.	

Code	Fault type	Possible cause	Solution
E101	[101] EAI overtemperature fault	● The temperature sensor measurement is inaccurate, or the sensor is not calibrated correctly. ● Equipment or ambient temperature too high.	● Set related parameters for calibration. ● Lower the equipment or ambient temperature.
E102	[102] EAI temperature sensor disconnection fault	● The temperature sensor is disconnected.	● Check the temperature sensor cable.
E621	[621] Hydraulic overpressure fault	● Control parameters are set improperly. ● The pressure feedback value exceeds the overvoltage threshold. ● The AI3 pressure feedback wiring is abnormal.	● Adjust the pressure loop or speed loop PID control parameters. ● Check the AI3 pressure feedback wiring.
E622	[622] Hydraulic pump stall fault	● The hydraulic pump is damaged or stalled.	● Check whether the hydraulic pump is damaged or whether there are mechanical faults in the hydraulic circuit.
E623	[623] UVW phase reverse sequence fault	● Motor cables UVW are connected reversely.	● Swap any two phase motor cables. ● Verify that the motor parameters are correct.
E624	[624]Motor temperature sensor disconnection	● The motor temperature sensor is disconnected. ● The resolver encoder cable is disconnected.	● Check the resolver encoder cable or motor temperature sensor cable.

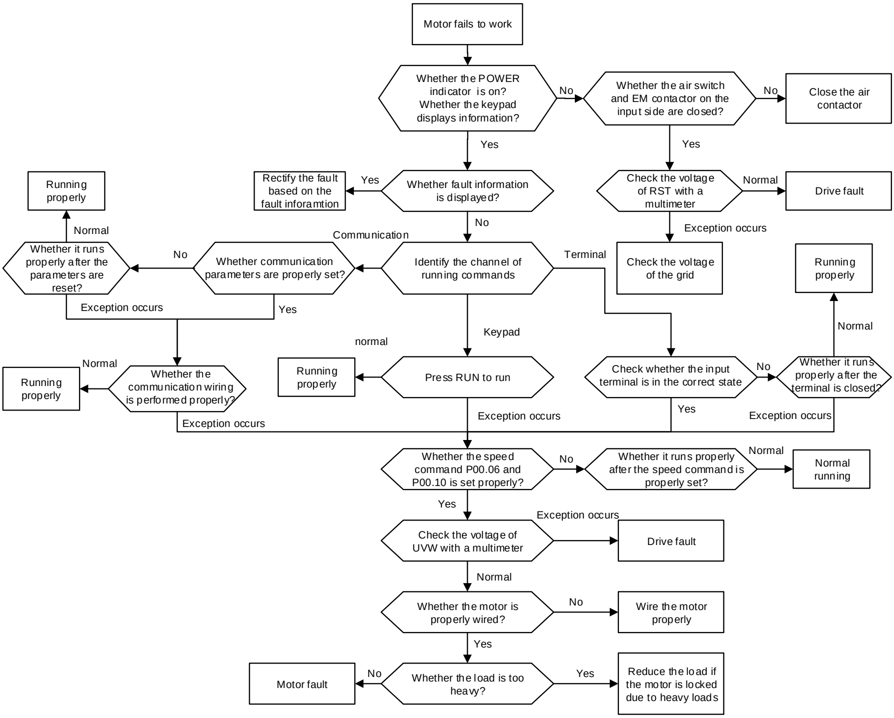
8.2.2 Other states

Code	State type	Possible cause	Solution
PoFF	System power failure	● The system is powered off or the bus voltage is too low.	● Check the grid environment.
A9105	Resolver encoder disconnection alarm	● Incorrect encoder line sequence, or signal wires poorly connected. ● The encoder signal is interfered. ● Encoder is damaged.	● Check whether the encoder wiring is normal, and route the encoder cable separately from the power cable. ● Use a shielded cable for the encoder cable, and ensure the shield layer is grounded reliably. Ensure the system is grounded reliably. ● Replace the encoder with a new one.
A9106	Pressure sensor disconnection alarm	● Pressure sensor signal wires are improperly connected, or signal wires are poorly connected. ● The pressure feedback value is less than the disconnection detection threshold.	● Check the wiring of pressure feedback to control board terminals AI3, +15V and GND. ● Check whether the AD sampling value of AI3 exceeds the AI3 disconnection detection threshold in standby mode.
A9107	Motor model error alarm	● The motor model specified by the combination of P73.64 and P73.65 is not supported.	● Enter a supported motor model listed in Appendix G Motor model and code table. ● Set P73.64 to 0 and manually enter the motor parameters in P2 group.
A9108	Motor temperature sensor disconnection alarm	● The motor temperature sensor is disconnected. ● The resolver encoder cable is disconnected.	● Check the resolver encoder cable or motor temperature sensor cable.
A9109	Slave offline alarm	● Fault occurred in one of the CAN slave drives.	● Check whether the communication card wiring is loose or disconnected. ● Check that CCOM is connected in the CAN master/slave communication line.
A9110	Slave fault alarm	● Fault occurred in one of the CAN slave drives.	● Detect the CAN slave drive and analyze the corresponding fault cause.

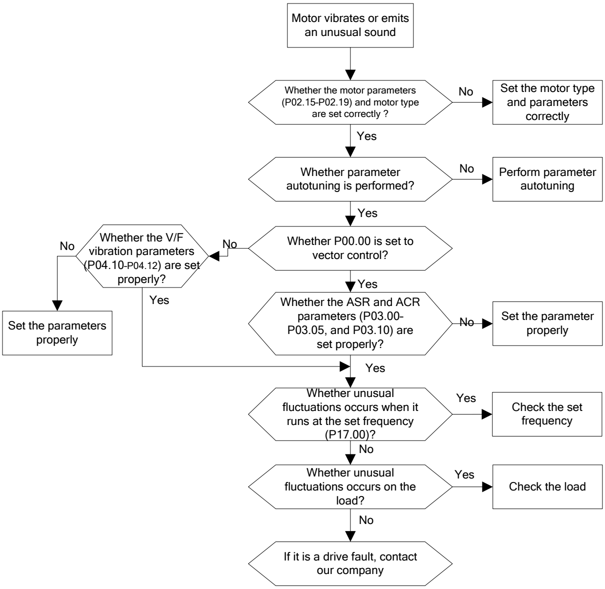
Code	State type	Possible cause	Solution
A9111	Analog zero-drift check failure	● The zero-drift value of the detection channel exceeds the allowable error range (see section 6.7.3 Pressure feedback zero-drift calibration for details).	● Check the wiring or replace the cables. ● Check whether there are strong interference sources.

8.3 Analysis on common faults

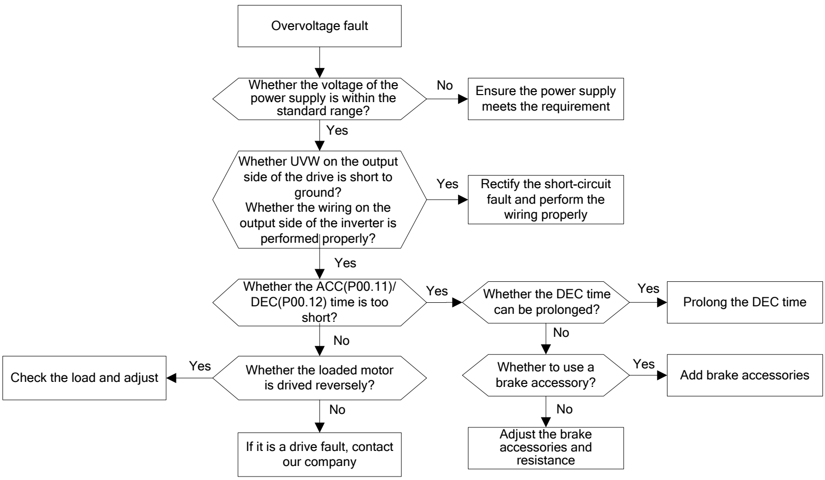
8.3.1 Motor fails to work



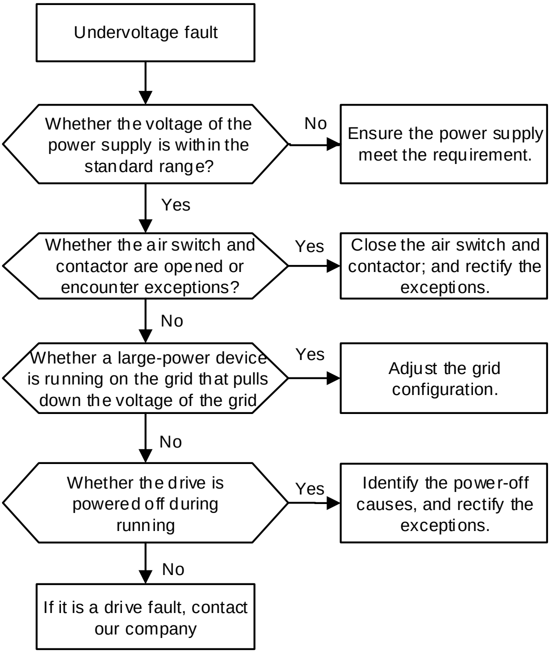
8.3.2 Motor vibrates



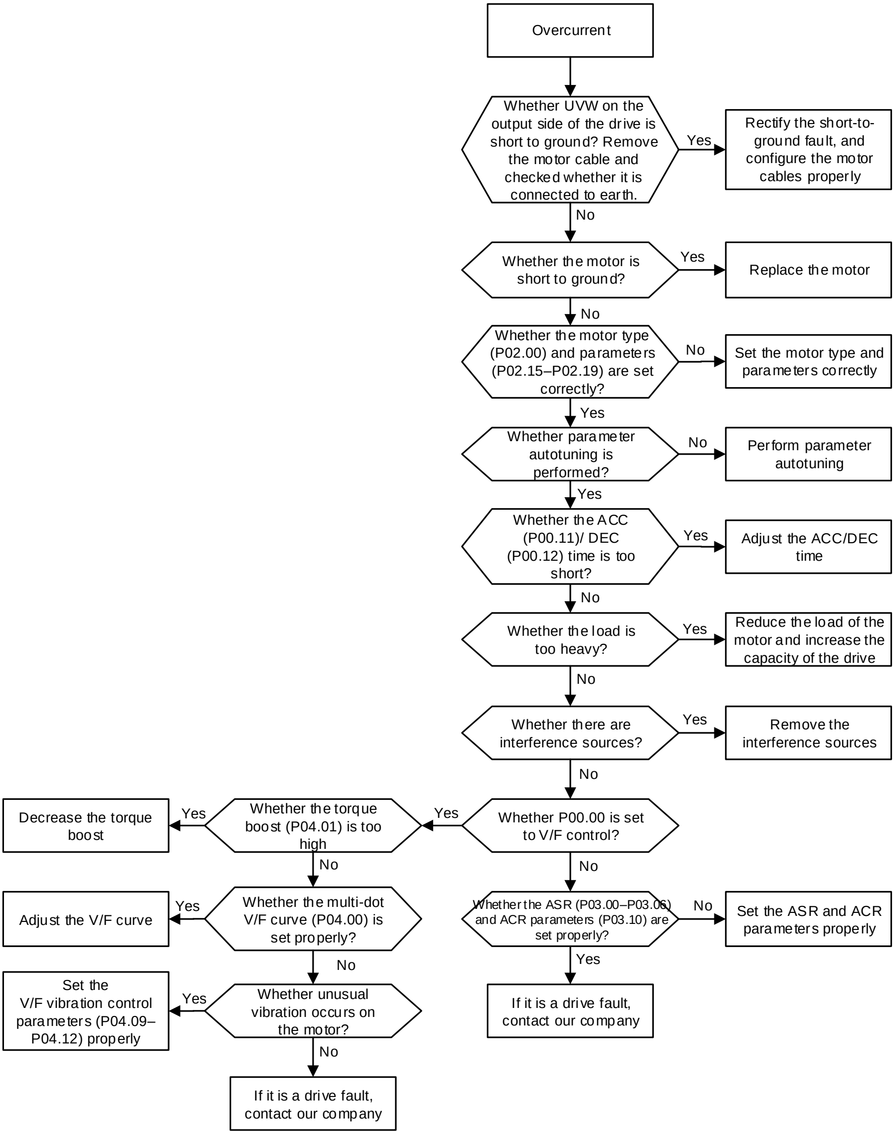
8.3.3 Overvoltage



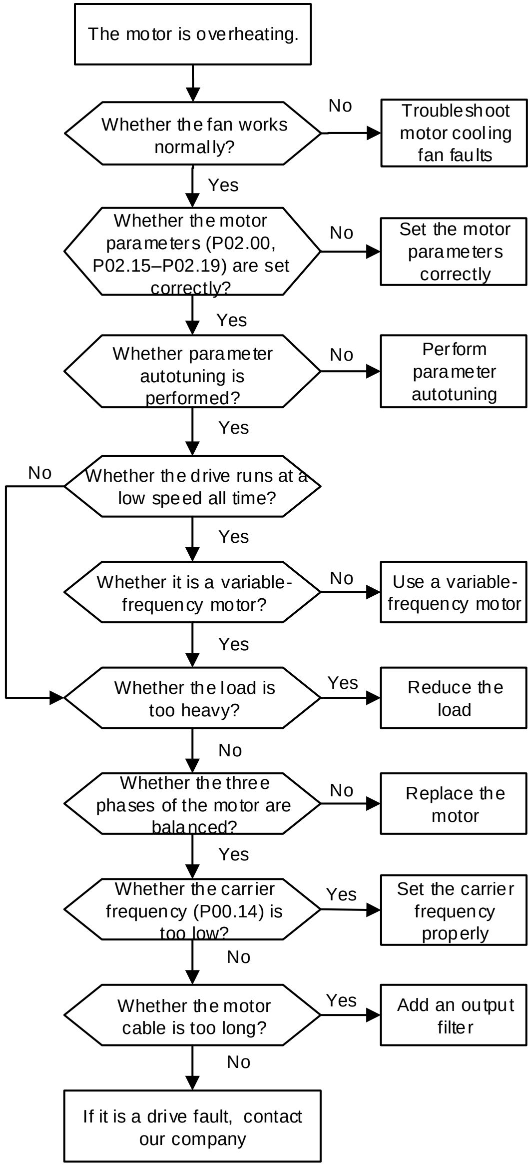
8.3.4 Undervoltage



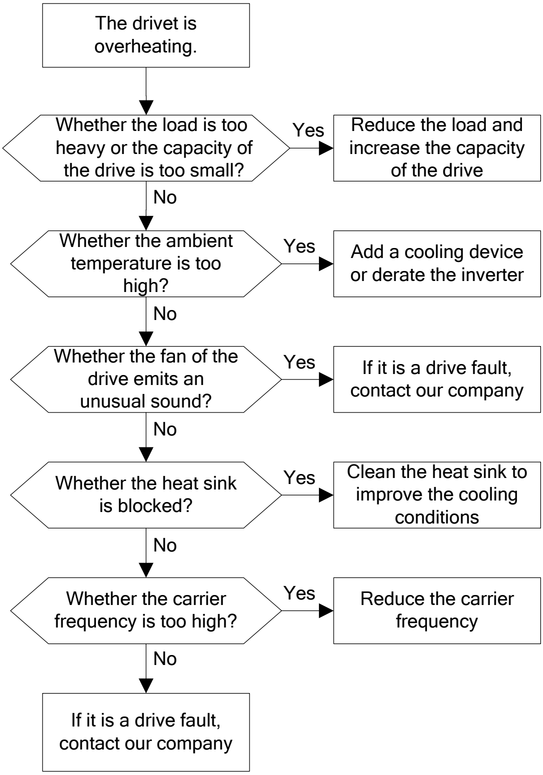
8.3.5 Overcurrent



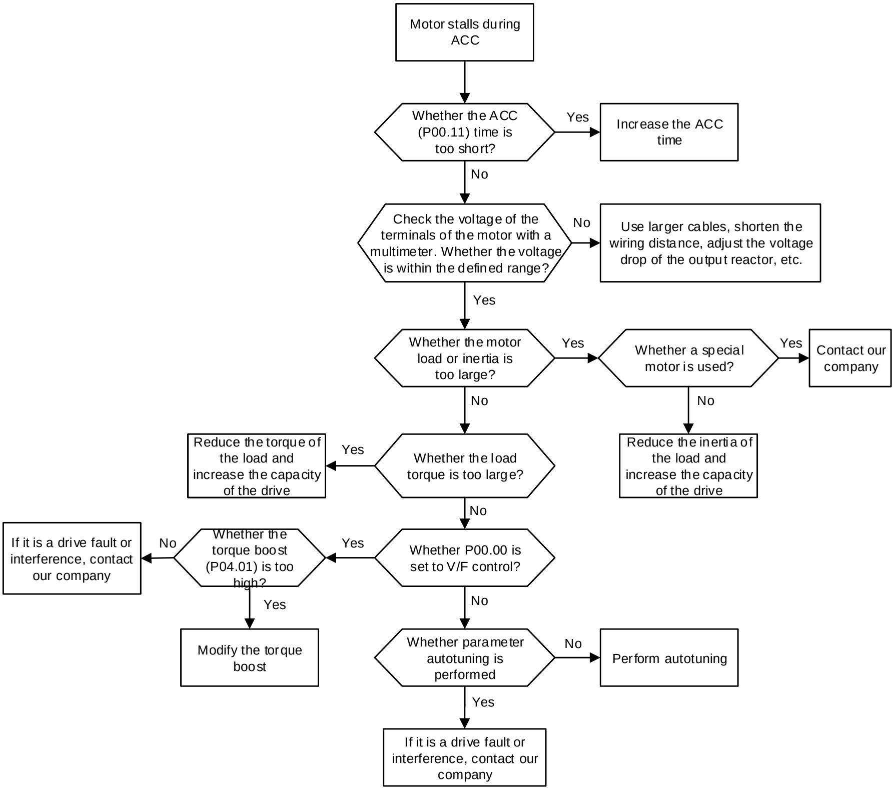
8.3.6 Motor overheating



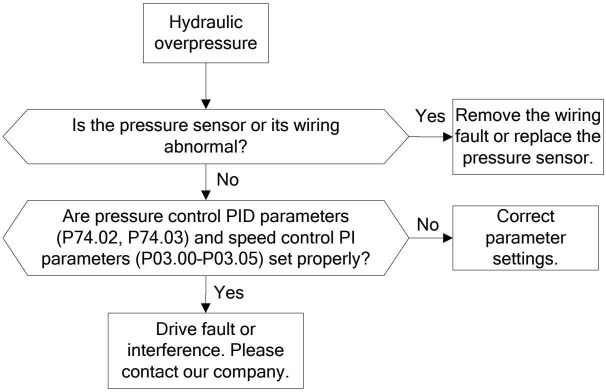
8.3.7 Drive overheating



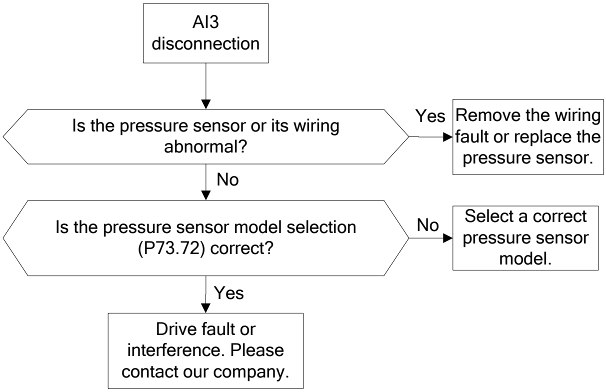
8.3.8 Motor stalls during ACC



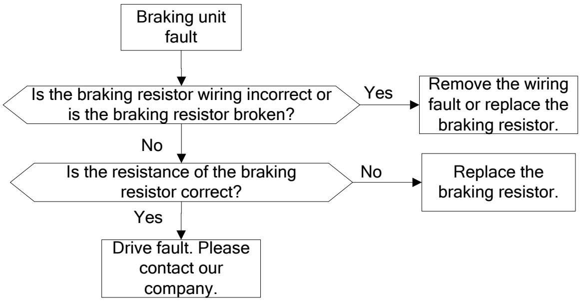
8.3.9 Overpressure in hydraulic system



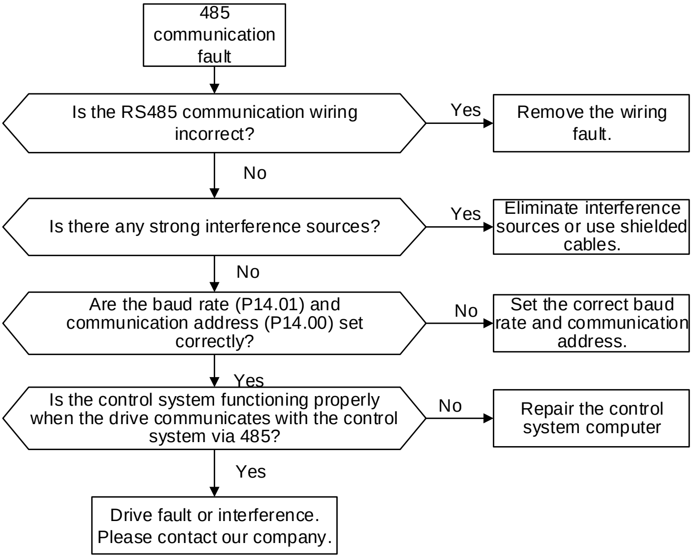
8.3.10 AI3 disconnection



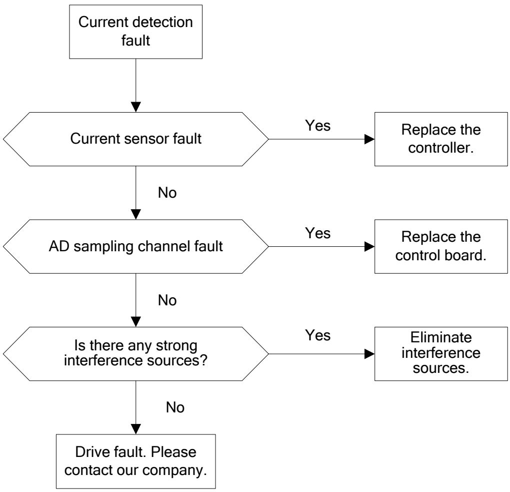
8.3.11 Braking unit fault



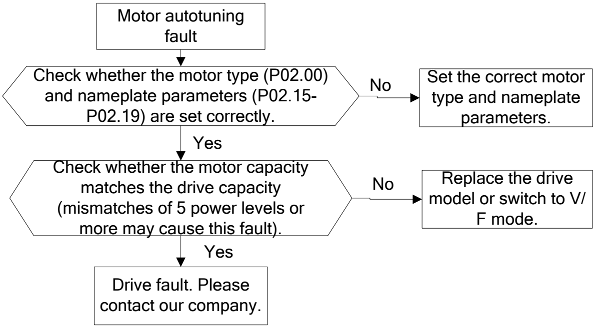
8.3.12 RS485 communication fault



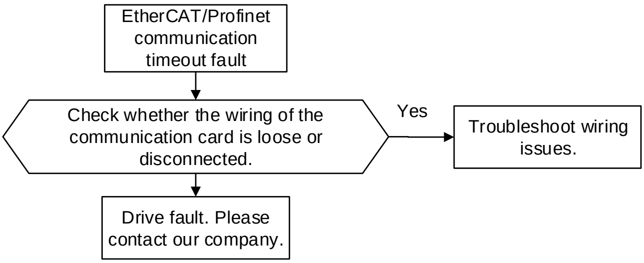
8.3.13 Current detection fault



8.3.14 Motor autotuning fault



8.3.15 EtherCAT/PROFINET communication timeout



8.4 Countermeasures for common interferences

8.4.1 Interference on meter switches and sensors

■ **Symptom and solution**

Sensor signals (such as pressure and temperature) are collected and displayed by the HMI. The sensor readings become inaccurate after the drive starts. The specific symptoms and solutions are listed in the table below:

Symptom	Solution
Incorrect display of upper limit or lower limit value, such as 999 or -999.	● Check and ensure that the sensor feedback cable is 20cm or farther away from the motor cable. ● Check and ensure that the ground wire of the motor is connected to the PE terminal of the drive (if the ground wire of the motor has been connected to the ground block, you need to use
The displayed value changes randomly (often occurred to pressure transmitter).	
The displayed value is stable but shows significant deviation; for example, the	

Symptom	Solution
temperature reading is tens of degrees higher than normal (common in thermocouples).	a multimeter to measure and ensure that the resistance between the ground block and PE terminal is lower than 1.5Ω). At the same time, you can short connect J10 at the drive input end. ● Try to add a safety capacitor of 0.1μF to the signal end of the feedback signal terminal of the sensor. ● Try to add a safety capacitor of 0.1μF to the power end of the sensor meter (pay attention to the voltage of the power supply and the voltage endurance of the capacitor). ● For interference on meters connected to the AO terminal of the drive, if the AO uses 0–20mA current signal, add a capacitor of 0.47μF between the AO and GND terminals; if the AO uses 0–10V voltage signal, add a capacitor of 0.1μF between the AO and GND terminals. ● The signal cable needs to use the shielded cable, and the shield layer must be grounded reliably to the PE or GND.
The signal collected by the sensor is not displayed directly but acts as a feedback signal for drive system operation. For example, the drive is supposed to decelerate when the air compressor has reached the upper limit pressure; however, it starts to decelerate before that limit is reached.	
All kinds of meters (such as frequency meters and ammeters) connected to the drive AO terminals display highly inaccurate values.	
Proximity switches are used in the system. After the drive is started, the indicator of a proximity switch flickers, and the output level flips.	

Note:

- When a decoupling capacitor is required, add it to the terminal of the device connected to the sensor. For example, if a thermocouple is to transmit signals of 0 to 20mA to a temperature meter, the capacitor needs to be added on the terminal of the temperature meter; if an electronic ruler is to transmit signals of 0 to 30V to a PLC signal terminal, the capacitor needs to be added on the terminal of the PLC.
- If a large number of meters or sensors are disturbed, it is recommended that you configure an external C2 filter on the drive input power end. For details, see section D.3.2 EMC filter.

8.4.2 RS485 communication interferences

■ **Symptom and solution**

The RS485 communication interference mainly manifests as communication delay, desynchronization, and intermittent or complete disconnection after the drive starts.

If communication is abnormal regardless of whether the drive is running or not, the issue is not necessarily caused by interference. The following methods can be used:

- Check whether the RS485 communication bus is disconnected or in poor contact.
- Check whether the A and B wires of the RS485 communication bus are connected reversely.
- Check whether the communication protocol of the drive is consistent with that of the host controller, such as the baud rate, data bits, and check bit.

If communication issues are confirmed to be caused by interference, the following methods can be used:

- Simple inspection.
- Arrange the communication cables and motor cables in different cable trays.
- In multi-drive application scenarios, adopt the daisy chain connection mode to connect the communication cables between drives, which can improve the anti-interference capability.
- In multi-machine application, it is necessary to confirm that the drive capacity of the master is strong enough.
- In the connection of multiple drives, you need to configure one 120Ω terminal resistor at both ends.

Solution:

- Check and ensure that the ground wire of the motor is connected to the PE terminal of the drive (if the ground wire of the motor has been connected to the ground block, you need to use a multimeter to measure and ensure that the resistance between the grounding block and PE terminal is lower than 1.5Ω).
- Do not connect the drive and motor to the same ground terminal as the host controller (PLC, HMI, and touch screen). It is recommended that you connect the drive and motor to the power ground, and connect the host controller separately to a ground stud.
- Try to short the signal reference ground terminal (GND) of the drive with that of the host controller to ensure that ground potential of the communication chip on the control board of the drive is consistent with that of the communication chip of the host controller.
- Try to change the short-connection cap of jumper J9 on the drive control board from pins 1, 2 to pins 2, 3.
- Try to add a safety capacitor of 0.1μF on the power terminal of the host controller (PLC, HMI, and touch screen). During this process, pay attention to the voltage of the power supply and the voltage endurance capability of the capacitor. Alternatively, you can use a magnet ring (Fe-based nanocrystalline magnet rings are recommended). Put the power L/N line or +/- line of the host controller through the magnet ring in the same direction and wind 8 coils around the magnet ring.

8.4.3 Stop failure and dimly lit indicators due to motor cable coupling

■ Symptom and solution

Symptom	Solution
Stop failure: In a drive system where a DI terminal is used to control the start and stop, the motor cable and control cable are arranged in the same cable tray. After the system is started properly, the DI terminal cannot be used to stop the system.	● Check and confirm that the affected signal cables are routed at least 20cm away from the motor cables. ● Add a safety capacitor of 0.1μF between the digital input (DI) terminal and the COM terminal. ● Connect the digital input (DI) terminal that controls the start and stop to other idle digital input terminals in parallel. For example, if DI1 is used to control the start and stop and DI4 is idle, you can try to short connect DI1 to DI4.
Dimly lit indicators: After the drive starts, the system exhibits abnormal symptoms such as faintly glowing or flickering indicators (relay, power distribution box, PLC) and buzzing noises.	

Note: If the controller (such as PLC) in the system controls more than five drives at the same time through digital input terminals (DI), this scheme is not applicable.

8.4.4 Leakage current and residual current device (RCD) issues

■ **Working principle**

Drives output high-frequency PWM voltage to drive motors. In this process, the distributed capacitance between the internal IGBT of a drive and the heat sink and that between the stator and rotor of a motor may inevitably cause the drive to generate high-frequency leakage current to the ground. An RCD is used to detect the power-frequency leakage current when a grounding fault occurs on a circuit. The application of a drive may cause misoperation of an RCD.

■ **RCD selection guidelines**

✧ Drive systems are special. In these systems, it is required that the rated residual current of common RCDs at all levels is larger than 200mA, and the drives are grounded reliably.

✧ For RCDs, the time limit of an action needs to be longer than that of a next action, and the time difference between two actions needs to be longer than 20ms. For example, 1s, 0.5s, and 0.2s.

✧ For circuits in drive systems, electromagnetic RCDs are recommended. Electromagnetic RCDs have strong anti-interference capability and thus can prevent the impact of high-frequency leakage current.

Electronic RCD	Electromagnetic RCD
Low cost, high sensitivity, small in volume, susceptible to voltage fluctuation of the grid and ambient temperature, and weak anti-interference capability.	Requiring a highly sensitive and accurate zero-sequence current transformer. Made of high-permeability permalloy, which involves a complex and costly process but offers high immunity to interference and stability against voltage and temperature fluctuations.

■ **Symptom and solution**

Symptom	Solution
RCD misoperation at the transient drive power-on	● Solution to RCD misoperation (handling the drive) ✧ Remove the "EMC/J10" jumper cap (for models 45kW and above). ✧ Try to decrease the carrier frequency to 1.5kHz (P00.14=1.5). ✧ Try to modify the modulation method to "3PH modulation and 2PH modulation" (P08.40=0x0000).
RCD misoperation after drive running	● Solution to RCD misoperation (handling the system power distribution): ✧ Check that the power cable is not submerged in water. ✧ Check that the power cables are not damaged or spliced. ✧ Check that there is no secondary grounding on the neutral wire. ✧ Check that the main power cable terminal is in good contact with the air switch or contactor (all screws are tightened). ✧ Check 1PH powered devices, and ensure that no earth wires are used as neutral wires by these devices. ✧ Drive power cable and motor cable should not be shielded ones.

8.4.5 Live device housing

■ **Live device housing description**

After the drive is started, there is sensible voltage on the housing, and you may feel an electric shock when touching the housing. However, when the drive is powered on but not running, the system housing is not live (or the voltage is well below safe touch limits).

■ **Symptom and solution**

Symptom	Solution
Live device housing	● Ground the drive cabinet housing through the power ground or stud. ● If there is no grounding on the site, you need to connect the motor housing to the drive grounding terminal PE, and ensure that the jumper at "EMC/J10" at the middle of the drive housing is shorted already.

9 Inspection and maintenance

9.1 Daily inspection and regular maintenance

The product internal components will age due to the ambient temperature, humidity, dust, vibration and other factors, which causes potential failures or shortens the service life. Therefore, to extend the drive service life and prevent safety hazards, daily inspection and regular maintenance are required.

Check item	Content	Method
Daily inspection: Recommended on each day.		
Ambient environment	Whether the ambient temperature, humidity, vibration, dust, gas, and oil are too great, and whether there is condensation or water droplets inside and outside the machine	Visual inspection and instrument measurement
	Whether there are foreign matters, such as tools, or dangerous substances placed nearby	Visual inspection
Power voltage	Whether the voltage between the main circuit and control circuit is normal	Multimeter or voltage meter
Keypad	Whether display is clear	Visual inspection
	Whether some characters or fields are displayed incompletely	Visual inspection
Fan	Whether it runs normally	Visual inspection
Load	Whether the motor is overloaded or overheating, or it sounds abnormally.	Visual inspection
Regular maintenance: Recommended on a quarterly basis, especially in harsh environments such as with dust, oil, or corrosive gases. Before regular maintenance, cut off the power and wait at least 15min.		
Entire machine	Whether the bolts become loose or come off	Visual inspection
	Whether the machine is deformed, cracked, or damaged, or the color changes due to overheating and aging	Visual inspection
	Whether much dirt or dust is attached	Visual inspection
	Whether there is abnormal sound or vibration, odor, discoloration (transformer, reactor and fan)	Auditory, olfactory, and visual inspection
Motor	Whether the installation is secure, motor insulation is normal, and the fan runs properly	Instrument or visual inspection
Cable	Whether there is discoloration, deformation, or damage	Visual inspection

Check item	Content	Method
Cable	Whether the cable connectors or bolts become loose	Visual inspection
Connection terminals	Whether there is overheating or damage	Visual inspection
Electrolytic capacitor	Whether there is electrolyte leakage, discoloration, cracks, and housing expansion	Visual inspection
	Whether the safety valve is exposed outside	Visual inspection
External braking resistor	Whether there is displacement caused due to overheating	Olfactory and visual inspection
	Whether aging, skin breakage, or wire damage occurs to the resistor cable	Visual inspection, or measuring with a multimeter after removing one cable end
Contactor and relay	Whether there is vibration sound during running	Auditory inspection
	Whether the contacts are in good contact	Visual inspection
Control PCB and connector	Whether the screws and connectors become loose	Tighten them
	Whether there is unusual smell or discoloration	Olfactory and visual inspection
	Whether there is corrosion or rust stains	Visual inspection
Ventilation duct	Whether there are foreign matters blocking or attached to the cooling fan, air inlets, or air outlets	Visual inspection

For more details about maintenance, contact the local INVT office, or visit our website www.invt.com, and click the online chat icon on the homepage.

9.2 Replacement of wearing parts

The wearing parts of the servo drive mainly include the cooling fan and electrolytic capacitor, of which the service life is closely related to the running environment and maintenance conditions. In normal use at the ambient temperature of 40°C, the general life time is as follows:

Device name	Service life
Fan	⩾ 5 years
Electrolytic capacitor	⩾ 5 years

9.2.1 Cooling fan

- **Possible damage cause**

Bearing wear, blade aging, water, oil, dust and other environmental factors may cause circuit board damage.

- **Cooling fan replacement procedure**

Step 1 Stop the drive, disconnect the AC power supply, and wait for at least the time indicated on the drive.

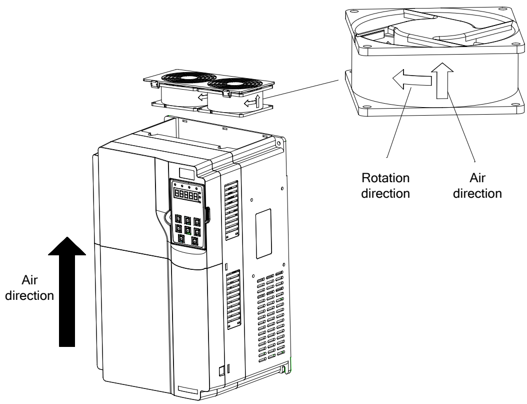
Step 2 Release the fan cable from the cable clamp.

Step 3 Remove the fan cable.

Step 4 Remove the fan with a screwdriver.

Step 5 Install the new cooling fan into the servo drive. Secure the fan cable into the cable clamp in the reverse order of removal, and reassemble the drive. Ensure that the fan's airflow direction matches the drive's airflow direction, as shown in the figure below.

Figure 9-1 Fan maintenance



Note:

- Before disassembling or installing the drive, stop it, cut off the power, and wait at least 15 minutes.
- Different drive models may be slightly different in the fan quantity and position. The fan disassembly and assembly methods may be different.
- When installing the fan, ensure the air arrow points upward, and regardless of

whether the fan is installed at the bottom or the top, ensure that the fan blows upward.

9.2.2 Electrolytic capacitor

- **Possible damage cause**

The possible causes include high input power harmonics, high ambient temperature, frequent load jumps, and electrolyte aging.

- **Filter capacitor replacement**

It is recommended that a professional be asked for the replacement because the filter capacitor involves drive internal components.

9.3 Reforming

If the drive has been left unused for a long time, you need to follow the instructions to reform the DC bus electrolytic capacitor before using it. The storage time is calculated from the date the product is delivered. For detailed operation, contact us.

Storage period	Procedure
Less than 1 year	No charging is required.
1 to 2 years	Before the first run, apply the voltage of one class lower than the drive voltage class to the drive for 1 hour.
2 to 3 years	Use a voltage controlled power supply to charge the drive: ● Charge the drive at 25% of the rated voltage for 30 minutes. ● Then, charge it at 50% of the rated voltage for 30 minutes. ● Charge it at 75% for another 30 minutes. ● Finally, charge it at 100% of the rated voltage for 30 minutes.
More than 3 years	Use a voltage controlled power supply to charge the drive: ● Charge the drive at 25% of the rated voltage for 2 hours. ● Then, charge it at 50% of the rated voltage for 2 hours. ● Charge it at 75% for another 2 hours. ● Finally, charge it at 100% of the rated voltage for 2 hours.

The method for using a voltage controlled power supply to charge the drive is described as follows:

The selection of a voltage controlled power supply depends on the power supply of the drive. For drives with an incoming voltage of 1PH/3PH 220 VAC, you can use a 220 VAC/2A voltage regulator. Both 1PH and 3PH drives can be charged with a 1PH voltage controlled power supply (connecting L+ to R, and N to S or T). Since a single rectifier is used, all DC bus capacitors are charged simultaneously

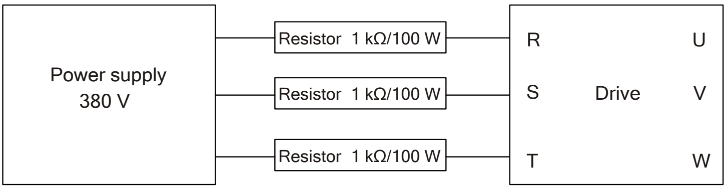
For drives of a high voltage class, ensure that the voltage requirement (for example, 380V) is met during charging. Capacitor changing requires little current; therefore, you can use a small-capacity power supply (2A is sufficient).

The method for using a resistor (incandescent lamp) to charge the drive is described as follows:

If you directly connect the drive device to a power supply to charge the DC bus capacitor, it needs to be charged for a minimum of 60 minutes. The charging operation must be performed at a normal indoor temperature without load, and you must connect a resistor in series mode in the 3PH circuit of the power supply.

For a 380V drive device, use a resistor of 1kΩ/100W. If the voltage of the power supply is no higher than 380V, you can also use an incandescent lamp of 100W. If an incandescent lamp is used, it may go off or the light may become very weak.

Figure 9-2 380V driving-device charging circuit example



Appendix A Derating

If the ambient temperature at the drive installation site exceeds 40°C, the drive installation site altitude exceeds 1000m, a ventilation cover is used, or the carrier frequency is higher than the recommended (see P00.14), the drive needs to be derated.

A.1 Derating due to temperature

For temperatures between +40°C and +50°C, the rated output current should be derated by 1% for each increased 1°C.

Note: It is not recommended to use the drive in an environment with the temperature higher than 50°C. If you do, we shall not hold accountable for the consequences caused.

A.2 Derating due to altitude

When the installation site altitude is lower than 1000m, the drive can run at the rated power. When the altitude exceeds 1000m, derate by 1% for every increase of 100m. When the altitude exceeds 3000m, consult our local dealer or office for details.

A.3 Derating due to carrier frequency

The carrier frequency of the drive varies with power class. The drive rated power is defined based on the carrier frequency factory setting. If the carrier frequency exceeds the factory setting, the drive power should be derated. For specific derating requirements at different carrier frequencies, see Table A-1.

Table A-2 Derating for 380V 2–8kHz carrier frequencies

Drive model	Carrier frequency						
	2kHz	3kHz	4kHz	5kHz	6kHz	7kHz	8kHz
MH860C-S018TF7	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
MH860C-S025TF7	100.00%	100.00%	100.00%	100.00%	100.00%	87.92%	82.64%
MH860C-S032TF7	100.00%	100.00%	100.00%	100.00%	100.00%	88.44%	81.56%
MH860C-S038TF7	100.00%	100.00%	100.00%	92.26%	85.42%	79.37%	73.95%
MH860C-S045TF7	100.00%	100.00%	100.00%	100.00%	100.00%	85.60%	79.47%
MH860C-S060TF7	100.00%	100.00%	100.00%	100.00%	100.00%	92.17%	85.00%
MH860C-S075TF7	100.00%	100.00%	100.00%	100.00%	90.66%	82.80%	75.73%
MH860C-S092TF7	100.00%	100.00%	100.00%	100.00%	100.00%	92.50%	85.87%
MH860C-S115TF7	100.00%	100.00%	100.00%	100.00%	100.00%	93.48%	87.57%
MH860C-S150TF7	100.00%	100.00%	100.00%	88.13%	78.66%	70.67%	64.13%
MH860C-S180TF7	100.00%	100.00%	100.00%	88.89%	79.44%	71.67%	65.28%
MH860C-S215TF7	100.00%	100.00%	87.44%	77.44%	71.16%	65.81%	60.98%

Drive model	Carrier frequency						
	2kHz	3kHz	4kHz	5kHz	6kHz	7kHz	8kHz
MH860C-S260TF7	100.00%	100.00%	-	-	-	-	-
MH860C-S305TF7	100.00%	100.00%	-	-	-	-	-
MH860C-S340TF7	100.00%	100.00%	-	-	-	-	-
MH860C-S380TF7	100.00%	100.00%	-	-	-	-	-
MH860C-S425TF7	100.00%	100.00%	-	-	-	-	-
MH860C-S480TF7	100.00%	100.00%	-	-	-	-	-
MH860C-S530TF7	100.00%	99.1%	-	-	-	-	-
MH860C-S600TF7	100.00%	86.7%	-	-	-	-	-
MH860C-S650TF7	100.00%	100.00%	-	-	-	-	-

Appendix B Applicable standards

B.1 List of applicable standards

The drive complies with the following standards:

EN/ISO 13849-1	Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design
IEC/EN 60204-1	Safety of machinery—Electrical equipment of machines—Part 1: General requirements
IEC/EN 62061	Safety of machinery—Safety-related functional safety of electrical, electronic, and programmable electronic control systems
IEC/EN 61800-3	Adjustable speed electrical power drive systems—Part 3: EMC requirements and specific test methods
IEC/EN 61800-5-1	Adjustable speed electrical power drive systems—Part 5-1: Safety requirements—Electrical, thermal and energy
IEC/EN 61800-5-2	Adjustable speed electrical power drive systems—Part 5-2: Safety requirements—Function

B.2 CE/TUV/UL/CCS certification

The CE mark affixed to the drive indicates that it is CE-compliant, meeting the regulations of the European low-voltage directive (2014/35/EU) and EMC directive (2014/30/EU).

The TUV mark affixed to the drive indicates that it is TUV-certified. TUV certification includes TUV-MARK, TUV-CE, TUV-CB, GS, and VDE certifications, which have high authority and recognition in the field of electronic appliances and components.

The UL mark affixed to the drive indicates that it is UL-certified. UL certification is a voluntary certification in the United States (but mandatory in some states). Certified products meet the relevant UL standard requirements and can enter the US market.

The CCS mark affixed to the drive indicates that it is CCS-certified. CCS is a marine classification society of China. Certified products comply with applicable marine standards and are approved for use in marine and offshore applications.

B.3 EMC compliance declaration

Electro Magnetic Compatibility (EMC) describes the ability of electronic and electrical devices to work properly in the electromagnetic environment without generating excessive electromagnetic interference that affects nearby devices or systems. The drive is compliant with the EMC product standard (EN 61800-3) and is applicable to both the first environment and the second environment.

B.4 EMC product standard

The EMC product standard (EN 61800-3) describes the EMC requirements on drives.

Application environment categories:

First environment: Residential environments, including application scenarios where the drive is directly connected without intermediate transformer to a low-voltage power supply network which supplies residential buildings.

Second environment: Environment that includes all application scenarios where the drive is not directly connected to a low-voltage power supply network which supplies residential buildings.

C1: Drive of rated voltage lower than 1000V, applied to the first environment.

C2: Drive of rated voltage lower than 1000V, which is neither a plug, socket, nor mobile device and must be installed and commissioned by a professional when used in the first environment.

Note: The product may generate radio interference in residential environments. You need to take measures to reduce the interference.

C3: Drive of rated voltage lower than 1000V, applied to the second environment. They cannot be applied to the first environment.

Note: Drives of C3 cannot be applied to a residential low-voltage public grid. When applied to such networks, the drives may generate radio frequency electromagnetic interference.

C4: Drive of rated voltage higher than 1000V, or rated current higher than or equal to 400A, applied to complex systems in the second environment.

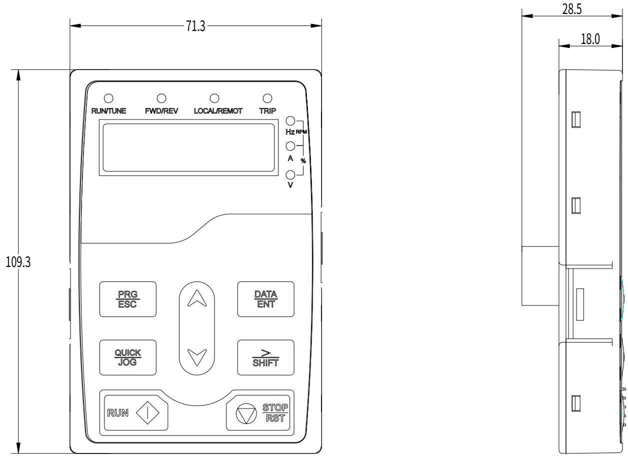
Note: The EMC standard IEC/EN 61800-3 no longer restricts the power distribution of the drive, but defines the use, installation, and commissioning of the drive. Specialized personnel or organizations must have the necessary skills (including EMC-related knowledge) for installing and/or commissioning the electrical drive systems.

Appendix C Dimension drawings

C.1 Keypad structure

C.1.1 Keypad structure diagram

Figure C-1 keypad structure diagram (unit: mm)



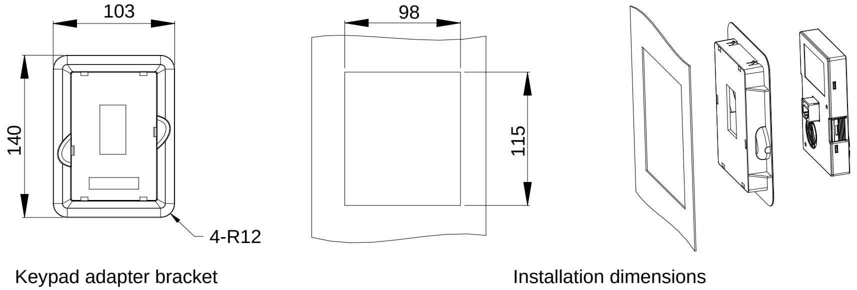
Note: Models of 22kW and above use the keypad structure shown above.

C.1.2 Keypad external mounting

When you need to externally mount the optional LED or LCD keypad of the drive on a cabinet door, two installation methods are available:

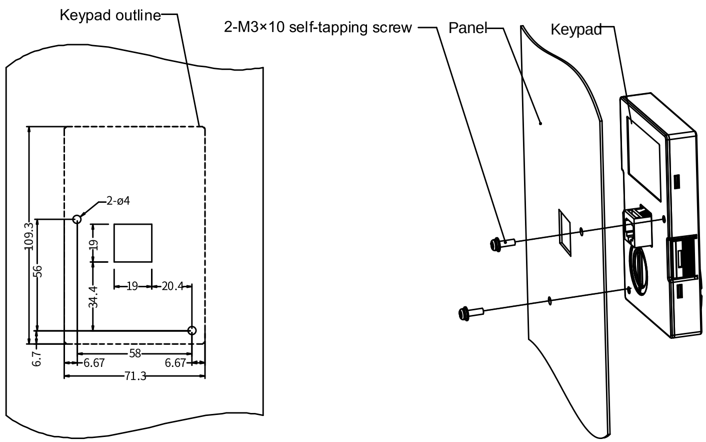
Method 1: Cut an opening in the cabinet door according to the dimensions shown in Figure C-2, and use an optional external mounting bracket (Model: GD350-JPZJ) for flush mounting. Then install the keypad into the bracket.

Figure C-2 Opening dimensions for keypad with mounting bracket (optional, unit: mm)



Method 2: Drill the keypad cutout and mounting holes as specified in Figure C-3, and directly fasten the keypad using the two included M3 self-tapping screws.

Figure C-3 Opening dimensions for keypad without mounting bracket



C.2 Drive outline dimensions

C.2.1 Wall mounting dimensions

Figure C-4 MH860C-S018TF7–S075TF7 dimension diagram

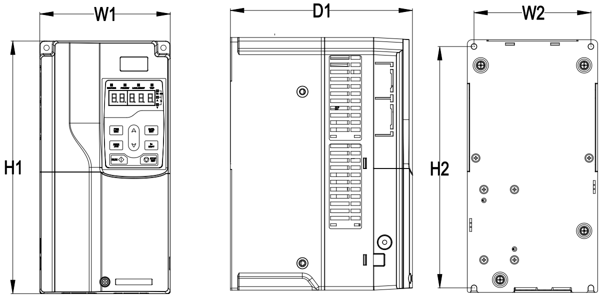


Table C-1 MH860C-S018TF7–S215TF7 wall-mounting dimensions (unit: mm)

Drive model	Outline dimensions			Mounting hole spacing			Hole diameter	Fixing screw
	W1	H1	D1	H2	W2	D2		
MH860C-S018TF7 MH860C-S025TF7	145	280	203	268	130	-	Ø 6	M5
MH860C-S032TF7 MH860C-S038TF7	169	320	210	308	154	-	Ø 6	M5
MH860C-S045TF7	200	341	208	328.6	185	-	Ø 6	M5
MH860C-S060TF7 MH860C-S075TF7	250	400	222	380	230	-	Ø 6	M5

Figure C-5 MH860C-S092TF7–S150TF7 dimension diagram

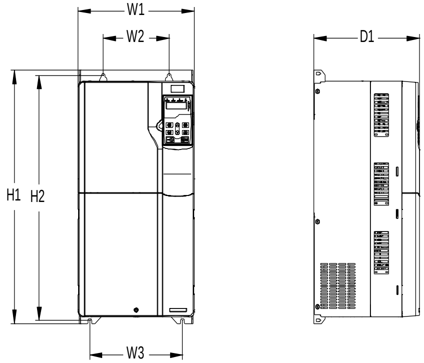


Figure C-6 MH860C-S180TF7–S305TF7 dimension diagram

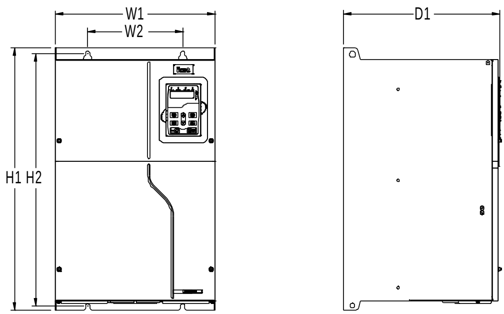


Table C-2 MH860C-S092TF7–S305TF7 wall-mounting dimensions (unit: mm)

Drive model	Outline dimensions			Mounting hole spacing			Hole diameter	Fixing screw
	W1	H1	D1	H2	W2	W3		
MH860C-S092TF7 MH860C-S115TF7 MH860C-S150TF7	282	560	257	542	160	226	Ø9	M8
MH860C-S180TF7 MH860C-S215TF7	338	554	330	534	200	-	Ø9.5	M8
MH860C-S260TF7 MH860C-S305TF7	338	825	390	800	260	-	Ø11	M10

C.2.2 Flange mounting dimensions

Figure C-7 MH860C-S018TF7–S038TF7 dimension diagram

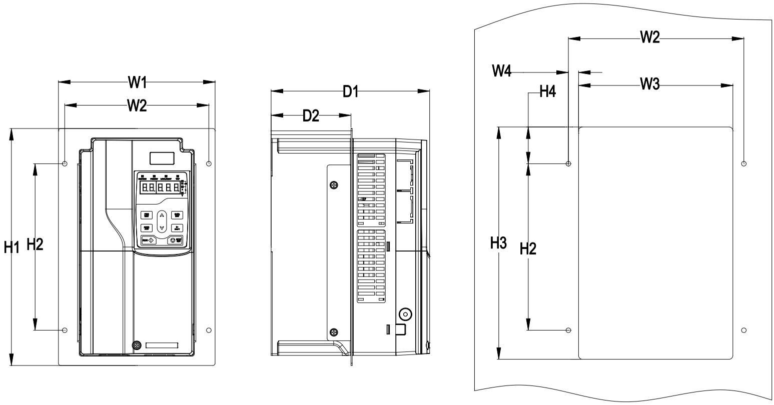


Figure C-8 MH860C-S045TF7–S150TF7 dimension diagram

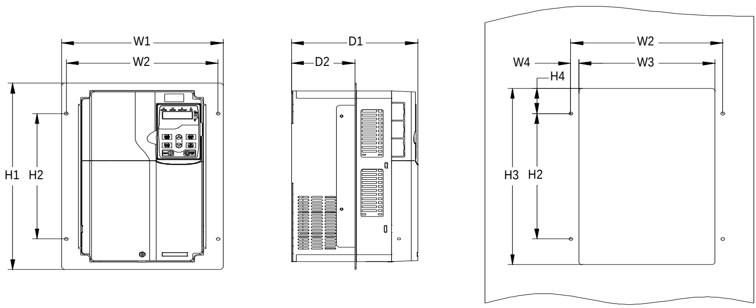


Figure C-9 MH860C-S180TF7–S305TF7 dimension diagram

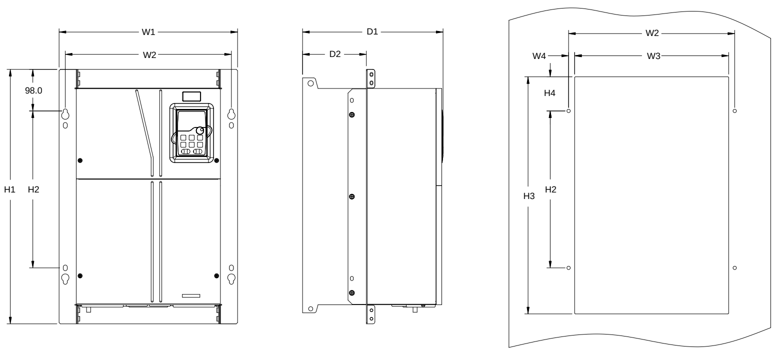


Table C-3 MH860C-S018TF7–S305TF7 flange mounting dimensions (unit: mm)

Drive model	Outline dimensions			Mounting hole spacing							Hole diameter	Fixing screw
	W1	H1	D1	H2	H3	H4	W2	W3	W4	D2		
MH860C-S018TF7 MH860C-S025TF7	200	306	203	215	282	33.5	184	164	10	102	Ø6	M5
MH860C-S032TF7 MH860C-S038TF7	224	346	210	255	322	33.5	208	189	9.5	108	Ø6	M5
MH860C-S045TF7	266	371	208	250	350.6	50.3	250	224	13	104	Ø6	M5
MH860C-S060TF7 MH860C-S075TF7	316	430	222	300	410	55	300	274	13	118.3	Ø6	M5
MH860C-S092TF7 MH860C-S115TF7 MH860C-S150TF7	352	580	257	400	570	90	332	306	13	134	Ø9	M8
MH860C-S180TF7 MH860C-S215TF7	418.5	600	330	370	559	80.5	389.5	361	14.2	149.5	Ø10	M8
MH860C-S260TF7 MH860C-S305TF7	428	868	390	625	830	80	394	345	24.5	183	Ø11	M10

C.2.3 Floor mounting dimensions

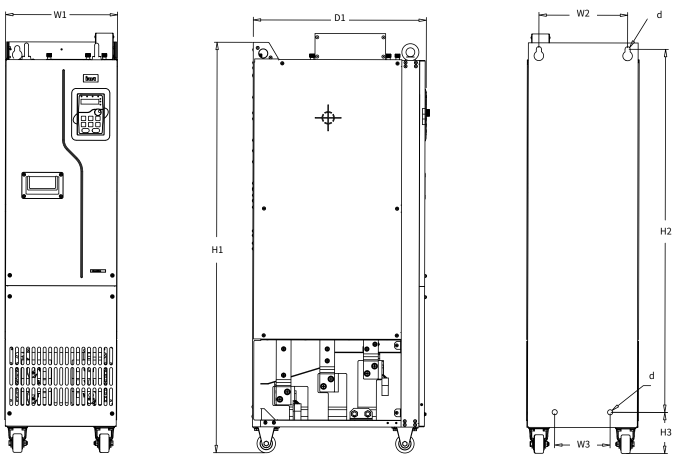
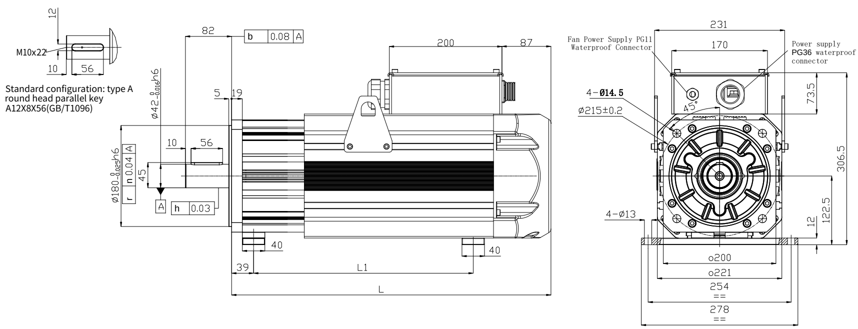


Figure C-10 380V 185G/200P–450G/500P floor-mounting dimension diagram (unit: mm)

Drive model	Outline dimensions			Mounting hole spacing				Hole diameter	Fixing screw
	W1	H1	D1	H2	H3	W2	W3		
MH860C-S340TF7	330	1288	552	1150	122	225	185	Ø13	M10
MH860C-S380TF7									
MH860C-S425TF7									
MH860C-S480TF7									
MH860C-S530TF7									
MH860C-S600TF7									
MH860C-S650TF7	330	1398	552	1280	101	240	200	Ø14	M10

C.3 Servo motor dimensions

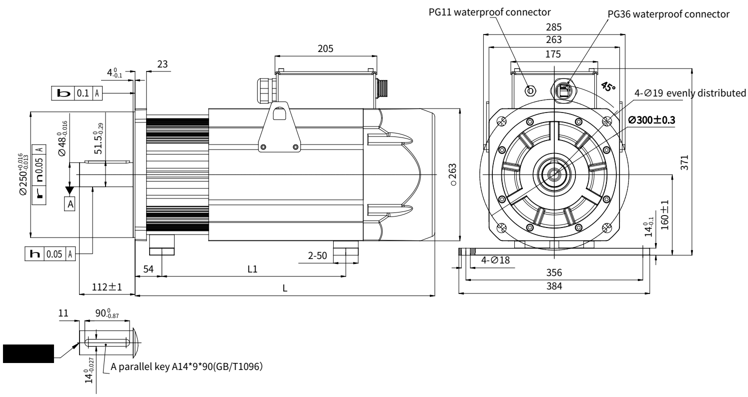
C.3.1 200-frame



Model	L1 (mm)	L (mm)
IMS20B-20M63C15C	165	343
IMS20B-20M71C17C	165	343
IMS20B-20M80C20C	165	343
IMS20B-20M94C15C	190	371
IMS20B-20M11D17C	190	371
IMS20B-20M12D20C	190	371
IMS20B-20M13D15C	220	399
IMS20B-20M14D17C	220	399
IMS20B-20M17D20C	220	399
IMS20B-20M16D15C	230	427
IMS20B-20M18D17C	230	427
IMS20B-20M20D20C	230	427
IMS20B-20M19D15C	270	455

Model	L1 (mm)	L (mm)
IMS20B-20M21D17C	270	455
IMS20B-20M24D20C	270	455
IMS20B-20M22D15C	300	483
IMS20B-20M25D17C	300	483
IMS20B-20M27D20C	300	483
IMS20B-20M25D15C	340	511
IMS20B-20M29D17C	340	511
IMS20B-20M32D20C	340	511
IMS20B-20M28D15C	360	539
IMS20B-20M32D17C	360	539
IMS20B-20M36D20C	360	539
IMS20B-20M31D15C	390	567
IMS20B-20M36D17C	390	567
IMS20B-20M40D20C	390	567

C.3.2 263-frame

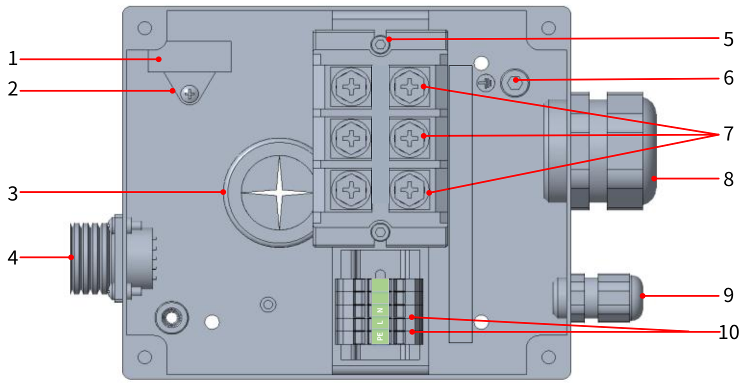


Model	L1 (mm)	L (mm)
IMS20B-26M28D15C	255	523
IMS20B-26M32D17C	255	523
IMS20B-26M37D20C	255	523
IMS20B-26M35D15C	300	563
IMS20B-26M39D17C	300	563
IMS20B-26M45D20C	300	563
IMS20B-26M41D15C	370	603
IMS20B-26M46D17C	370	603

Model	L1 (mm)	L (mm)
IMS20B-26M50D20C	370	603
IMS20B-26M47D15C	400	643
IMS20B-26M53D17C	400	643
IMS20B-26M58D20C	400	643
IMS20B-26M53D15C	440	683
IMS20B-26M61D17C	440	683
IMS20B-26M65D20C	440	683
IMS20B-26M60D15C	480	723
IMS20B-26M68D17C	480	723
IMS20B-26M74D20C	480	723
IMS20B-26M66D15C	520	763
IMS20B-26M75D17C	520	748
IMS20B-26M82D20C	520	748
IMS20B-26M78D15C	560	788
IMS20B-26M86D17C	560	788
IMS20B-26M90D20C	560	788

C.3.3 Motor terminals and terminal box description

Figure C-11 Standard motor terminal box



No.	Component	No.	Component	No.	Component
1	Fan capacitor	2	M4 hex socket screw	3	Motor cable outlet (Avoid dropping small parts or foreign objects)
4	YD28 aviation connector	5	2-M5 hex socket screw	6	M8 (M6) screw (Connecting terminal box and housing)/Grounding label
7	UVW power line M8 bolts	9	PG36 waterproof cable gland	9	PG11 waterproof cable gland
10	220V fan power wiring terminals				

Note: The above applies to the terminal box and terminals for 200-/263-frame motors.

Appendix D Peripheral accessories

D.1 Cable

Cables mainly include power cables and control cables. For the selection of cable types, see the following table.

Cable type		Symmetrical shielded cable	Four-core cable	Double-shielded twisted-pair cable	Single-shielded twisted-pair cable
Power cable	Input power cable	√	-	-	-
	Motor cable	√	-	-	-
Control cable	Analog signal control cable	-	-	√	-
	Digital signal control cable	-	-	√	√

D.1.1 Power cable

Power cables mainly include input power cables and motor cables. To meet the EMC requirements stipulated in the CE standards, it is recommended to use symmetrical shielded cables as motor cables and input power cables (as shown in the following figure). Compared with four-core cables, symmetrical shielded cables can reduce electromagnetic radiation as well as the current and losses in the motor cables.

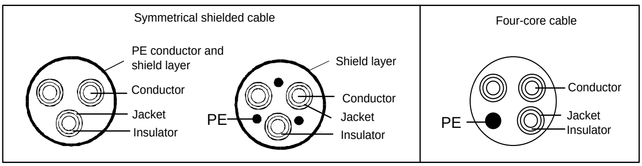


Table D-1 AC 3PH 380V–480V

Drive model	Recommended cable size (mm²)				Screw	
	R, S, T U, V, W	PE	P1, (+)	PB, (+), (-)	Terminal screw	Fastening torque (N • m)
MH860C-S018TF7	4	4	4	4	M5	2–2.5
MH860C-S025TF7	6	6	6	6	M5	2–2.5
MH860C-S032TF7	10	10	10	10	M5	2–2.5
MH860C-S038TF7	10	10	10	10	M5	2–2.5
MH860C-S045TF7	16	10	16	16	M6	3.5
MH860C-S060TF7	16	10	16	16	M6	3.5
MH860C-S075TF7	25	16	25	25	M6	3.5
MH860C-S092TF7	35	16	35	35	M8	9–11
MH860C-S115TF7	50	25	50	50	M8	9–11
MH860C-S150TF7	70	35	70	70	M8	9–11
MH860C-S180TF7	95	50	95	95	M12	31–40
MH860C-S215TF7	120	70	120	120	M12	31–40
MH860C-S260TF7	150	70	150	150	M12	39
MH860C-S305TF7	185	95	185	150	M12	39
MH860C-S340TF7	95*2	95	95*2	95*2	M12	39
MH860C-S380TF7	95*2	95	95*2	95*2	M12	39
MH860C-S425TF7	120*2	120	120*2	120*2	M12	39
MH860C-S480TF7	150*2	150	150*2	150*2	M12	39
MH860C-S530TF7	150*2	150	150*2	150*2	M12	39
MH860C-S600TF7	185*2	185	185*2	185*2	M12	39
MH860C-S650TF7	95*4	95*2	95*4	95*4	M16	39

Note:

- The cables recommended for the main circuit can be used in scenarios where the ambient temperature is lower than 40°C, the wiring distance is shorter than 100m, and the current is the rated current.
- The current carrying capacities in the table are based on a conductor temperature limit of 70°C. If you select a cable with a limit of 90°C, refer to the relevant national standards.
- The terminals PB, (+), and (-) are used to connect to braking accessories.
- If the electrical conductivity of the motor cable shield layer does not meet the requirements, a separate PE conductor must be used.
- The input power cables and motor cables must be able to carry the corresponding

load currents.

- The maximum temperature margin of the motor cables in continuous operation should not be lower than 70°C.
- The conductivity of the PE grounding conductor is the same as that of the phase conductor, that is, the cross-sectional areas are the same.

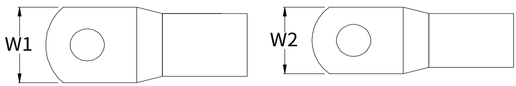
■ **Crimp terminal selection**

The cross-sectional area of the cable needs to be increased due to factors such as excessive cable length or specific laying conditions. When the width of the copper tube terminal exceeds the allowable width of the drive terminal, the SG narrow head terminals can be used. The W2 size of the SG narrow-head series terminal is smaller than the W1 size of the GTNR or SC series terminal in the same specifications.

GTNR terminal reference brand: Suzhou Yuanli

SC, SG terminal reference brands: Richeng

The terminal models vary by brand, and the manufacturer's model specifications shall prevail.



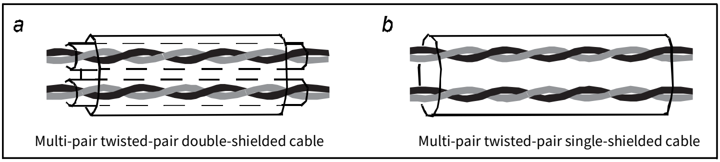
GTNR, SC series SG narrow-head series

Drive power range	GTNR series, SC series	SG narrow-head series
37kW and lower	√	-
45kW and higher	√	-

D.1.2 Control cable

Control cables mainly include analog signal control cables and digital signal control cables. For analog signal control cables, use double-shielded twisted pair cable (Figure a) with a individually-shielded pair for each signal and different ground conductors for different analog signals. For digital signals, a double-shielded cable is preferred, but single-shielded or unshielded twisted pairs can also be used (Figure b).

Figure D-1 Control cable routing



Note:

- Analog signal cables and digital signal cables must be routed separately.
- For frequency signals, only shielded cables can be used. A relay cable needs to have a metal braided shield.

D.2 Breaker and electromagnetic contactor

The circuit breaker is mainly used to prevent electric shock accidents and short circuits to ground that may cause fires due to leakage current. The electromagnetic contactor is mainly used to switch the main circuit power on and off, which can effectively cut off the input power of the drive in case of system failure to ensure safety.

Table D-2 AC 3PH 380V–480V

Drive model	Breaker rated current (A)	Fast-acting fuse rated current (A)	Contactor rated current AC-3 (A)
MH860C-S018TF7	32	40	32
MH860C-S025TF7	40	50	38
MH860C-S032TF7	50	63	50
MH860C-S038TF7	63	80	50
MH860C-S045TF7	80	100	65
MH860C-S060TF7	100	125	80
MH860C-S075TF7	100	160	95
MH860C-S092TF7	125	160	110
MH860C-S115TF7	160	200	150
MH860C-S150TF7	200	250	185
MH860C-S180TF7	225	315	225
MH860C-S215TF7	250	355	265
MH860C-S260TF7	320	400	330
MH860C-S305TF7	400	500	330
MH860C-S340TF7	500	630	400
MH860C-S380TF7	500	630	500

Drive model	Breaker rated current (A)	Fast-acting fuse rated current (A)	Contactor rated current AC-3 (A)
MH860C-S425TF7	630	800	500
MH860C-S480TF7	630	800	500
MH860C-S530TF7	630	800	630
MH860C-S600TF7	800	900	630
MH860C-S650TF7	800	1000	800

Note: The accessory specifications described in the preceding table are ideal values. You can select accessories based on the site conditions, but try not to use those with lower values.

D.3 Optional parts

Optional external accessories such as reactors, filters, braking components, and mounting brackets must be ordered separately.

D.3.1 Harmonic filters

To enhance grid protection, reduce harmonic interference from the drive to the grid, and improve input power factor, consider configuring external DC reactors, input reactors, or passive harmonic filters based on your specific application needs.

If you want to use long cables between the drive and the motor, select external output reactors, dv/dt filters, or sine-wave filters based on the motor cable length. This helps mitigate excessive dv/dt, reducing voltage stress on the motor windings as well as protecting them, and extending the motor's lifespan. Refer to the table below for recommended output filter selections according to motor cable length.

Table D-3 Output filter selection based on motor cable length

Non-shielded cable length	50m–150m	150m–450m	450m–1000m
Shielded cable length	30m–100m	100m–230m	230m–500m
Output filter type	Output reactor (1%)	-	-
	-	dv/dt filter	-
	-	-	Sine-wave filter

Table D-4 Reactor model selection for 380V drive models

Drive power	Input reactor	DC reactor	Output reactor
7.5kW	GDL-ACL0025-4CU	-	GDL-OCL0020-4CU
11kW	GDL-ACL0035-4AL	-	GDL-OCL0025-4CU
15kW	GDL-ACL0040-4AL	-	GDL-OCL0035-4AL
18.5kW	GDL-ACL0051-4AL	-	GDL-OCL0040-4AL
22kW	GDL-ACL0051-4AL	-	GDL-OCL0050-4AL
30kW	GDL-ACL0070-4AL	-	GDL-OCL0060-4AL
37kW	GDL-ACL0090-4AL	-	GDL-OCL0075-4AL
45kW	GDL-ACL0110-4AL	-	GDL-OCL0092-4AL
55kW	GDL-ACL0150-4AL	-	GDL-OCL0115-4AL
75kW	GDL-ACL0150-4AL	Standard	GDL-OCL0150-4AL
90kW	GDL-ACL0220-4AL	Standard	GDL-OCL0220-4AL
110kW	GDL-ACL0220-4AL	Standard	GDL-OCL0220-4AL
132kW	GDL-ACL0265-4AL	Standard	GDL-OCL0220-4AL
160kW	GDL-ACL0330-4AL	Standard	GDL-OCL0265-4AL
185kW	GDL-ACL0390-4AL	Standard	GDL-OCL0330-4AL
200kW	GDL-ACL0390-4AL	Standard	GDL-OCL0400-4AL
220kW	GDL-ACL0450-4AL	Standard	GDL-OCL0400-4AL
250kW	GDL-ACL0500-4AL	Standard	GDL-OCL0450-4AL
280kW	GDL-ACL0500-4AL	Standard	GDL-OCL0500-4AL
315kW	GDL-ACL0580-4AL	Standard	GDL-OCL0560-4AL
355kW	GDL-ACL0660-4AL	Standard	GDL-OCL0660-4AL

Note:

- The rated input voltage drop of input reactor is designed to 1.5%.
- The rated output voltage drop of output reactor is designed to 1%.

Table D-5 Filter model selection for 380V drive models

Drive power	Input filter	Output filter	
	Passive harmonic filter	dv/dt filter	Sine-wave filter
7.5kW	GDL-H0025-4AL	GDL-DUL0020-4CU	GDL-OSF0020-4AL
11kW	GDL-H0032-4AL	GDL-DUL0025-4CU	GDL-OSF0025-4AL
15kW	GDL-H0040-4AL	GDL-DUL0032-4CU	GDL-OSF0032-4AL
18.5kW	GDL-H0047-4AL	GDL-DUL0040-4AL	GDL-OSF0040-4AL
22kW	GDL-H0056-4AL	GDL-DUL0045-4AL	GDL-OSF0045-4AL
30kW	GDL-H0070-4AL	GDL-DUL0060-4AL	GDL-OSF0060-4AL
37kW	GDL-H0080-4AL	GDL-DUL0075-4AL	GDL-OSF0075-4AL
45kW	GDL-H0100-4AL	GDL-DUL0100-4AL	GDL-OSF0095-4AL
55kW	GDL-H0130-4AL	GDL-DUL0120-4AL	GDL-OSF0120-4AL
75kW	GDL-H0160-4AL	GDL-DUL0150-4AL	GDL-OSF0150-4AL
90kW	GDL-H0190-4AL	GDL-DUL0180-4AL	GDL-OSF0180-4AL
110kW	GDL-H0225-4AL	GDL-DUL0220-4AL	GDL-OSF0220-4AL
132kW	GDL-H0265-4AL	GDL-DUL0260-4AL	GDL-OSF0260-4AL
160kW	GDL-H0320-4AL	GDL-DUL0320-4AL	GDL-OSF0320-4AL
185kW	GDL-H0400-4AL	GDL-DUL0400-4AL	GDL-OSF0400-4AL
200kW	GDL-H0400-4AL	GDL-DUL0400-4AL	GDL-OSF0400-4AL
220kW	GDL-H0485-4AL	GDL-DUL0480-4AL	GDL-OSF0480-4AL
250kW	GDL-H0485-4AL	GDL-DUL0480-4AL	GDL-OSF0480-4AL
280kW	GDL-H0545-4AL	GDL-DUL0540-4AL	GDL-OSF0600-4AL
315kW	GDL-H0610-4AL	GDL-DUL0600-4AL	GDL-OSF0600-4AL
355kW	GDL-H0800-4AL	GDL-DUL0800-4AL	GDL-OSF0800-4AL

Note:

- The rated input voltage drop of input reactor is designed to 1.5%.
- The rated output voltage drop of output reactor is designed to 1%.

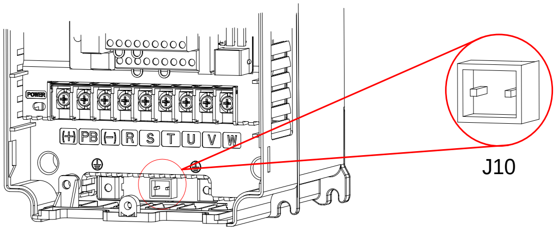
D.3.2 EMC filter

The filter effectively suppresses interference from the environment and noise generated during drive operation. J10 is connected in the factory for the 380V 7.5–355kW drive models, all of which meet the requirements of Category C3.

Disconnect J10 in any of the following situations:

- The EMC filter is applicable to the neutral-grounded grid system. If it is used for the IT grid system (that is, non-neutral grounded grid system), disconnect J10.

- If leakage protection occurs during configuration of a residual-current circuit breaker, disconnect J10.



Note: Do not connect C3 filters in IT power systems.

Table D-6 Filter model selection for 380V drive models

Drive model	Input filter	Output filter
MH860C-S018TF7	FLT-P04032L-B	FLT-L04032L-B
MH860C-S025TF7		
MH860C-S032TF7	FLT-P04045L-B	FLT-L04045L-B
MH860C-S038TF7		
MH860C-S045TF7	FLT-P04065L-B	FLT-L04065L-B
MH860C-S060TF7		
MH860C-S075TF7	FLT-P04100L-B	FLT-L04100L-B
MH860C-S092TF7		
MH860C-S115TF7	FLT-P04150L-B	FLT-L04150L-B
MH860C-S150TF7		
MH860C-S180TF7	FLT-P04240L-B	FLT-L04240L-B
MH860C-S215TF7		
MH860C-S260TF7	FLT-P04400L-B	FLT-L04400L-B
MH860C-S305TF7		
MH860C-S340TF7		
MH860C-S380TF7	FLT-P04600L-B	FLT-L04600L-B
MH860C-S425TF7		
MH860C-S480TF7		
MH860C-S530TF7	FLT-P04800L-B	FLT-L04800L-B
MH860C-S600TF7		
MH860C-S650TF7		

D.3.3 Encoder cable

The resolver encoder cable is a critical component connecting the encoder and the drive in closed-loop control. Encoder cables of various lengths are available to suit actual application requirements.

Table D-7 Resolver cable selection

No.	Cable length	Ordering information	Cable model
1	3	67001-04189	DAEL-08-03-BB0-*-07A0
2	5	67001-04190	DAEL-08-05-BB0-*-07A0
3	10	67001-04191	DAEL-08-10-BB0-*-07A0
4	15	67001-04192	DAEL-08-15-BB0-*-07A0
5	20	67001-04193	DAEL-08-20-BB0-*-07A0
6	25	67001-04194	DAEL-08-25-BB0-*-07A0
7	30	67001-04195	DAEL-08-30-BB0-*-07A0

Note:

- The encoder cables listed in the table integrate motor temperature sensor wires.
- If the motor encoder interface does not integrate temperature sensor wires, the temperature sensor must be wired separately according to the motor wiring definition.

D.3.4 Braking component

The braking component includes braking resistors and braking units, which can be used to dissipate the regenerative energy generated by the motor, greatly improving braking and deceleration capabilities. When the drive driving a high-inertia load decelerates or needs to decelerate abruptly, the motor runs in the power generation state and transmits the regenerative energy to the DC circuit of the drive, causing the bus voltage of the drive to rise. If the bus voltage exceeds a specific value, the drive reports an overvoltage fault. To prevent this from happening, you need to install braking components. Select braking resistors according to the specific requirements (such as the braking torque and braking duty cycle) on site.

Table D-8 Braking component selection for 380V models

Servo drive model	Braking unit specification	Braking resistor specification		
		Recommended power (W)	Recommended resistance (Ω)	Min. resistance (Ω)
MH860C-S018TF7	Built-in	1000	⩾36	31
MH860C-S025TF7		1000	⩾36	31
MH860C-S032TF7		1000	⩾32	23
MH860C-S038TF7		2000	⩾27	23
MH860C-S045TF7		2500	⩾22	17
MH860C-S060TF7		3000	⩾17	12
MH860C-S075TF7		4000	⩾16	12
MH860C-S092TF7		5000	⩾16	12
MH860C-S115TF7		6000	⩾16	9
MH860C-S150TF7		8000	⩾12	7
MH860C-S180TF7		10000	⩾8	5
MH860C-S215TF7		11000	⩾6	5
MH860C-S260TF7	DBU100H-220-4	24000	⩾3.7	3.2
MH860C-S305TF7	DBU100H-320-4	28000	⩾2.8	2.2
MH860C-S340TF7		30000	⩾2.5	
MH860C-S380TF7	DBU100H-400-4	33000	⩾2.2	1.8
MH860C-S425TF7		38000	⩾2	
MH860C-S480TF7	Two DBU100H-320-4	21000×2	⩾1.8	2.2//2.2
MH860C-S530TF7		24000×2	⩾1.6	
MH860C-S600TF7		27000×2	⩾1.4	
MH860C-S650TF7		30000×2	⩾1.2	

D.3.5 Flange mounting bracket

Flange mounting is applicable to 380V 7.5–160kW drives. An optional flange mounting bracket is required for flange mounting.

Table D-9 Flange mounting bracket selection

Name	Ordering information	Applied to
Flange mounting bracket	19005-00347	380V 7.5–11kW
	19005–00346	380V 15–18.5kW
	19005–00094	380V 22kW
	19005–00093	380V 30–37kW
	19005–00092	380V 45–75kW
	19005–00091	380V 90–110kW
	19005–00296	380V 132–160kW

Appendix E Expansion card

E.1 Expansion card function description and installation

E.1.1 Function description

The drive can be equipped with various expansion cards to extend its functions. All models support the simultaneous installation of two cards. The cards are sold separately (all 108x39mm).

Figure E-1 Expansion card installation position

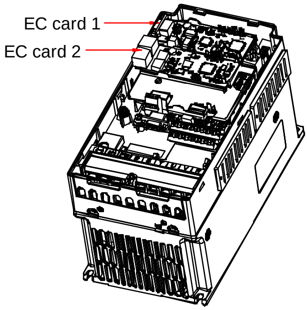


Figure E-2 Model definition

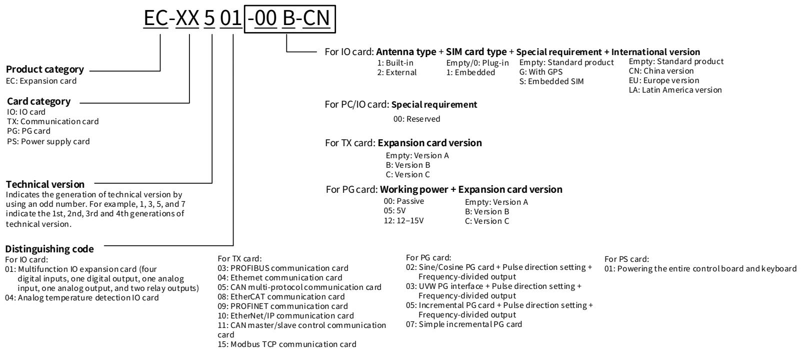


Table E-1 Function description

Expansion card type	Model	Specification	Ordering code
IO expansion card 1	EC-IO501-00	● Four digital inputs ● One digital output ● One analog input ● One analog output ● Two relay outputs: one double-contact output and one single-contact output	11023-00083
IO expansion card 2	EC-IO504-00	● Three analog outputs ● Three analog inputs ● One PT1000 ● Three relay outputs: single-contact NO.	11023–00180
PROFIBUS-DP communication card	EC-TX503D	Supporting the PROFIBUS-DP protocol	11023-00151
PROFINET communication card	EC-TX509-U8	Supporting the PROFINET protocol	11023-00213
EtherNet IP communication card	EC-TX510B	● When the DIP switch is set to EtherNet IP: ✧ Supporting the EtherNet IP protocol. ✧ Equipped with two EtherNet IP ports, supporting 10/100M half/full duplex operation. ✧ Equipped with two RJ45 ports. The ports are interchangeable (no distinction between input and output). ✧ Supporting star and linear IP network topologies. ● When the DIP switch is set to Modbus TCP: ✧ Supporting the Modbus TCP protocol and Modbus TCP slave nodes.	11023-00197

Expansion card type	Model	Specification	Ordering code
EtherNet IP communication card	EC-TX510B	✧ Equipped with two Modbus TCP ports, supporting 10/100M half/full duplex operation. ✧ Supporting star and line TCP network topologies. ● When the DIP switch is set to Ethernet: ✧ Supporting INVT Ethernet protocol. ● Supporting the connection to INVT's host controller monitoring software INVT Workshop for monitoring and oscilloscope, allowing multi-card networked monitoring.	11023-00197
EtherCAT communication card	EC-TX508B	● Supporting the EtherCAT PZD protocol and automatic network address configuration. ● Not supporting EtherCAT synchronization cycles.	11023–00150
Sin/Cos PG card	EC-PG502	● Applicable to Sin/Cos encoders with or without CD signals. ● Supporting the frequency-divided output of A, B, and Z. ● Supporting input of pulse train reference.	11023-00109
Incremental PG card with UVW	EC-PG503-05	● Applicable to differential encoders of 5V. ● Supporting the orthogonal input of A, B, and Z. ● Supporting the pulse input of phase U, V, and W. ● Supporting the frequency-divided output of A, B, and Z. ● Supporting input of pulse train reference.	11023-00085

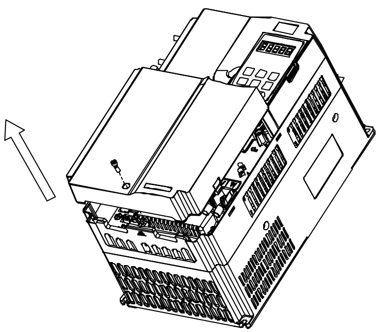
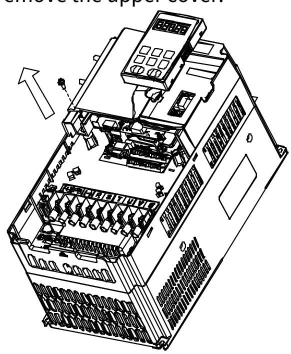
Expansion card type	Model	Specification	Ordering code
Multi-function incremental PG card	EC-PG505-12	● Applicable to OC encoders of 5V or 12V. ● Applicable to push-pull encoders of 5V or 12V. ● Applicable to differential encoders of 5V. ● Supporting the orthogonal input of A, B, and Z. ● Supporting the frequency-divided output of A, B, and Z. ● Supporting input of pulse train reference.	11023-00087
24V incremental PG card	EC-PG505-24B	● Applicable to OC encoders of 24V. ● Applicable to push-pull encoders of 24V. ● Supporting the orthogonal input of A, B, and Z. ● Supporting the frequency-divided output of A, B, and Z. ● Supporting input of pulse train reference.	11023-00139
Simplified incremental PG card	EC-PG507-12	● Applicable to OC encoders of 5V or 12V. ● Applicable to push-pull encoders of 5V or 12V. ● Applicable to differential encoders of 5V.	11023–00115
24V simplified incremental PG card	EC-PG507-24	● Applicable to OC encoders of 24V. ● Applicable to push-pull encoders of 24V. ● Applicable to differential encoders of 24V.	11023–00121
24V power supply expansion card	EC-PS501-24	● Input voltage range: DC18–30V (Rated 24Vdc)/2A ● Three channels of output voltage: +5V/1A (±5%), +15V/0.2A (±10%), -15V/0.2A (±10%)	11023-00135

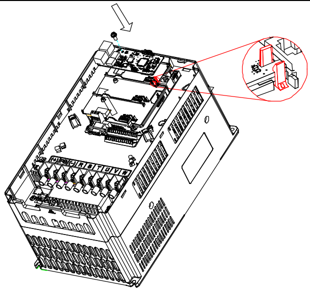
E.1.2 Installation and wiring

	Make sure the device has been powered off before installation.

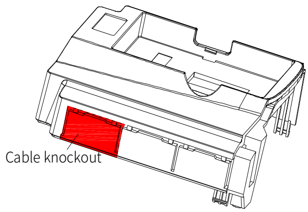
Note:

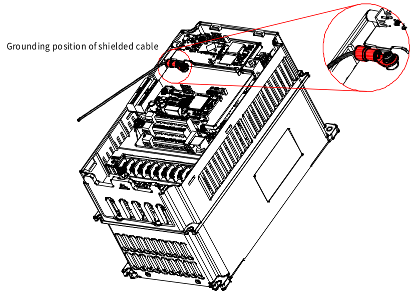
- The expansion card can be installed in either SLOT1 or SLOT2 card slot, depending on the actual wiring.
- If physical interference occurs on the external wires after the expansion card is installed, change the installation slot to facilitate the wiring. For example, since the connector of the DP card cable is large, you are recommended to install the card in SLOT1.
- To ensure high anti-interference capability in closed-loop control, you need to use a shielded cable as the encoder cable and ground the two ends of the cable. That is, connect the motor side shield layer to the motor housing, and connect the PG card side shield layer to the PE terminal.

Step 1 Unscrew the lower part of the housing and remove the lower cover. 	Step 2 Unscrew the screws in the middle of the housing, remove the keypad, and remove the upper cover. 
Step 3 Align the expansion card positioning holes with the machine positioning studs, insert the expansion card and secure it with screws (M3*10).	Step 4 Conduct wiring based on the expansion card type and connect the shielded cable as follows.

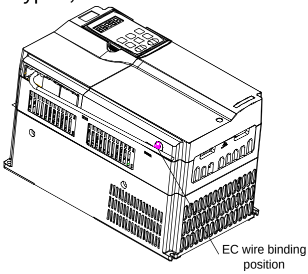


Step 5 Remove the cable knockout corresponding to the expansion card position on the left side of the upper cover.





Step 6 Route the cable through the opening, and then install the upper cover, keypad, and lower cover in order.



E.2 I/O expansion card

E.2.1 IO expansion card 1 (EC-IO501-00)

The EC-IO501-00 is a multi-functional I/O expansion card that can be applied to scenarios where the local I/O interfaces are insufficient. It can provide four digital inputs, one digital output, one analog input, one analog output, and two relay outputs. It uses European-style screw terminals for relay output and spring terminals for the others. CME and COM are shorted through J3 before delivery, while J5 is a jumper for selecting the output type (voltage or current) of AO2.

Figure E-3 EC-IO501-00 expansion card

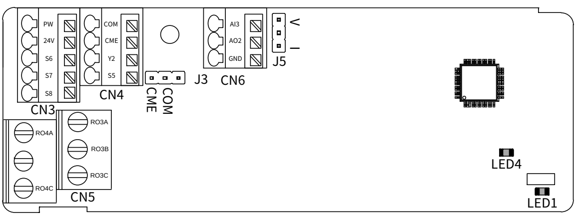


Table E-2 Terminal description

<table>
<tr><th>Category</th><th>Symbol</th><th>Name</th><th>Specification</th></tr>
<tr><td>Power supply</td><td>PW</td><td>External power supply</td><td>● Used to provide input digital working power from the external to the internal
● Voltage range: 12–30V
● PW and +24V have been shorted before delivery.</td></tr>
<tr><td rowspan="2">Analog input/output</td><td>AI3-GND</td><td>Analog input 1</td><td>● Input range: For AI3, 0–10V or 0–20mA
● Input impedance: 20kΩ for voltage input; 250Ω for current input.
● Whether voltage or current is used for input is set through the corresponding function code.
● Resolution: 5mV when 10V corresponds to 50Hz
● Accuracy: ±0.5% (at 25°C, input ⩾ 5V or ⩾ 10mA)</td></tr>
<tr><td>AO2-GND</td><td>Analog output 1</td><td>● Output range: 0–10V or 0–20mA
● Whether voltage or current is used for output is set through the jumper J5.
● Accuracy: ±0.5% (at 25°C, output ⩾ 5V or ⩾ 10mA)</td></tr>
<tr><td rowspan="5">Digital input and output</td><td>S5-COM</td><td>Digital input 1</td><td rowspan="4">● Internal impedance: 3.3kΩ
● 12–30V voltage input is acceptable.
● Bi-directional input terminal
● Max. input frequency: 1kHz</td></tr>
<tr><td>S6-COM</td><td>Digital input 2</td></tr>
<tr><td>S7-COM</td><td>Digital input 3</td></tr>
<tr><td>S8-COM</td><td>Digital input 4</td></tr>
<tr><td>Y2-CME</td><td>Digital output</td><td>● Switch capacity: 50mA/30V
● Output frequency range: 0–1kHz
● The terminals CME and COM are shorted through J3 before delivery.</td></tr>
<tr><td rowspan="5">Relay output</td><td>RO3A</td><td>NO contact of relay 3</td><td rowspan="5">● Contact capacity: 3A/AC250V, 1A/DC30V
● Cannot be used as a high-frequency switching output.</td></tr>
<tr><td>RO3B</td><td>NC contact of relay 3</td></tr>
<tr><td>RO3C</td><td>Common contact of relay 3</td></tr>
<tr><td>RO4A</td><td>NO contact of relay 4</td></tr>
<tr><td>RO4C</td><td>Common contact of relay 4</td></tr>
</table>

Table E-3 Indicator description

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.
LED4	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.

E.2.2 I/O expansion card 2 (EC-IO504-00)

EC-IO504-00 is a multifunctional I/O expansion card that can be used in scenarios where the local AI, AO, and RO interfaces are insufficient. The relay outputs use European-style screw terminals, while the AI/AO interfaces use spring-type terminals. The AI/AO interfaces support jumper selection for voltage or current types, and the PT sensors support jumper selection for enabling or disabling.

Figure E-4 EC-IO504-00 expansion card

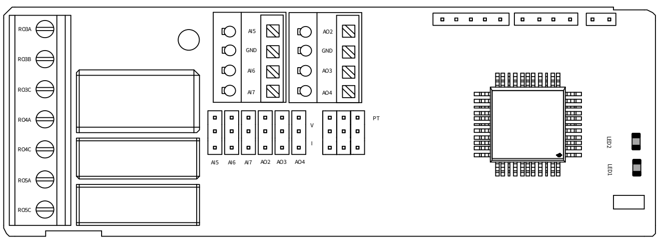


Table E-4 Terminal description

Category	Symbol	Name	Specification
Power supply	GND	Zero potential	Reference zero potential for the analog power supply at +10V.
Analog input/output	AI5	Analog input 5	● Input range: 0–10V or 0–20mA ● Input impedance: 20kΩ for voltage input; 250Ω for current input. ● Voltage or current input is determined by function codes and the corresponding jumper cap settings. ● Resolution: 5mV when 10V corresponds to 50Hz ● Accuracy: ±0.5% (at 25°C, input ⩾ 5V or ⩾ 10mA)
	AI6	Analog input 6	
	AI7	Analog input 7	
	AO2	Analog output 2	● Output range: 0–10V or 0–20mA; supports AO function code calibration. ● Whether voltage or current is used for output is set through the jumper. ● Accuracy: ±0.5% when output exceeds 5V or 10mA at 25°C ● At 25°C, when the output exceeds 10V after calibration, the linearity is within ±0.1% of full scale
	AO3	Analog output 3	
	AO4	Analog output 4	
Relay output	RO3A	NO contact of relay 3	● Contact capacity: 3A/AC 250V, 1A/DC 30V ● Cannot be used as a high-frequency switching output.
	RO3B	NC contact of relay 3	
	RO3C	Common terminal of relay 3	
	RO4A	NO contact of relay 4	
	RO4B	NC contact of relay 4	
	RO4C	Common terminal of relay 4	

Table E-5 Indicator description

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.
LED2	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.

E.3 Communication card

E.3.1 PROFIBUS-DP communication card (EC-TX503D)

Figure E-5 EC-TX503D expansion card

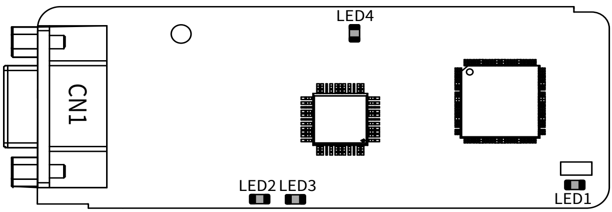
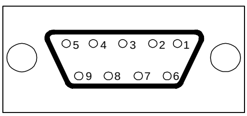


Table E-6 CN1 description

CN1	Connector pin		Description
 9-pin D-type connector	1	-	Unused
	2	-	Unused
	3	B-Line	Data+ (twisted pair 1)
	4	RTS	Request to send
	5	GND_BUS	Isolated ground
	6	+5V BUS	Isolated power supply of 5 V DC
	7	-	Unused
	8	A-Line	Data- (twisted pair 2)
	9	-	Unused
	Housing	SHLD	PROFIBUS cable shield

Note:

- +5V BUS and GND_BUS are used for the bus terminator. Devices such as optical transceivers (RS485) may need to obtain power through these pins.
- Some devices use RTS to determine the direction of transmission and reception. In normal applications, only A-Line, B-Line, and the shield need to be used.

Table E-7 Indicator description

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.
LED2	Communication indicator	On: The expansion card is connected with the master device and data exchange can be performed. Off: The expansion card is disconnected from the master device.
LED3	Fault indicator	On: The expansion card is offline and data exchange cannot be performed. Blinking (On: 500ms; Off: 500ms): A configuration error occurs. The length of the user parameter data set during the initialization of the communication card is different from that during the network configuration. Blinking (On: 250ms; Off: 250ms): User parameter data is incorrect. The length or content of the user parameter data set during the initialization of the communication card is different from that during the network configuration. Blinking (On: 125ms; Off: 125ms): An error occurs in the ASIC initialization of PROFIBUS communication. Off: No fault
LED4	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.

Note: For details, see the manual of the communication card.

E.3.2 PROFINET communication card (EC-TX509)

The terminal CN2 of the PROFINET communication card adopts standard RJ45 interfaces, which are not distinguished from each other and can be used interchangeably.

Figure E-6 EC-TX509-U8 expansion card

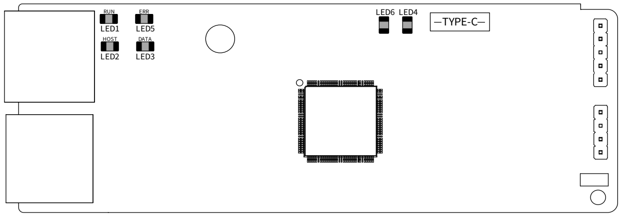


Table E-8 Indicator description

Symbol	Name	Description
LED1	Communication indicator	On: Communication established successfully, with normal IO data exchange. Blinking (On: 500ms; Off: 500ms): Communication established successfully, but without valid IO data exchange. Blinking (On: 100ms; Off: 100ms): In the communication configuration phase. For example, when triggered by DCP configuration commands, it will blink simultaneously with the ERR indicator. Off: The communication between the communication card and PLC is not online.
LED2	Status indicator	On: The communication card is handshaking with the drive. Blinking (On: 500ms; Off: 500ms): The communication card and the drive are in the normal communication stage. **Note:** After the handshaking is completed, it should blink regardless of whether there is data transmission between the communication card and the main control board. Off: The communication card is in the initialization or parameter configuration phase.
LED3	Communication indicator	Blinking (On: 500ms; Off: 500ms): Normal data update between the communication card and the main control board. Off: No data update or abnormal update between the communication card and main control board.
LED4	Power indicator	3.3V power indicator
LED5	Fault indicator	Blinking (On: 100ms; Off: 100ms): Abnormal communication establishment. Off: No fault
LED6	Status indicator	Blinking (On: 500ms; Off: 500ms): Communication card heartbeat LED (indicates the card is operating normally).

Note: The EC-TX509-U8 is functionally equivalent to EC-TX509C and can be used as an alternative to meet PROFINET communication needs.

The PROFINET communication card supports linear and star network topologies.

Figure E-7 Linear network topology electrical connection diagram

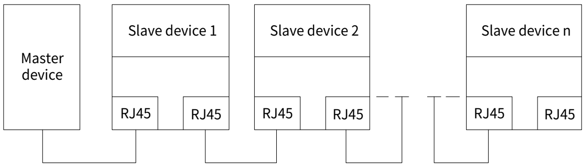
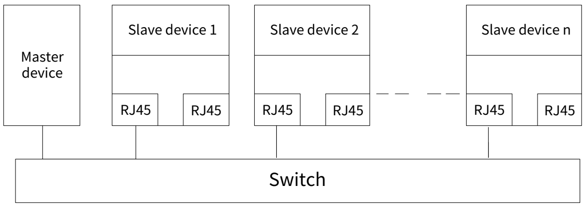


Figure E-8 Star network topology electrical connection diagram

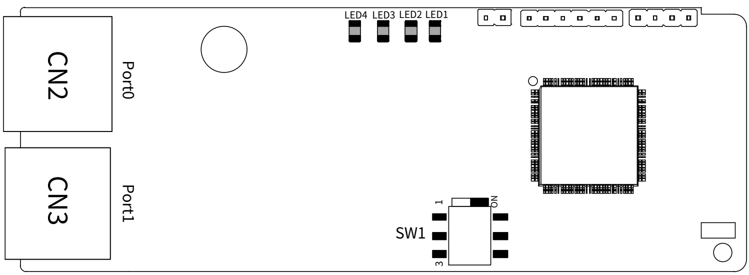


Note: For the star network topology, you need to prepare PROFINET switches.

E.3.3 EtherNet IP multi-protocol communication card (EC-TX510B)

The expansion card features two standard RJ45 communication ports. These ports are interchangeable. It supports selecting the protocol via the DIP switch before power-on. The default selection is EtherNet IP, with Modbus TCP and Ethernet communication as options.

Figure E-9 EC-TX510B expansion card



Note: For this card, before power-on, set the SW1 switch according to the mapping between protocols and positions.

Table E-9 SW1 definition

SW1			
1	**2**	**3**	**Protocol type**
ON	ON	ON	EtherNet IP
OFF	ON	ON	Ethernet
ON	OFF	ON	Modbus TCP
Other	Other	Other	Reserved

Table E-10 Indicator function description when EtherNet IP selected

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is handshaking with the drive. Blinking (On: 1s; Off: 1s): Normal communication between the expansion card and the drive. Off: The expansion card and drive communicate improperly.
LED2	Status indicator	On: The communication between the expansion card and PLC is online and data exchange is allowed. Off: The communication between the expansion card and PLC is not online.
LED3	Status indicator	On: Failed to set up I/O between the expansion card and the PLC. Blinking (On: 1s; Off: 1s): PLC configuration error. Blinking (On: 500ms; Off: 500ms): The card failed to send data to the PLC. Blinking (On: 250ms; Off: 250ms): The connection between the card and the PLC timed out.
LED4	Power indicator	On: 3.3V power indicator

Table E-11 Indicator function description when Modbus TCP selected

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is handshaking with the drive. Blinking (On: 1s; Off: 1s): Normal communication between the expansion card and the drive. Off: The expansion card and drive communicate improperly.
LED2	Status indicator	On: The communication between the expansion card and PLC is online and data exchange is allowed. Off: The communication between the expansion card and PLC is not online.

Symbol	Name	Description
LED3	Status indicator	On: Expansion card has no valid data received. Blinking (On: 1s; Off: 1s): The message function code is not used or defined. Blinking (On: 125ms; Off: 125ms): Message address error.
LED4	Power indicator	On: 3.3V power indicator

Table E-12 Indicator function description when Ethernet selected

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is handshaking with the drive. Blinking (On: 1s; Off: 1s): Normal communication between the expansion card and the drive (handshake successful). Off: The expansion card and drive communicate improperly.
LED2	Status indicator	On: The connection between the expansion card and PC is successful. Off: The connection between the expansion card and PC has failed (abnormal network cable).
LED3	Status indicator	Blinking (On: 250ms; Off: 250ms): The expansion card is successfully connected to the PC but communication fails (abnormal IP address). Off: No fault
LED4	Power indicator	On: 3.3V power indicator

Electrical connection:

The communication card adopts standard RJ45 interfaces, which can be used in linear, star, and ring network topologies. The electrical connection diagram is shown as follows.

Use CAT5, CAT5e, and CAT6 network cables for the connection. When the communication distance is greater than 50m, use high-quality network cables that meet national standards.

Figure E-10 Linear network topology electrical connection diagram

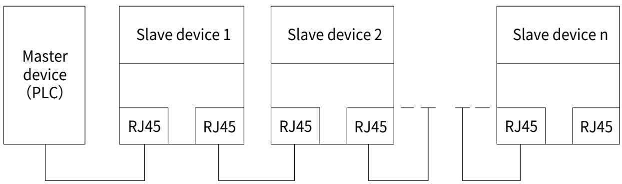
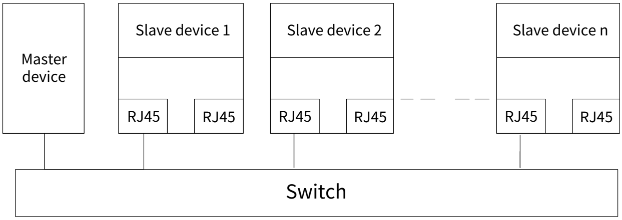
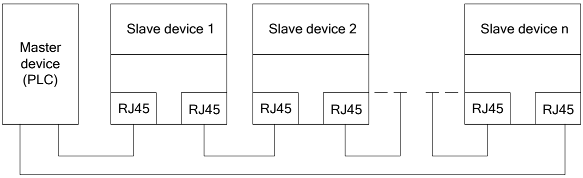


Figure E-11 Star network topology electrical connection diagram



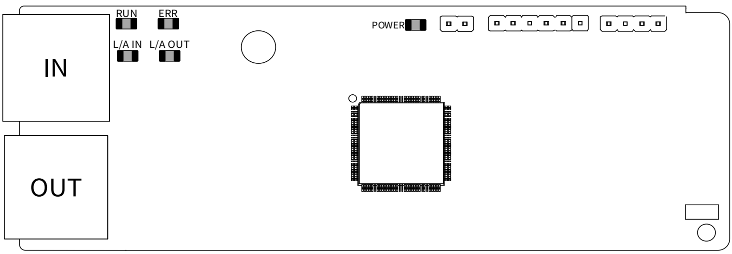
Note: For the star network topology, you need to prepare Ethernet switches.

Figure E-12 Ring network topology electrical connection diagram



E.3.4 EtherCAT communication card (EC-TX508)

EC-TX508 is defined as an EtherCAT slave communication card, which can be used on the product.



- Supported functions

  EtherCAT PZD protocol

  Automatic network address configuration

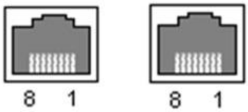
- Supported services

  Manufacturer-defined object dictionary

- Not supporting EtherCAT synchronization cycle

- Communication port

Standard RJ45 ports are used in EtherCAT communication. The communication card provides two RJ45 ports with transmission direction defined. The following figure shows the ports. IN (indicating input) and OUT (indicating output) are EtherCAT network ports.



Interface functions:

Pin	Name	Description
1	TX+	Transmit Data+
2	TX-	Transmit Data-
3	RX+	Receive Data+
4	n/c	Not connected
5	n/c	Not connected
6	RX-	Receive Data-
7	n/c	Not connected
8	n/c	Not connected

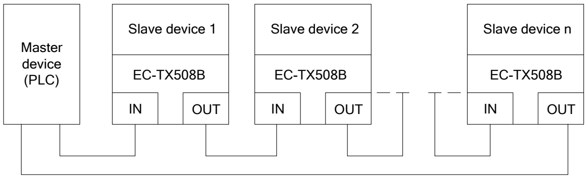
- Status indicator

The EtherCAT communication card provides four LED indicators and four network port indicators to indicate its states. The specific definitions are as follows:

Symbol	Name	Description
RUN	Status indicator	On: OP state Blinking (On: 200ms; Off: 200ms): Pre-OP state Blinking (On: 1s; Off: 1s): Safe-OP state Off: Init state
ALM	Fault indicator	On: OP fault state Blinking (On: 200ms; Off: 200ms): Init, Pre-OP fault state Blinking (On: 1s; Off: 1s): Safe-OP fault state Off: No fault
PWR	Power indicator	On: 3.3V power indicator
Network port indicator (IN)	Status indicator	On: Ethernet connection is established. Off: Ethernet connection is not established.
Network port indicator (OUT)	Status indicator	On: Ethernet connection is established. Off: Ethernet connection is not established.

- Electrical connection

An EtherCAT network often consists of a master (such as PLC) and multiple slaves (such as drives or bus expansion terminals). Each EtherCAT slave has two standard Ethernet interfaces. The wiring diagram is shown below.



E.4 PG expansion card

E.4.1 Sin/Cos PG card (EC-PG502)

Figure E-13 EC-PG502 expansion card

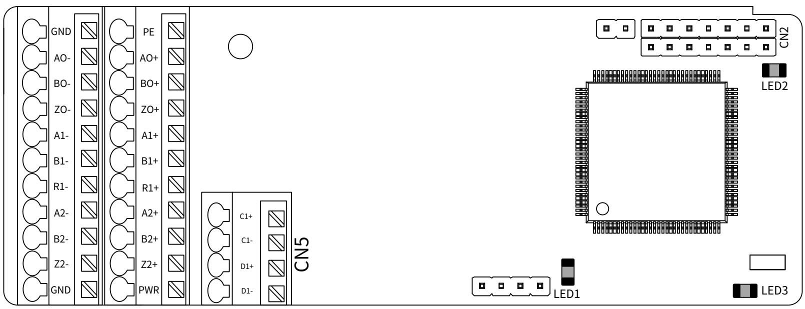


Table E-13 Terminal description

Terminal symbol	Terminal name	Specification
PWR	Encoder power supply	Voltage: 5V ± 5% Max. output current: 150mA
GND		
A1+	Encoder interface	● Supporting Sin/Cos encoders ● SINA/SINB/SINC/SIND 0.6–1.2Vpp; SINR 0.2–0.85Vpp ● Max. frequency response of A/B signals: 200kHz Max. frequency response of C/D signals: 1kHz
A1-		
B1+		
B1-		
R1+		
R1-		
C1+		

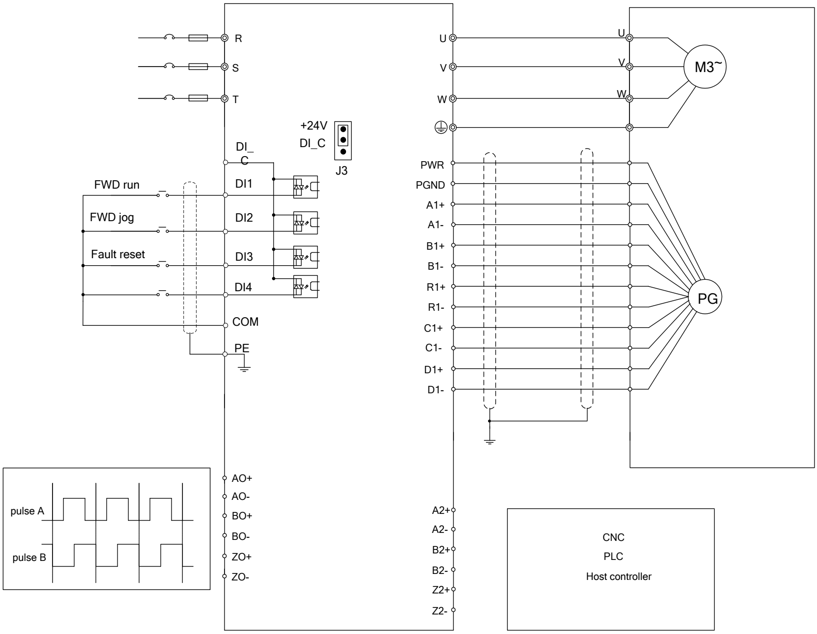
Terminal symbol	Terminal name	Specification
C1-	Encoder interface	
D1+		
D1-		
A2+	Pulse reference	● Supporting 5V differential signal ● Response frequency: 200kHz
A2-		
B2+		
B2-		
Z2+		
Z2-		
AO+	Frequency-divided output	● Differential output, compatible with 5V differential output ● Supporting frequency division of 1–255, which can be set through P20.16 or P24.16. Max. output frequency: 200kHz
AO-	Frequency-divided output	
BO+		
BO-		
ZO+		
ZO-		

Table E-14 Indicator description

Symbol	Name	Description
LED1	Encoder signal indicator	On: Encoder signals are normal. Blinking (On: 500ms; Off: 500ms): C1 or D1 of the encoder is disconnected. Off: A1 or B1 of the encoder is disconnected.
LED2	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.
LED3	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.

The following figure shows the external wiring of the PG card when it is used in combination with an encoder with CD signals.

Figure E-14 External wiring of the PG card and an encoder with CD signals



Note: If the connected encoder does not have CD signals, you do not need to connect the C1+, C1-, D1+, and D1- terminals of the PG card.

E.4.2 Encoder interface (EC-PG503-05)

The EC-PG503-05 expansion card supports the input of absolute position signals, integrating the advantages of absolute and incremental encoders and adopts spring terminals for easy use.

Figure E-15 EC-PG503-05 expansion card

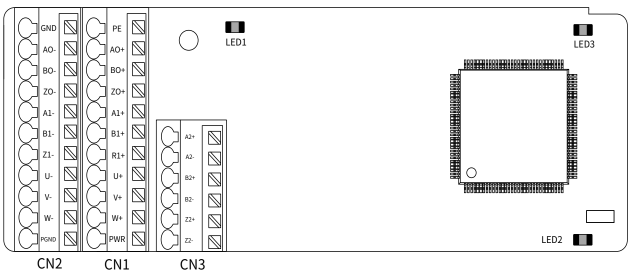


Table E-15 Terminal description

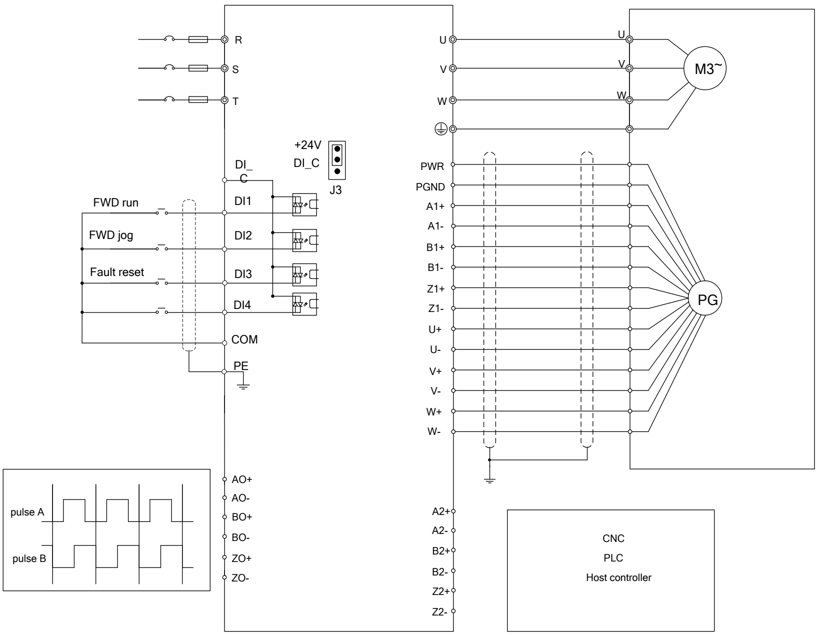
Terminal symbol	Terminal name	Specification
PWR	Encoder power supply	Voltage: 5V ± 5% Max. output current: 200mA
PGND		
A1+	Encoder interface	● Differential incremental PG interface of 5V ● Response frequency: 400kHz
A1-		
B1+		
B1-		
Z1+		
Z1-		
A2+	Pulse reference	● Differential input of 5V ● Response frequency: 200kHz
A2-		
B2+		
B2-		
Z2+		
Z2-		
AO+	Frequency-divided output	● Differential output of 5V ● Supports frequency division of 1–255, which can be set through P20.16 or P24.16
AO-		
BO+		
BO-		
ZO+		
ZO-		
U+	UVW encoder interface	● Absolute position (UVW information) of the hybrid encoder, differential input of 5V ● Response frequency: 40kHz
U-		
V+		
V		
W+		
W-		

Table E-16 Indicator description

Symbol	Name	Description
LED1	Encoder signal indicator	On: Encoder signals are normal. Blinking (On: 500ms; Off: 500ms): A1 or B1 signal is disconnected during encoder rotating.
LED2	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board.

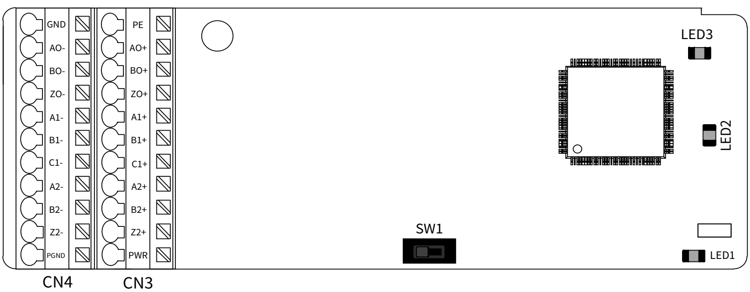
Symbol	Name	Description
LED2	Status indicator	Off: The expansion card is disconnected from the control board.
LED3	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.

Figure E-16 External wiring diagram when using EC-PG503-05



E.4.3 Multifunction incremental PG card (EC-PG505-12)

Figure E-17 EC-PG505-12 expansion card



SW1: the switch used to set the voltage class (5V or 12V) of the power supply of the encoder. It can be operated with an auxiliary tool.

Table E-17 Terminal description

Terminal symbol	Terminal name	Specification
PWR	Encoder power supply	Voltage: 5V/12V ± 5% Max. output: 150mA Select the voltage class through SW1 based on the voltage class of the used encoder.
PGND		
A1+	Encoder interface	● Applicable to 5V/12V push-pull encoders ● Applicable to 5V/12V open collector (OC) encoders ● Applicable to 5V differential encoders ● Response frequency: 400kHz
A1-		
B1+		
B1-		
Z1+		
Z1-		
A2+	Pulse reference	● Supporting the same signal types as the encoder signal types ● Response frequency: 400kHz
A2-		
B2+		
B2-		
Z2+		
Z2-		
AO+	Frequency-divided output	● Differential output of 5V ● Supports frequency division of 1–255, which can be set through P20.16 or P24.16
AO-		
BO+		
BO-		
ZO+		
ZO-		

Table E-18 Indicator description

Symbol	Name	Description
LED1	Signal indicator	On: Other cases Blinking (On: 500ms; Off: 500ms): A1 or B1 signal is disconnected during encoder rotating.
LED2	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.
LED3	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board.

Symbol	Name	Description
LED3	Status indicator	Off: The expansion card is disconnected from the control board.

The EC-PG505-12PG card is equipped with pull-up resistors internally and can be used with various incremental encoders through different external wiring configurations. For the specific wiring, see Figure E-18, Figure E-19, and Figure E-20.

Figure E-18 External wiring diagram when used with an open collector encoder

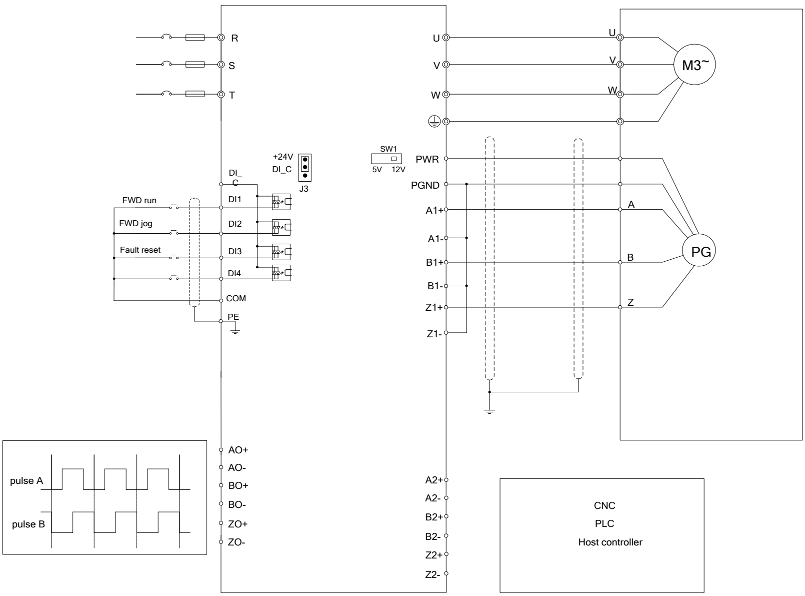


Figure E-19 External wiring diagram when used with a push-pull encoder

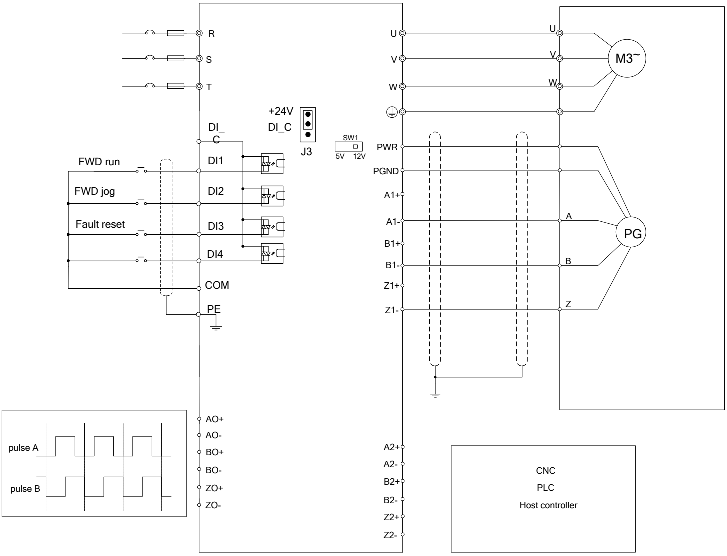
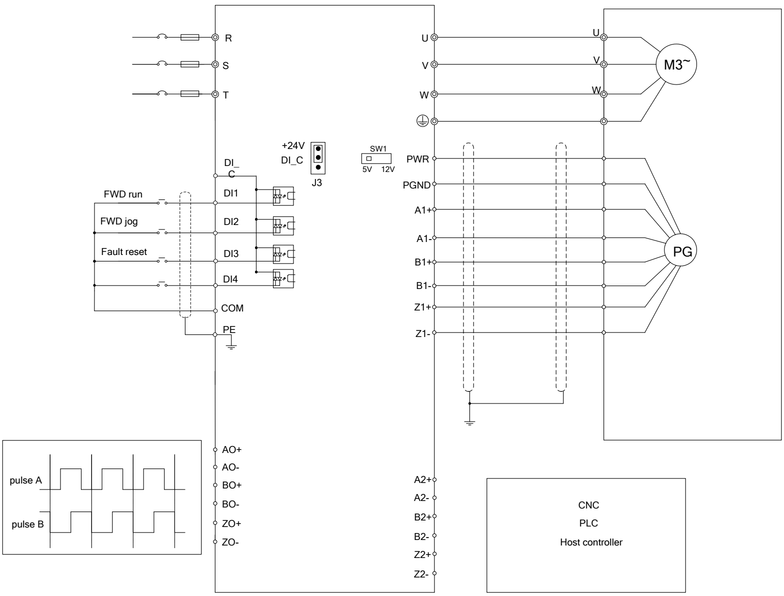


Figure E-20 External wiring diagram when used with a differential encoder



E.4.4 24V incremental PG card (EC-PG505-24B)

Figure E-21 EC-PG505-24B expansion card

Table E-19 Terminal description

Symbol	Name	Specification
PWR	Encoder power supply	Voltage: 24V ± 5% Max. output current: 150mA
PGND		
A1+	Encoder interface	● Applicable to 24V push-pull encoders ● Applicable to 24V OC encoders ● Applicable to 24V differential encoders ● Response frequency: 400kHz
A1-		
B1+		
B1-		
Z1+		
Z1-		
A2+	Pulse reference	● Applicable to 24V push-pull and OC encoders ● Applicable to 5V differential encoders ● Response frequency: 400kHz
A2-		
B2+		
B2-		
Z2+		
Z2-		
AO+	Frequency-divided output	● Supports open collector output with a pull-up resistor externally connected to the input port ● Supports frequency division of 1–255, which can be set through P20.16 or P24.16 ● Supporting frequency-divided output source selection, which can be set through P20.17 or P24.17
BO+		
ZO+		

Table E-20 Indicator description

Symbol	Name	Description
LED1	Signal indicator	On: Other cases Blinking (On: 500ms; Off: 500ms): A1 or B1 signal is disconnected during encoder rotating.
LED2	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.
LED3	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.

The EC-PG505-24B uses spring terminals, and AO-, BO-, and ZO- are internally shorted to PGND. The PG expansion card is configured with a pull-up resistor and can work in combination with multiple types of incremental encoders through various external wiring modes. For the specific wiring, see Figure E-22 and Figure E-23.

Figure E-22 External wiring diagram when used with an open collector encoder

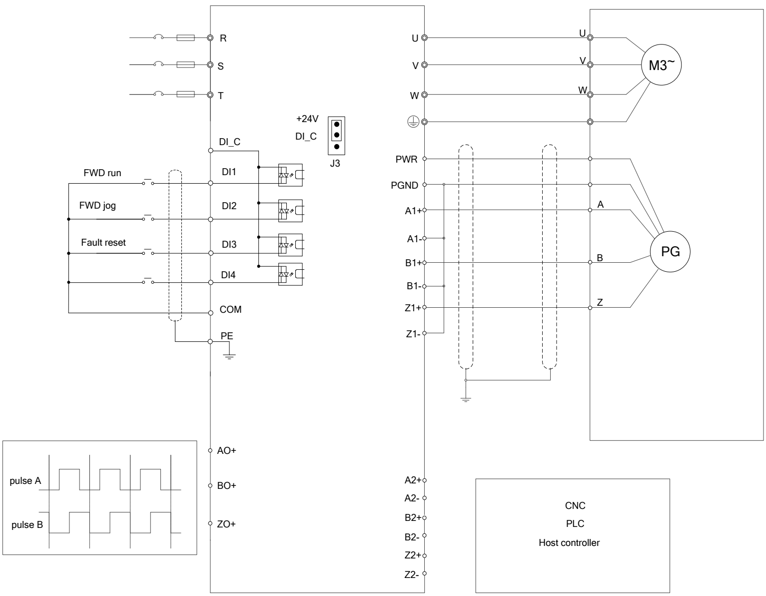
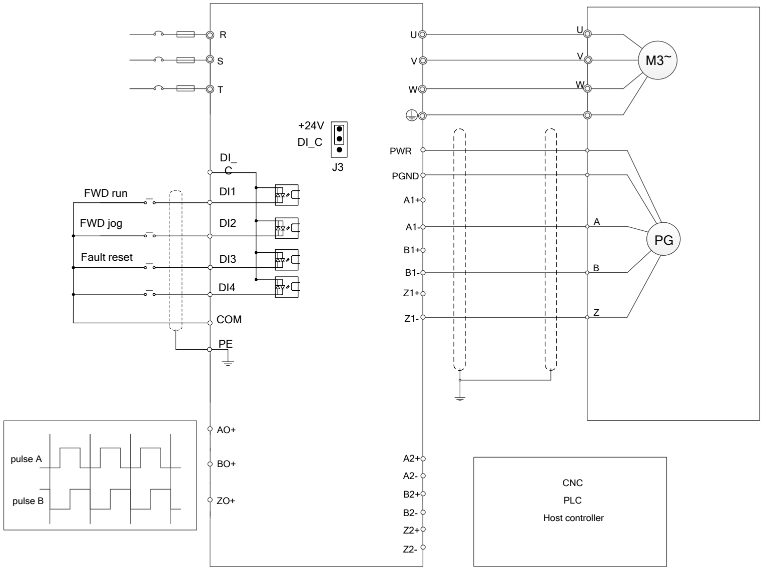
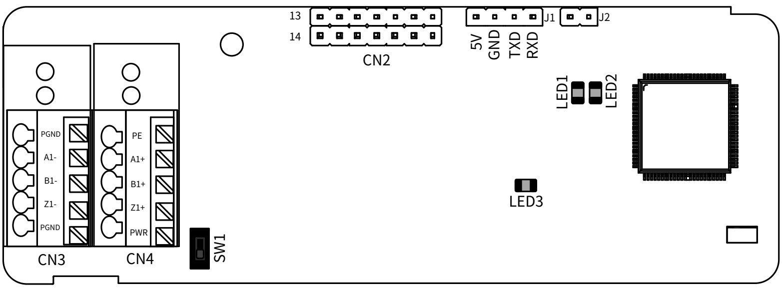


Figure E-23 External wiring diagram when used with a push-pull encoder



E.4.5 Simplified incremental PG card (EC-PG507-12)

Figure E-24 EC-PG507-12 expansion card



SW1: the switch used to set the voltage class (5V or 12V) of the power supply of the encoder. It can be operated with an auxiliary tool.

Table E-21 Terminal description

Symbol	Name	Specification
PWR	Encoder power supply	Voltage: 5V/12V ± 5% Max. output: 150mA Select the voltage class through SW1 based on the voltage class of the used encoder.
PGND		
A1+	Encoder interface	● Applicable to 5V/12V push-pull encoders ● Applicable to 5V/12V open collector (OC) encoders ● Applicable to 5V differential encoders ● Response frequency: 400kHz ● Supporting the encoder cable length of up to 50m
A1-		
B1+		
B1-		
Z1+		
Z1-		

Table E-22 Indicator description

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.
LED2	Signal indicator	On: Encoder signals are normal. Off: A1 or B1 of the encoder is disconnected.
LED3	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.

Note: EC-PG507-12 can work in combination with multiple types of incremental encoders through various external wiring modes, which are similar to the wiring methods of EC-PG505-12.

E.4.6 24V simplified incremental PG card (EC-PG507-24)

Figure E-25 EC-PG507-24 expansion card

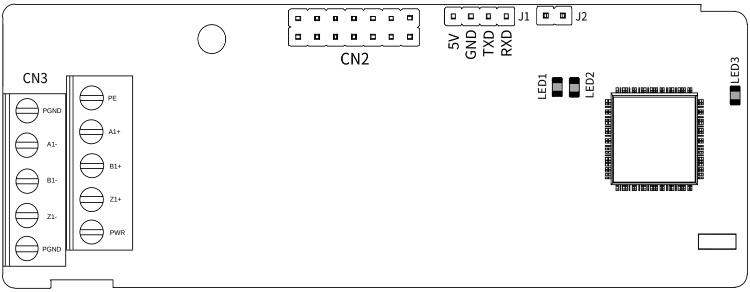


Table E-23 Terminal description

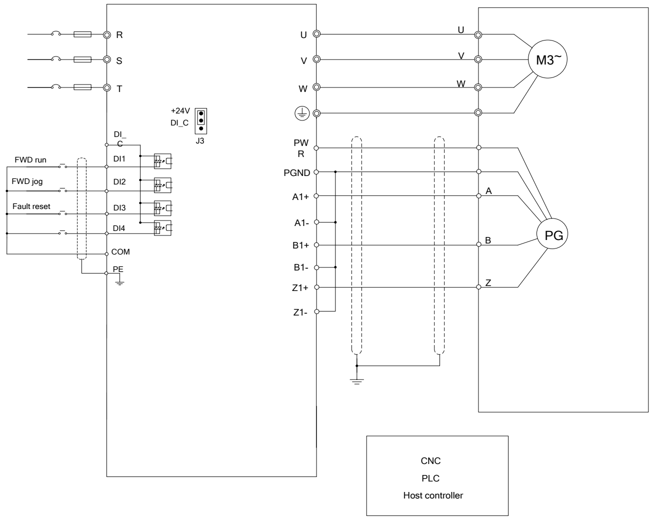
Symbol	Name	Specification
PE	Grounding terminal	Connected to the ground to enhance the anti-interference performance
PWR	Encoder power supply	Voltage: 24V ± 5% Max. output current: 150mA **Note:** PGND is the isolated power ground.
PGND		
A1+	Encoder interface	● Applicable to 24V push-pull encoders ● Applicable to 24V OC encoders ● Applicable to 24V differential encoders ● Response frequency: 200kHz ● Supporting the encoder cable length of up to 100m
A1-		
B1+		
B1-		
Z1+		
Z1-		

Table E-24 Indicator description

Symbol	Name	Description
LED1	Status indicator	On: The expansion card is establishing a connection with the control board. Blinking (On: 500ms; Off: 500ms): The expansion card is properly connected to the control board. Off: The expansion card is disconnected from the control board.
LED2	Signal indicator	On: Encoder pulses are normal. Off: A1 or B1 of the encoder is disconnected.
LED3	Power indicator	On: The expansion card is powered on. Off: The expansion card is not powered on.

The EC-PG507-24 expansion card uses 5.08mm pitch terminals. It is equipped with a pull-up resistor internally. It can work in combination with multiple types of incremental encoders through various external wiring methods, as shown in the following figures.

Figure E-26 External wiring diagram when used with an open collector encoder



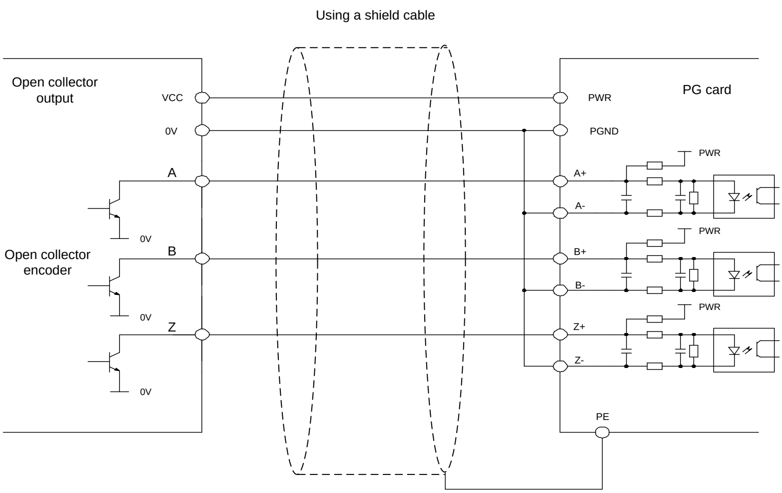
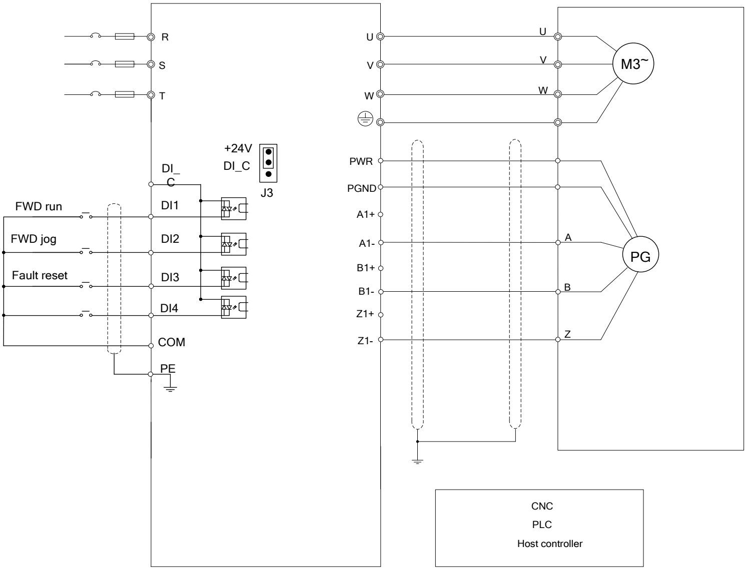


Figure E-27 External wiring diagram when used with a push-pull encoder



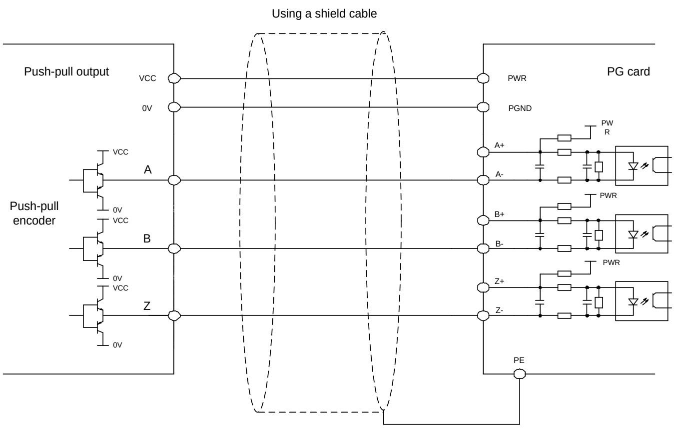
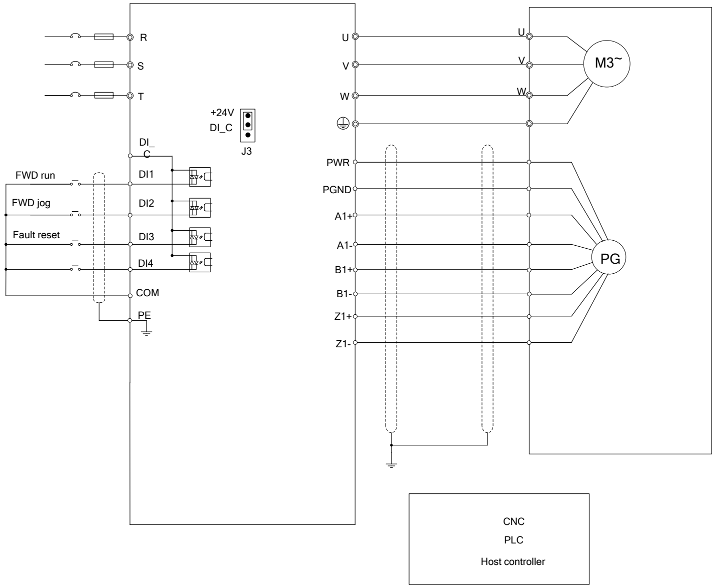
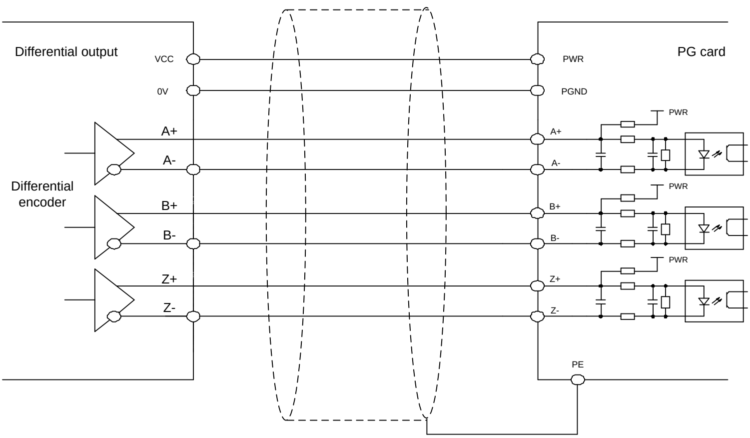


Figure E-28 External wiring diagram when used with a differential encoder





E.5 Power supply expansion card

E.5.1 24V power supply expansion card (EC-PS501-24)

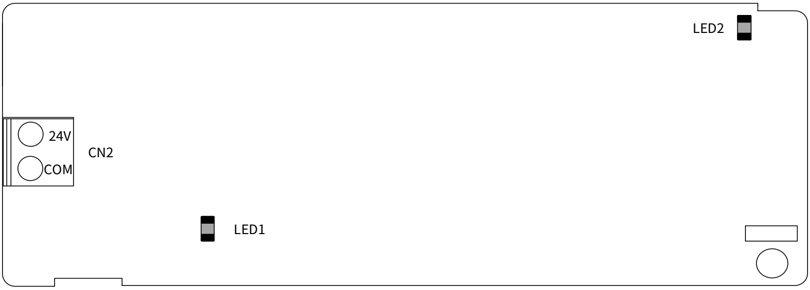


Table E-25 Indicator description

Symbol	Name	Function
LED1	24V power indicator	Indicator for the external 24V power.
LED2	5V power indicator	Indicator for the 5V power provided for the control board, converted by the switching power supply.

The 24V power supply card is mainly used to connect to external 24V power to power the control board, allowing for independent commissioning without requiring the three-phase mains power (R/S/T). During wiring, connect to +24V and COM according to the CN2 sign.

Note: When using this expansion card, set parameter P08.64 (24V power supply card power-on delay time) to 2.00s.

Appendix F Function parameter list

The function parameters of the drive are divided into groups by function. Among the function parameter groups, the P98 group is the analog input and output calibration group, while the P99 group contains the factory function parameters, which are user inaccessible. Each group includes several function codes (each function code identifies a function parameter). A three-level menu style is applied to function codes. For example, "P08.08" indicates the 8th function code in the P08 group.

The function group numbers correspond to the level-1 menus, the function codes correspond to the level-2 menus, and the function parameters correspond to the level-3 menus.

The function code table contains:

Column 1 "Function code": Code of the function group and parameter.

Column 2 "Name": Full name of the function parameter.

Column 3 "Description": Detailed description of the function parameter.

Column 4 "Default": Initial value set in factory.

Column 5 "Modify": Whether the function parameter can be modified, and conditions for the modification:

"○" indicates that the value of the parameter can be modified when the drive is in stopped or running state.

"◎" indicates that the value of the parameter cannot be modified when the drive is in running state.

"●" indicates that the value of the parameter is detected and recorded, and cannot be modified. (When "Restore factory settings" is performed, the actual detected parameter values or recorded values will not be restored.)

The parameters adopt the decimal system (DEC) or hexadecimal system (HEX). If the hexadecimal system is adopted, all bits are mutually independent on data during parameter editing, and the setting ranges can be 0–F.

"Default" indicates the factory setting of the function parameter. If the value of the parameter is detected or recorded, the value cannot be restored to the factory setting.

To better protect parameters, the drive provides the password protection function. After a password is set (that is, P07.00 is set to a non-zero value), 0.0.0.0.0 is displayed when you press the PRG/ESC key to enter the function code editing interface. You need to enter the correct user password to enter the interface. For the factory parameters, you need to enter the correct factory password to enter the interface. (You are not advised to modify the factory parameters. Incorrect parameter setting may cause operation exceptions or even damage to the drive.) When password protection is not active, the user password can be modified at any time. The last entered value will be used as the user password. You can set P07.00 to 0 to cancel the user password. When P07.00 is set to a non-zero value during power-on, parameters are prevented from being modified by using the user password function. The same rules apply to the user password function when modifying function code parameters via serial communication.

Group P00—Basic functions

Function code	Name	Description	Default	Modify
P00.00	Speed control mode	Specifies a speed control mode. Setting range: 0–3 0: SVC 0 1: SVC 1 2: V/F control mode 3: Closed-loop vector control mode **Note:** When using a vector control mode (0, 1, or 3), enable the drive to perform motor parameter autotuning first.	3	◎
P00.01	Channel of running commands	Specifies a channel of running commands. Setting range: 0–2 0: Keypad 1: Terminal 2: Communication	0	○
P00.02	Communication channel of running commands	Specifies a communication channel of running commands. Setting range: 0–7 0: Modbus/Modbus TCP communication 1: PROFIBUS/CANopen/DeviceNet communication 2: Ethernet communication 3: EtherCAT/PROFINET/Ethernet IP communication 4–6: Reserved 7: USB communication **Note:** The Modbus TCP communication mode of option 0, and options 1, 2, and 3 are extended functions, which are valid only when corresponding expansion cards are configured.	0	○

Function code	Name	Description	Default	Modify
P00.03	Max. output frequency	Specifies the max. output frequency of the drive, which is the basis of the frequency setting and the acceleration (ACC) and deceleration (DEC) speed. Setting range: Max (P00.04, 10.00)–599.00Hz **Note:** The minimum setting is limited by the motor rated frequency.	150.00Hz	◎
P00.04	Upper limit of running frequency	Specifies the upper limit of the drive output frequency, which should be less than or equal to the max. output frequency. If the set frequency is higher than the upper limit of the running frequency, the upper limit of the running frequency is used for running. Setting range: P00.05–P00.03 (Max. output frequency)	150.00Hz	○
P00.05	Lower limit of running frequency	Specifies the lower limit of the drive output frequency. If the set frequency is lower than the lower limit of the running frequency, the lower limit of the running frequency is used for running. Setting range: 0.00Hz–P00.04 (Upper limit of running frequency) **Note:** ● Max. output frequency ≥ Upper limit of running frequency ≥ Lower limit of running frequency ● It is recommended to set it to 0.00Hz for low-speed pressure holding conditions in hydraulic mode.	0.00Hz	○
P00.06	Setting channel of A frequency command	Specifies the frequency command source. Setting range: 0–18 0: Keypad 1: AI1 2: AI2 3: EAI3 4: Communication speed (-100.0%–100.0%, relative to P73.40)	0	○
P00.07	Reserved		18	●

Function code	Name	Description	Default	Modify
		5–7: Reserved 8: Modbus/Modbus TCP communication 9: PROFIBUS/CANopen/DeviceNet communication 10: Ethernet communication 11–12: Reserved 13: EtherCAT/PROFINET/EtherNet IP communication 14: Reserved 15: EAI5 16: EAI6 17: EAI7 18: Reserved		
P00.08–P00.09	Reserved	-	-	-
P00.10	Frequency set through keypad	Specifies the frequency set through the keypad. Setting range: 0.00Hz–P00.03 (Max. output frequency)	50.00Hz	○
P00.11	ACC time 1	Specifies the ACC time of ramp frequency. Setting range: 0.0–3600.0s	Model depended	○
P00.12	DEC time 1	Specifies the DEC time of ramp frequency. Setting range: 0.0–3600.0s	Model depended	○
P00.13	Running direction selection	Specifies the running direction. Setting range: 0–2 0: Run in the default direction 1: Run in the opposite direction 2: Disable reverse running **Note:** In hydraulic mode, when P00.13 = 2 and the drive runs at 0Hz, the output voltage is 0 and the drive enters sleep state.	0	○
P00.14	Carrier frequency setting	Setting range: 1.0–8.0kHz Specifies the carrier frequency. A high carrier frequency results in an ideal current waveform, low current harmonics, and reduced motor noise, but it will increase the switching loss, increase drive temperature,	Model depended	○

Function code	Name	Description	Default	Modify
		and impact the output capacity. At the same time, the drive leakage current and electromagnetic interference will increase. On the contrary, an extremely low carrier frequency may cause unstable operation at low frequency, decrease the torque, or even lead to oscillation. The carrier frequency has been properly set in the factory before the drive is delivered. In general, you do not need to modify it. The mapping between drive models and default carrier frequency values is as follows: 380V 7.5–11kW: 6kHz 380V 15–55kW: 4kHz 380V 55kW and higher: 3kHz **Note:** When the frequency used exceeds the default carrier frequency, the drive needs to be derated by 10% for each increase of 1kHz.		
P00.15	Motor parameter autotuning	Setting range: 0x000–0x134 Ones place: Motor basic parameter autotuning 0: No operation 1: Complete parameter rotary autotuning 2: Complete parameter static autotuning 3: Partial parameter static autotuning 4: Drive autotuning Tens place: Initial pole angle autotuning 0: No operation 1: Rotary autotuning 2: Static autotuning 3: Rotary autotuning 2 Hundreds place: System inertia autotuning 0: Disable 1: Enable	0x000	◎

Function code	Name	Description	Default	Modify
P00.16	AVR function selection	Specifies the drive automatic voltage regulation (AVR) function, which can eliminate the impact of the bus voltage fluctuation on the drive output voltage. Setting range: 0–1 0: Invalid 1: Valid during the whole process	1	○
P00.17	Reserved	-	-	-
P00.18	Function parameter restoration	Specifies the function parameter restoration. Setting range: 0–6 0: No operation 1: Restore to default values (excluding motor parameters) 2: Clear fault records 3–4: Reserved 5: Restore to default values (factory test mode) 6: Restore to default values (including motor parameters) **Note:** Restoring to default values will delete the user password. After the selected operation is performed, the function code is automatically restored to 0. The options 5 and 6 should be used under the instructions of the manufacturer.	0	◎

Group P01—Start and stop control

Function code	Name	Description	Default	Modify
P01.00	Running mode of start	Specifies the running mode of start. Setting range: 0–4 0: Direct start 1: Start after DC braking 2–4: Reserved	0	◎
P01.01	Starting frequency of direct start	Specifies the initial frequency during drive start. Setting range: 0.00Hz–P00.03	0.00Hz	◎

Function code	Name	Description	Default	Modify
P01.02	Starting frequency hold time	Specifies the hold time of starting frequency. Setting range: 0.0–50.0s	0.0s	◎
P01.03	Braking current before start	Specifies the DC braking current before startup. Setting range: 0.0–100.0%	0.0%	◎
P01.04	Braking time before start	Specifies the DC braking time before startup. Setting range: 0.00–50.00s	0.00s	◎
P01.05	ACC/DEC mode	Specifies the changing mode of the frequency during start and running. Setting range: 0–1 0: Linear type. The output frequency increases or decreases linearly. 1: S curve. The output frequency increases or decreases according to the S curve. **Note:** The S curve is generally applied to scenarios where smoother start or stop is required. When S curve mode is selected, P01.06, P01.07, P01.27, and P01.28 need to be set accordingly.	0	◎
P01.06	Time of starting segment of ACC S curve	Specifies the time of the starting segment of the ACC S curve. It works with P01.07 to determine the curvature of the S curve. Setting range: 0.0–50.0s	0.1s	◎
P01.07	Time of ending segment of ACC s curve	Specifies the time of the ending segment of the ACC S curve. It works with P01.06 to determine the curvature of the S curve. Setting range: 0.0–50.0s	0.1s	◎
P01.08	Stop mode	Specifies the stop mode. Setting range: 0–1 0: Decelerate to stop. After a stop command takes effect, the drive lowers output frequency based on the DEC mode and the defined DEC time; after the frequency drops to the stop speed (P01.15), the drive stops. 1: Coast to stop. After a stop command takes effect, the drive ceases the output immediately, and the load coasts to stop according to mechanical inertia.	0	○

Function code	Name	Description	Default	Modify
P01.09	Starting frequency of braking for stop	Specifies the starting frequency of DC braking for stop. Setting range: 0.00Hz–P00.03 (Max. output frequency)	0.00Hz	○
P01.10	Demagnetization time	Specifies the demagnetization time, that is, the wait time before DC braking for stop. Setting range: 0.00–30.00s	0.00s	○
P01.11	DC braking current for stop	Specifies the DC braking current for stop, that is, the DC braking energy. Setting range: 0.0–100.0% (of the drive rated output current)	0.0%	○
P01.12	DC braking time for stop	Specifies the duration of DC braking. Setting range: 0.00–50.00s **Note:** If the value is 0, DC braking is invalid, and the drive decelerates to stop within the specified time.	0.00s	○
P01.13	FWD/REV run deadzone time	Specifies the transition time of the FWD/REV run switching, the mode of which is specified by P01.14. Setting range: 0.0–3600.0s	0.0s	○
P01.14	FWD/REV run switching mode	Specifies the forward/reverse run switching mode. Setting range: 0–2 0: Switch at zero frequency 1: Switch at the starting frequency 2: Switch after the speed reaches the stop speed with a delay	1	◎
P01.15	Stop speed	Specifies the stop speed (frequency). Setting range: 0.00Hz–P00.03 (Max. output frequency)	0.00Hz	◎
P01.16	Stop speed detection mode	Specifies the stop speed detection mode. If the detected value is less than the value of P01.15, the drive stops. Setting range: 0–1 0: Detect by the set speed (the only option in V/F mode) 1: Detect according to speed feedback	0	◎
P01.17	Stop speed detection time	Specifies the stop speed detection time. Setting range: 0.00–100.00s	0.50s	◎

Function code	Name	Description	Default	Modify
P01.18	Terminal-based running command protection at power-on	Specifies whether the terminal running command is valid at power-on. Setting range: 0–2 0: The terminal-based running command is invalid at power-on 1: The terminal-based running command condition is valid at power-on 2: The terminal-based running command is valid at power-on **Note:** When set to 1, operation is enabled only when the reference frequency exceeds P08.06 (running frequency of jogging).	0	○
P01.19	Action selected when running frequency less than lower limit frequency (valid when lower limit frequency greater than 0)	Specifies the run status of the drive when the set frequency is below the lower limit. Setting range: 0x00–0x12 Ones place: Action selection 0: Run at the frequency lower limit 1: Stop 2: Sleep Tens place: Stop mode 0: Coast to stop 1: Decelerate to stop	0x00	◎
P01.20	Wake-up-from-sleep delay	Specifies the wake-up-from-sleep delay time. Setting range: 0.0–3600.0s (Valid only when the ones place of P01.19 is 2.)	0.0s	○
P01.21	Power-off restart selection	Specifies whether the drive automatically runs after re-power on. Setting range: 0–1 0: Disable 1: Enable. If the restart condition is met, the drive will run automatically after waiting the time defined by P01.22.	0	○
P01.22	Wait time for power-on restart	Specifies the wait time before the automatic running of the drive that is re-powered on. Setting range: 0.0–3600.0s (valid only when P01.21 = 1)	1.0s	○
P01.23	Start delay time	Setting range: 0.0–600.0s	0.0s	○
P01.24	Stop speed delay	Setting range: 0.0–600.0s	0.0s	○

Function code	Name	Description	Default	Modify
P01.25	Open-loop 0Hz output selection	Setting range: 0–2 0: Output without voltage 1: Output with voltage 2: Output with the DC braking current for stop	0	○
P01.26	DEC time during emergency stop	Setting range: 0.0–60.0s	2.0s	○
P01.27	Time of starting segment of DEC S curve	Setting range: 0.0–50.0s	0.1s	◎
P01.28	Time of ending segment of DEC S curve	Setting range: 0.0–50.0s	0.1s	◎
P01.29	Short-circuit braking current	Setting range: 0.0–150.0% (of the drive rated output current)	0.0%	○
P01.30	Hold time of short-circuit braking for start	When the drive starts in direct start mode (P01.00=0), set P01.30 to a non-zero value to enter short-circuit braking. Setting range: 0.00–50.00s	0.00s	○
P01.31	Hold time of short-circuit braking for stop	During stop, if the running frequency of drive is lower than the starting frequency of brake for stop (P01.09), set P01.31 to a non-zero value to enter short-circuit braking for stop, and then carry out DC braking in the time set by P01.12. (For details, see the descriptions for P01.09–P01.12.) Setting range: 0.00–50.00s	0.00s	○
P01.32	Pre-exciting time for jogging	Setting range: 0.000–10.000s	0.000s	○
P01.33	Starting frequency of braking for stop in jogging	Setting range: 0.00Hz–P00.03	0.00Hz	○
P01.34	Sleep delay	Setting range: 0–3600.0s	0.0s	○
P01.35–P01.43	Reserved	-	-	-

Group P02—Parameters of motor 1

Function code	Name	Description	Default	Modify
P02.00	Type of motor 1	Setting range: 0–1 0: Asynchronous motor (AM) 1: Synchronous motor (SM)	1	◎
P02.01	Rated power of AM 1	Setting range: 0.1–3000.0kW	Model depended	◎
P02.02	Rated frequency of AM 1	Setting range: 0.01Hz–P00.03 (Max. output frequency)	120.00Hz	◎
P02.03	Rated speed of AM 1	Setting range: 1–60000rpm	Model depended	◎
P02.04	Rated voltage of AM 1	Setting range: 0–1200V	Model depended	◎
P02.05	Rated current of AM 1	Setting range: 0.8–6000.0A	Model depended	◎
P02.06	Stator resistance of AM 1	Setting range: 0.001–65.535Ω	Model depended	○
P02.07	Rotor resistance of AM 1	Setting range: 0.001–65.535Ω	Model depended	○
P02.08	Leakage inductance of AM 1	Setting range: 0.1–6553.5mH	Model depended	○
P02.09	Mutual inductance of AM 1	Setting range: 0.1–6553.5mH	Model depended	○
P02.10	No-load current of AM 1	Setting range: 0.1–6553.5A	Model depended	○
P02.11	Magnetic saturation coefficient 1 of iron core of AM 1	Setting range: 0.0–100.0%	80.0%	○
P02.12	Magnetic saturation coefficient 2 of iron core of AM 1	Setting range: 0.0–100.0%	68.0%	○
P02.13	Magnetic saturation coefficient 3 of iron core of AM 1	Setting range: 0.0–100.0%	57.0%	○
P02.14	Magnetic saturation coefficient 4 of iron core of AM 1	Setting range: 0.0–100.0%	40.0%	○

Function code	Name	Description	Default	Modify
P02.15	Rated power of SM 1	Setting range: 0.1–3000.0kW	Model depended	◎
P02.16	Rated frequency of SM 1	Setting range: 0.01Hz–P00.03 (Max. output frequency)	120.00Hz	◎
P02.17	Number of pole pairs of SM 1	Setting range: 1–128	4	◎
P02.18	Rated voltage of SM 1	Setting range: 0–800V	Model depended	◎
P02.19	Rated current of SM 1	Setting range: 0.8–6000.0A	Model depended	◎
P02.20	Stator resistance of SM 1	Setting range: 0.001–65.535Ω	Model depended	○
P02.21	Direct-axis inductance of SM 1	Setting range: 0.01–655.35mH	Model depended	○
P02.22	Quadrature-axis inductance of SM 1	Setting range: 0.01–655.35mH	Model depended	○
P02.23	Counter-emf constant of SM 1	Setting range: 0–800V	300	○
P02.24	Initial pole position of SM 1	Setting range: 0x0000–0xFFFF	0x0000	●
P02.25	Rotation frequency percentage setting for SM 1 counter-emf identification	Setting range: 5.0–100.0%	60.0%	◎
P02.26	Overload protection selection of motor 1	Setting range: 0–2 0: No protection 1: Common motor protection (with low-speed compensation). As the cooling effect of a common motor is degraded at low speed running, the corresponding electronic thermal protection value needs to be adjusted properly. The low compensation indicates lowering the overload protection threshold of the motor whose running frequency is lower than 30Hz. 2: Variable-frequency motor protection (without low speed compensation). Because the heat dissipation function for a variable-frequency motor is not	0	◎

Function code	Name	Description	Default	Modify
		impacted by the rotation speed, it is not necessary to adjust the protection value at low speed running.		
P02.27	Overload protection coefficient of motor 1	Specifies the motor overload protection coefficient. A lower motor overload protection coefficient indicates a higher overload multiple (M). When M=116%, protection is performed after motor overload lasts for 1 hour; when M=150%, protection is performed after motor overload lasts for 12 minutes; when M=180%, protection is performed after motor overload lasts for 5 minutes; when M=200%, protection is performed after motor overload lasts for 60 seconds; and when M⩾400%, protection is performed immediately. Setting range: 20.0–250.0%	100.0%	○
P02.28	Power display calibration coefficient of motor 1	Used to adjust the power display value of motor 1. However, it does not affect the control performance of the drive. Setting range: 0.00–3.00	1.00	○
P02.29	Parameter display selection of motor 1	Setting range: 0–1 0: Display based on motor type (In this mode, only parameters related to the current motor type are displayed.) 1: Display all. In this mode, all the motor parameters are displayed.	0	○
P02.30	System inertia of motor 1	Setting range: 0.001–30.000kg • m^2	0.001kg • m^2	○
P02.31	Reserved	-	-	-
P02.32	Power factor of AM 1	Setting range: 0.00–1.00 **Note:** For asynchronous motors, P02.32 needs to be set according to the motor nameplate before P02.31 is enabled; otherwise, the calculation may be inaccurate.	0.85	○
P02.33–P02.38	Reserved	-	-	-

Group P03—Vector control of motor 1

Function code	Name	Description	Default	Modify
P03.00	Speed-loop proportional gain 1 of motor 1	Setting range: 0.0–200.0 ✎ **Note:** Applicable only to vector control mode.	8.0	○
P03.01	Speed-loop integral time 1 of motor 1	Setting range: 0.020–10.000s ✎ **Note:** Applicable only to vector control mode.	0.200s	○
P03.02	Low-point frequency for speed-loop switching of motor 1	Setting range: 0.00Hz–P03.05 ✎ **Note:** Applicable only to vector control mode.	10.00Hz	○
P03.03	Speed-loop proportional gain 2 of motor 1	Setting range: 0.0–200.0 ✎ **Note:** Applicable only to vector control mode.	8.0	○
P03.04	Speed-loop integral time 2 of motor 1	Setting range: 0.020–10.000s ✎ **Note:** Applicable only to vector control mode.	0.200s	○
P03.05	High-point frequency for speed-loop switching of motor 1	Setting range: P03.02–P00.03 (Max. output frequency) ✎ **Note:** Applicable only to vector control mode.	10.00Hz	○
P03.06	Speed-loop output filter of motor 1	0–8 (corresponding to 0–2^8/10ms)	0	○
P03.07	Electromotive slip compensation coefficient of vector control for motor 1	Slip compensation coefficient is used to adjust the slip frequency of vector control and improve the speed control accuracy of the system. Adjusting the parameter properly can control the steady-state speed error. Setting range: 50–200%	100%	○
P03.08	Braking slip compensation coefficient of vector control of motor 1	Slip compensation coefficient is used to adjust the slip frequency of vector control and improve the speed control accuracy of the system. Adjusting the parameter properly can control the steady-state speed error. Setting range: 50–200%	100%	○
P03.09	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P03.10	Current-loop bandwidth of motor 1	Setting range: 0–2000	400	○
P03.11	Torque setting method	Setting range: 0–15 0–1: Keypad (P03.12) 2: AI1 3: AI2 4: EAI3 5: Reserved 6: Multi-step torque 7: Modbus/Modbus TCP communication 8: PROFIBUS/CANopen/DeviceNet communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET/EtherNet IP communication 12: Reserved 13: EAI5 14: EAI6 15: EAI7 **Note:** 100% corresponds to the motor rated current.	0	○
P03.12	Torque set through keypad	Setting range: -300.0–300.0% (of the motor rated current)	20.0%	○
P03.13	Torque reference filter time	Setting range: 0.000–10.000s	0.010s	○
P03.14	Setting source of forward rotation frequency upper limit in torque control	Setting range: 0–15 0: Keypad (P03.16) 1: AI1 2: AI2 3: EAI3 4: Reserved 5: Multi-step setting 6: Modbus/Modbus TCP communication 7: PROFIBUS/CANopen/ DeviceNet	0	○

Function code	Name	Description	Default	Modify
		communication 8: Ethernet communication 9: Reserved 10: EtherCAT/PROFINET/EtherNet IP communication 11: Reserved 12: EAI5 (same as the above) 13: EAI6 (same as the above) 14: EAI6 (same as the above) 15: Reserved **Note:** 100% corresponds to the max. frequency.		
P03.15	Setting source of reverse rotation frequency upper limit in torque control	Setting range: 0–12 0: Keypad (P03.17) 1–15: Same as those for P03.14	0	○
P03.16	Forward rotation frequency upper limit set through keypad in torque control	Specifies the frequency limit when P03.14=1. Setting range: 0.00Hz–P00.03 (100% corresponding to max. output frequency)	50.00Hz	○
P03.17	Reverse rotation frequency upper limit set through keypad in torque control	Specifies the frequency limit when P03.15=1. Setting range: 0.00Hz–P00.03 (100% corresponding to max. output frequency)	50.00Hz	○
P03.18	Setting source of electromotive torque upper limit	Setting range: 0–14 0: Keypad (P03.20) 1: AI1 2: AI2 3: EAI3 4: Reserved 5: Modbus/Modbus TCP communication 6: PROFIBUS/CANopen/DeviceNet communication 7: Ethernet communication	0	○

Function code	Name	Description	Default	Modify
		8: Reserved 9: EtherCAT/PROFINET/EtherNet IP communication 10: Reserved 11: EAI5 12: EAI6 13: EAI7 14: Reserved **Note:** 100% corresponds to the motor rated current.		
P03.19	Setting source of braking torque upper limit	Setting range: 0–14 0: Keypad (P03.21) 1–14: Same as those for P03.18	0	○
P03.20	Electromotive torque upper limit set through keypad	Specifies the torque limit. Setting range: 0.0–300.0% (of the motor rated current)	200.0%	○
P03.21	Braking torque upper limit set through keypad	Specifies the torque limit. Setting range: 0.0–300.0% (of the motor rated current)	200.0%	○
P03.22	Weakening coefficient in constant power zone	Used when the AM is in flux-weakening control. Setting range: 0.1–2.0	1.0	○
P03.23	Lowest weakening point of AM in constant power zone	Setting range: 5–100%	10%	○
P03.24	Max. voltage limit	Specifies the max. drive output voltage, which is a percentage of the motor rated voltage. Set the value according to on-site conditions. Setting range: 0.0–120.0%	105.0%	○
P03.25	Pre-exciting time	Specifies the pre-exciting time. Pre-exciting is performed for the motor when the drive starts up. A magnetic field is built up inside the motor to improve the torque performance during the start process. Setting range: 0.000–10.000s **Note:** Pre-excitation can improve the starting capability of AM with loads.	0.000s	○

Function code	Name	Description	Default	Modify
		For an AM, set 0 to disable the pre-excitation process. For an SM, if P13.01 is set to an enabling option, the pre-excitation process is directly skipped.		
P03.26	Flux-weakening proportional gain	Setting range: 0–8000	1000	○
P03.27	Speed display selection in vector control	Setting range: 0–1 0: Displayed as the actual value 1: Displayed as the set value	0	○
P03.28	Static friction compensation coefficient	Setting range: 0.0–100.0%	0.0%	○
P03.29	Frequency point corresponding to static friction	Setting range: 0.50Hz–P03.31	1.00Hz	○
P03.30	High speed friction torque compensation coefficient	Setting range: 0.0–100.0%	0.0%	○
P03.31	Frequency corresponding to high speed friction torque	Setting range: P03.29–P00.03(Hz)	50.00Hz	○
P03.32	Enabling torque control	Setting range: 0–1 0: Disable 1: Enable	0	○
P03.33	Flux-weakening integral gain	Setting range: 0.0–300.0%	2.0%	○
P03.34	Reserved	-	-	-
P03.35	Control mode optimization selection	Setting range: 0x0000–0x1111 Ones place: Torque command selection 0: Torque reference 1: Torque current reference Tens place: Reserved Hundreds place: Indicates whether to enable speed-loop integral separation 0: Disable 1: Enable Thousands place: Reserved	0x0000	○

Function code	Name	Description	Default	Modify
P03.36	Speed-loop differential gain of motor 1	Setting range: 0.00–10.00s	0.00s	○
P03.37–P03.39	Reserved	-	-	-
P03.40	Enabling inertia compensation	Setting range: 0–1 0: Disable 1: Enable	0	○
P03.41	Upper limit of inertia compensation torque	The max. inertia compensation torque is limited to prevent inertia compensation torque from being too large. Setting range: 0.0–150.0% (of the motor rated torque)	10.0%	○
P03.42	Inertia compensation filter times	Filter times of inertia compensation torque, used to smooth inertia compensation. Setting range: 0–10	7	○
P03.43	Inertia identification torque	Used to set Inertia identification torque. Setting range: 0.0–100.0% (of the motor rated torque)	10.0%	○
P03.44	Enabling motor inertia identification	Setting range: 0–2 0: No operation 1: Mode 1 2: Mode 2	0	◎
P03.45	SM max. flux weakening current	0.0–200.0%	150	◎
P03.46	Vector control loop optimization parameter	0x00–0x1F Bit0: Enable voltage feedforward compensation (valid in FVC) Bit1: Enable d-axis voltage cross decoupling (valid in FVC) Bit2: Enable q-axis voltage cross decoupling (valid in FVC) Bit3: Enable closed-loop disturbance feedforward compensation Bit4: q-Axis voltage restriction selection 0: Limit to 1.2 times the rated motor voltage 1: Limit to d-axis voltage Bit5–Bit15: Reserved	0x17	◎
P03.47	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P03.48	Speed-loop overshoot suppression gain	Setting range: 0–700	100	◎
P03.49	Closed-loop speed observer bandwidth	Setting range: 1.0–200.0	30.0	○
P03.50	Angle phase-locked loop proportional gain	Setting range: 0–2000	0	○
P03.51–P03.55	Reserved	-	-	-
P03.56	Synchronous motor closed-loop flux-weakening mode	0–2 0: Common flux weakening 1: Optimized flux weakening 1 2: Optimized flux weakening 2	0	○
P03.57	Switch from FVC to SVC mode	0x0000–0x2111 Ones place: Selection of resolver disconnection alarm 0: Report a fault 1: Report an alarm Tens place: Switch to SVC mode selection 0: Switch to SVC0 mode 1: Switch to SVC1 mode Hundreds place: Enable switchover to SVC 0: Disable 1: Enable Thousands place: SVC to SVC 0: Disable 1: Enable 2: Enable and reset disconnection alarm code	0x000	◎
P03.58	Motor UVW phase sequence reversal action selection	0–1 0: Disable 1: Report a fault and stop	0	◎
P03.59	Resolver disconnection detection filter count	1–15	5	○

Function code	Name	Description	Default	Modify
P03.60	Motor UVW phase sequence reversal action threshold	0.0–100.0	60.0	○
P03.61	Reserved	-	-	-

Group P04—V/F control

Function code	Name	Description	Default	Modify
P04.00	V/F curve setting of motor 1	Specifies the V/F curve of motor 1 to meet the needs of different loads. Setting range: 0–5 0: Linear V/F curve, applicable to constant torque loads 1: Multi-point V/F curve 2: Variable torque V/F curve (power of 1.3) 3: Variable torque V/F curve (power of 1.7) 4: Variable torque V/F curve (power of 2.0) Curves 2–4 are applicable to variable torque loads such as fans and water pumps. You can adjust according to the characteristics of the loads to achieve maximum energy savings. 5: Customized V/F (V/F separation). In this mode, V can be separated from F; you can change the characteristics of the curve by adjusting F through the frequency setting channel specified by P00.06 or by adjusting V through the voltage setting channel specified by P04.27.	0	◎
P04.01	Torque boost of motor 1	Setting range: 0.0% (automatic Torque boost); 0.1% –10.0%	0.0%	○
P04.02	Torque boost cut-off of motor 1	Setting range: 0.0–50.0%	20.0%	○
P04.03	V/F frequency point 1 of motor 1	When P04.00=1 (multi-point V/F curve), you can set the V/F curve through P04.03–P04.08. Setting range: 0.00Hz–P04.05 **Note:** V1＜V2＜V3, f1＜f2＜f3 Excessive low-frequency voltage setting will cause motor overheating or damage and trigger drive overcurrent stall or overcurrent protection.	0.00Hz	○

Function code	Name	Description	Default	Modify
P04.04	V/F voltage point 1 of motor 1	Setting range: 0.0–110.0% (of the rated voltage of motor 1) **Note:** See the description for P04.03.	0.0%	○
P04.05	V/F frequency point 2 of motor 1	Setting range: P04.03–P04.07(Hz) **Note:** See the description for P04.03.	0.00Hz	○
P04.06	V/F voltage point 2 of motor 1	Setting range: 0.0–110.0% (of the rated voltage of motor 1) **Note:** See the description for P04.03.	0.0%	○
P04.07	V/F frequency point 3 of motor 1	Setting range: P04.05–P02.02 (of the rated frequency of AM 1) or P04.05–P02.16 (of the rated frequency of SM 1) **Note:** See the description for P04.03.	0.00Hz	○
P04.08	V/F voltage point 3 of motor 1	Setting range: 0.0–110.0% (of the rated voltage of motor 1) **Note:** See the description for P04.03.	0.0%	○
P04.09	V/F slip compensation gain of motor 1	Used to compensate for the motor rotating speed change caused by load change in the space voltage vector mode, and thus improve the rigidity of the mechanical characteristics of the motor. Setting range: 0.0–200.0%	100.0%	○
P04.10	Low-frequency oscillation control factor of motor 1	In space voltage vector control mode, the motor, especially the high-power motor, may experience current oscillation at certain frequencies, which may cause unstable motor running, or even drive overcurrent. You can adjust the function codes properly to eliminate such phenomenon. Setting range: 0–100	10	○
P04.11	High-frequency oscillation control factor of motor 1	Setting range: 0–100	10	○
P04.12	Oscillation control threshold of motor 1	Setting range: 0.00Hz–P00.03 (Max. output frequency)	30.00Hz	○
P04.13–P04.25	Reserved	-	-	-
P04.26	Energy-save run selection	Setting range: 0–1 0: Disable 1: Automatic energy-saving run	0	◎

Function code	Name	Description	Default	Modify
P04.27	Voltage setting channel	Setting range: 0–16 0: Keypad (specified by P04.28) 1: AI1 2: AI2 3–4: Reserved 5: Multi-step speed running (The setting is determined by related parameters in group P10.) 6: Reserved 7: Modbus/Modbus TCP communication 8: PROFIBUS/CANopen/DeviceNet communication 9: Ethernet communication 10: Reserved 11: EtherCAT/PROFINET/EtherNet IP communication 12: Reserved 13: EAI5 14: EAI6 15: EAI7 16: Reserved	0	○
P04.28	Voltage set through keypad	The function code is the voltage digital setting when "keypad" is selected as the voltage setting channel. Setting range: 0.0–100.0%	100.0%	○
P04.29	Voltage increase time	Voltage increase time means the time needed for the drive to accelerate from min. output voltage to the max. output frequency. Setting range: 0.0–3600.0s	5.0s	○
P04.30	Voltage decrease time	Voltage decrease time means the time needed for the drive to decelerate from max. output voltage to the min. output frequency. Setting range: 0.0–3600.0s	5.0s	○
P04.31	Max. output voltage	Specifies the upper limit of output voltage. Setting range: P04.32–100.0% (of the motor rated voltage)	100.0%	◎
P04.32	Min. output voltage	Specifies the lower limit of output voltage. Setting range: 0.0%–P04.31	0.0%	◎
P04.33	Weakening coefficient in constant power zone (V/F)	1.00–1.30	1.00	○

Function code	Name	Description	Default	Modify
P04.34	Pull-in current 1 in V/F control of SM 1	When the SM 1 V/F control mode is enabled, the function code is used to set the reactive current of the motor when the output frequency is lower than the frequency specified by P04.36. Setting range: -100.0–100.0% (of the motor rated current)	30.0%	○
P04.35	Pull-in current 2 in V/F control of SM 1	When the SM 1 V/F control mode is enabled, the function code is used to set the reactive current of the motor when the output frequency is higher than the frequency specified by P04.36. Setting range: -100.0–100.0% (of the motor rated current)	10.0%	○
P04.36	V/F control pull-in current frequency switching point for SM 1	When the SM 1 V/F control mode is enabled, the function code is used to set the frequency threshold for the switching between pull-in current 1 and pull-in current 2. Setting range: 0.0–200.0% (of the motor rated frequency)	20.0%	○
P04.37	V/F control reactive closed-loop proportional coefficient for SM 1	When the SM 1 V/F control mode is enabled, the function code is used to set the proportional coefficient of reactive current closed-loop control. Setting range: 0–500	50	○
P04.38	V/F control reactive current closed-loop integral time for SM 1	When the SM 1 V/F control mode is enabled, the function code is used to set the integral coefficient of reactive current closed-loop control. Setting range: 0–300	30	○
P04.39	Reserved	-	-	-
P04.40	Enabling IF mode for AM 1	Setting range: 0–1 0: Disable 1: Enable	0	◎
P04.41	Current setting in IF mode for AM 1	When IF control is adopted for AM 1, the function code is used to set the output current. The value is a percentage in relative to the rated current of the motor. Setting range: 0.0–200.0%	120.0%	○

Function code	Name	Description	Default	Modify
P04.42	Proportional coefficient in IF mode for AM 1	When IF control is adopted for AM 1, the function code is used to set the proportional coefficient of the output current closed-loop control. Setting range: 0–5000	350	○
P04.43	Integral coefficient in IF mode for AM 1	When IF control is adopted for AM 1, the function code is used to set the integral coefficient of the output current closed-loop control. Setting range: 0–5000	150	○
P04.44	IF switch-out frequency point for AM 1	Setting range: 0.00Hz–P04.50	10.00 Hz	○
P04.45–P04.49	Reserved	-	-	-
P04.50	End frequency point for switching off IF mode for motor 1	Setting range: P04.44–P00.03 (Hz)	25.00 Hz	○
P04.51–P04.56	Reserved	-	-	-
P04.57	VF energy-saving mode selection for AM 1	Setting range: 0–2 0: Max. efficiency 1: Optimal power factor 2: Max. torque per ampere (MTPA)	0	○
P04.58	VF energy-saving optimization coefficient for AM 1	Setting range: 25.0–400.0%	100.0%	○
P04.59–P04.61	Reserved	-	-	-

Group P05—Input terminal functions

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P05.00</td><td>Reserved</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>P05.01</td><td>Function of DI1</td><td rowspan="6">Setting range: 0–95
0: No function
1: Forward running
2: Reverse running
3: Three-wire control
4: Forward jogging
5: Reverse jogging
6: Coast to stop
7: Fault reset
8: Running pause
9: External fault input
10: Increase frequency setting (UP)
11: Decrease frequency setting (DOWN)
12: Clear the frequency increase/decrease setting
13–28: Reserved
29: Switch between speed control and torque control
30–32: Reserved
33: Clear the frequency increase/decrease setting temporarily
34–35: Reserved
36: Switch the running command channel to keypad
37: Switch the running command channel to terminal
38: Switch the running command channel to communication
39–41: Reserved
42: Switch the setting source of torque upper limit to keypad
43–55: Reserved
56: Emergency stop
57: Motor overtemperature fault input
58–59: Reserved
60: Switch to FVC control
61–63: Reserved
64: FWD max. limit
65: REV max limit
66–70: Reserved
71: Switch to the master
72: Switch to the slave</td><td>1</td><td>◎</td></tr>
<tr><td>P05.02</td><td>Function of DI2</td><td>76</td><td>◎</td></tr>
<tr><td>P05.03</td><td>Function of DI3</td><td>7</td><td>◎</td></tr>
<tr><td>P05.04</td><td>Function of DI4</td><td>73</td><td>◎</td></tr>
<tr><td>P05.05</td><td>Function of DI5</td><td>82</td><td>◎</td></tr>
<tr><td>P05.06</td><td>Reserved</td><td>0</td><td>●</td></tr>
</table>

Function code	Name	Description	Default	Modify
		73: Flow splitting/combining selection 74: Flow splitting/combining selection 1 75: Plasticizing signal input 76: PID terminal 1 (hydraulic mode) 77: PID terminal 2 (hydraulic mode) 78–80: Reserved 81: Swash plate switching command (reserved) 82: Enable CAN master/slave network 83: Reserved 84: Internal multi-step reference 1 (pressure and flow) 85: Internal multi-step reference 2 (pressure and flow) 86: Internal multi-step reference 3 (pressure and flow) 87: Internal multi-step pressure and flow reference lock (P74.67–P74.82) 88–95: Reserved		
P05.07	Reserved	-	-	-
P05.08	Input terminal polarity selection	Specifies the polarity of the input terminal. When a bit is 0, the input terminal is positive. When a bit is 1, the input terminal is negative. Setting range: 0x00–0x3F Bit 0: DI1 Bit 1: DI2 Bit 2: DI3 Bit 3: DI4 Bit 4: DI5 Bit 5: Reserved	0x00	○
P05.09	Digital filter time	Specifies the filter time of DI1–DI5. In environments with heavy interference, increase this parameter to prevent maloperation. Setting range: 0.000–1.000s	0.010s	○
P05.10	Virtual terminal setting	Setting range: 0x00–0x3F (0: disable; 1: enable) Bit 0: DI1 virtual terminal Bit 1: DI2 virtual terminal Bit 2: DI3 virtual terminal Bit 3: DI4 virtual terminal Bit 4: DI5 virtual terminal Bit 5: Reserved	0x00	◎

Function code	Name	Description	Default	Modify
P05.11	Terminal control mode	Specifies the terminal control mode. Setting range: 0–3 0: Two-wire control mode 1 1: Two-wire control mode 2 2: Three-wire control mode 1 3: Three-wire control mode 2	0	◎
P05.12	DI1 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable input terminal switches on or switches off. Setting range: 0.000–50.000s **Note:** After a virtual terminal is enabled, the terminal status can be changed only by communication means. The communication address is 0x200A.	0.000s	○
P05.13	DI1 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable input terminal switches on or switches off. Setting range: 0.000–50.000s **Note:** After a virtual terminal is enabled, the terminal status can be changed only by communication means. The communication address is 0x200A.	0.000s	○
P05.14	DI2 switch-on delay		0.000s	○
P05.15	DI2 switch-off delay		0.000s	○
P05.16	DI3 switch-on delay		0.000s	○
P05.17	DI3 switch-off delay		0.000s	○
P05.18	DI4 switch-on delay		0.000s	○
P05.19	DI4 switch-off delay		0.000s	○
P05.20	DI5 switch-on delay		0.000s	○
P05.21	DI5 switch-off delay		0.000s	○
P05.22	Reserved		-	-
P05.23	Reserved		-	-
P05.24	AI1 lower limit	Setting range: 0.00V–P05.26	0.00V	○
P05.25	Corresponding setting of AI1 lower limit	Setting range: -300.0–300.0%	0.0%	○
P05.26	AI1 upper limit	Setting range: P05.24–10.00V	10.00V	○
P05.27	Corresponding setting of AI1 upper limit	Setting range: -300.0–300.0%	100.0%	○
P05.28	AI1 input filter time	Setting range: 0.000–10.000s	0.010s	○

Function code	Name	Description	Default	Modify
P05.29	AI2 lower limit	Setting range: -10.00V–P05.31	-10.00V	○
P05.30	Corresponding setting of AI2 lower limit	Setting range: -300.0–300.0%	-100.0%	○
P05.31	AI2 middle value 1	Setting range: P05.29–P05.33	0.00V	○
P05.32	Corresponding setting of AI2 middle value 1	Setting range: -300.0–300.0%	0.0%	○
P05.33	AI2 middle value 2	Setting range: P05.31–P05.35(Hz)	0.00V	○
P05.34	Corresponding setting of AI2 middle value 2	Setting range: -300.0–300.0%	0.0%	○
P05.35	AI2 upper limit	Setting range: P05.33–10.00V	10.00V	○
P05.36	Corresponding setting of AI2 upper limit	Setting range: -300.0–300.0%	100.0%	○
P05.37	AI2 input filter time	Setting range: 0.000–10.000s	0.010s	○
P05.38–P05.52	Reserved	-	-	-

Group P06—Output terminals

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P06.00</td><td>Reserved</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>P06.01</td><td>DO1 output</td><td rowspan="4">Setting range: 0–63
0: Invalid
1: Running
2: Running forward
3: Running reversely
4: Jogging
5: Drive in fault
6: Frequency level detection FDT1
7: Frequency level detection FDT2
8: Frequency reached
9: Running in zero speed
10: Frequency upper limit reached
11: Frequency lower limit reached
12: Ready for running</td><td>1</td><td>○</td></tr>
<tr><td>P06.02</td><td>DO2 output</td><td>38</td><td>○</td></tr>
<tr><td>P06.03</td><td>RO1 output</td><td>5</td><td>○</td></tr>
<tr><td>P06.04</td><td>Reserved</td><td>-</td><td>-</td></tr>
</table>

Function code	Name	Description	Default	Modify
		13: Pre-exciting 14: Overload pre-alarm 15: Underload pre-alarm 16–21: Reserved 22: Running time reached 23: Modbus/Modbus TCP communication virtual terminal output 24: PROFIBUS/CANopen/DeviceNet communication virtual terminal output 25: Ethernet communication virtual terminal output 26: DC bus voltage established 27: Z pulse output 28: In pulse superposition 29: Reserved 30: Positioning completed 31–33: Reserved 34: EtherCAT/PROFINET/EtherNet IP communication virtual terminal output 35: Reserved 36: Speed/position control switchover completed 37: Any frequency reached 38: Hydraulic valve pressure relief output 39: Swash plate switching output 40–49: Reserved 50: Motor OT pre-alarm 51–53: Reserved 54: Electro-hydraulic alarm output 55: Output at hydraulic pressure reached 56–62: Reserved 63: EAI detected OT pre-alarm		
P06.05	Output terminal polarity selection	Specifies the polarity of the output terminal. Setting range: 0x00–0x0F Bit0: DO1 Bit1: DO2 Bit2: RO1 Bit3: Reserved	0x00	○

Function code	Name	Description	Default	Modify
P06.06	DO1 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.07	DO1 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.08	DO2 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s **Note:** The function code is valid only when P06.00 is 1.	0.000s	○
P06.09	DO2 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s **Note:** The function code is valid only when P06.00 is 1.	0.000s	○
P06.10	RO1 switch-on delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.11	RO1 switch-off delay	Specifies the delay time corresponding to the electrical level change when a programmable output terminal switches on or switches off. Setting range: 0.000–50.000s	0.000s	○
P06.12–P06.13	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P06.14	AO1 output selection		35	○
P06.15	Reserved		-	-
P06.16	AO2 output selection	Setting range: 0–63 0: Running frequency 1: Set frequency 2: Ramp reference frequency 3: Rotational speed (100% corresponds to the speed corresponding to the max. output frequency) 4: Output current (100% corresponds to twice the drive rated current) 5: Output current (100% corresponds to twice the motor rated current) 6: Output voltage (100% corresponds to 1.5 times the drive rated voltage) 7: Output power (100% corresponds to twice the motor rated power) 8: Set torque (100% corresponds to twice the motor rated torque) 9: Output torque (Absolute value, 100% corresponds to twice the motor rated torque) 10: AI1 input 11: AI2 input 12: EAI3 input 13: Reserved 14: Value 1 set through Modbus/Modbus TCP communication 15: Value 2 set through Modbus/Modbus TCP communication 16: Value 1 set through PROFIBUS/CANopen/DeviceNet communication 17: Value 2 set through PROFIBUS/CANopen/DeviceNet communication 18: Value 1 set through Ethernet communication 19: Value 2 set through Ethernet communication	30	○

Function code	Name	Description	Default	Modify
		20: Reserved 21: Value 1 set through EtherCAT/PROFINET/EtherNet IP communication 22: Torque current (100% corresponds to triple the motor rated current) 23: Exciting current (100% corresponds to triple the motor rated current) 24: Set frequency (bipolar) 25: Ramp reference frequency (bipolar) 26: Rotational speed (bipolar) 27: Value 2 set through EtherCAT/PROFINET/EtherNet IP communication 28–29: Reserved 30: Rotational speed (100% corresponds to the speed corresponding to twice the motor rated frequency) 31: Output torque (Actual value, 100% corresponds to twice the motor rated torque) 32: AIAO detected temperature output (reserved) 33: Reserved 34: Pressure reference (100% corresponds to the full-scale pressure value set in P73.06) 35: Pressure feedback (100% corresponds to the full-scale pressure value set in P73.06) 36: Flow reference (100% corresponds to the full-scale flow value set in P73.07) 36: Flow feedback (100% corresponds to the full-scale flow value set in P73.07) 38: EAI5 input 39: EAI6 input 40: EAI7 input 41–63: Reserved		

Function code	Name	Description	Default	Modify
P06.17	AO1 output lower limit	Setting range: -300.0%–P06.19	0.0%	○
P06.18	AO1 output corresponding to lower limit	Setting range: 0.00–10.00V	0.00V	○
P06.19	AO1 output upper limit	Setting range: P06.17–300.0%	100.0%	○
P06.20	AO1 output corresponding to upper limit	Setting range: 0.00–10.00V	10.00V	○
P06.21	AO1 output filter time	Setting range: 0.000–10.000s	0.000s	○
P06.22	AO2 output lower limit	Setting range: -300.0%–P06.24	0.0%	○
P06.23	AO2 output corresponding to lower limit	Setting range: 0.00–10.00V	0.00V	○
P06.24	AO2 output upper limit	Setting range: P06.22–300.0%	100.0%	○
P06.25	AO2 output corresponding to upper limit	Setting range: 0.00–10.00V	10.00V	○
P06.26	AO2 output filter time	Setting range: 0.000–10.000s	0.000s	○
P06.27–P06.32	Reserved	-	-	-
P06.33	Detection value for any frequency reached	Setting range: 0.00Hz–P00.03	1.00Hz	○
P06.34	Detection time for any frequency reached	Setting range: 0.0–3600.0s	0.5s	○

Group P07—HMI

Function code	Name	Description	Default	Modify
P07.00	User password	By default, the user password is not enabled (the default value is 0). When you set the function code to a non-zero number, password protection is enabled. If you set the function code to 00000, the previous user password is cleared and password protection is disabled. After the user password setting takes effect, you need to enter the password to view or edit parameters. Do not forget the password. After you exit the function code editing interface, the password protection function is enabled within 1 minute. If password protection is enabled, 0.0.0.0.0 is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password to enter the interface. Setting range: 0–65535	0	○
P07.01	Parameter copy	Setting range: 0–4 0: No operation 1: Upload parameter to keypad 2: Download parameters (including motor parameters) 3: Download non-motor parameters 4: Download motor parameters	0	◎
P07.02	QUICK/JOG function selection	Setting range: 0x00–0x27 Ones place: Function selection of  key 0: No function 1: Jogging 2: Reserved	0x01	◎

Function code	Name	Description	Default	Modify
		3: Switch between forward and reverse rotation 4: Clear the UP/DOWN setting 5: Coast to stop 6: Switch command channels in sequence 7: Reserved Tens place: Reserved		
P07.03	Sequence of switching running-command channels by pressing QUICK/JOG	Specifies the sequence of switching running-command channels by pressing the key when P07.02=6. Setting range: 0–3 0: Keypad→Terminal→Communication 1: Keypad←→Terminal 2: Keypad←→Communication 3: Terminal←→Communication	0	○
P07.04	Stop function validity of STOP/RST	The function code is used to set the validity selection of stop function. For fault reset, key is valid in any conditions. Setting range: 0–3 0: Valid only for keypad control 1: Valid both for keypad and terminal control 2: Valid both for keypad and communication control 3: Valid for all control modes	0	○
P07.05	Selection 1 of parameters displayed in running state	0x0000–0xFFFF Bit0: Running frequency (Hz on) Bit1: Set frequency (Hz blinking) Bit2: Bus voltage (V on) Bit3: Output voltage (V on) Bit 4: Output current (A on) Bit5: Running speed (rpm on) Bit6: Output power (% on) Bit7: Output torque (% on)	0x00FF	○

Function code	Name	Description	Default	Modify
		Bit8–Bit9: Reserved Bit10: Input terminal state Bit11: Output terminal state Bit12: Set torque (% on) Bit13: Reserved Bit 14: Motor overload percentage (% on) Bit15: Reserved		
P07.06	Selection 2 of parameters displayed in running state	0x0000–0xFFFF Bit 0: AI1 value (V on) Bit 1: AI2 value (V on) Bit 2: AI3 value (V on) Bit3–Bit4: Reserved Bit 5: Drive overload percentage (% on) Bit 6: Ramp frequency reference (Hz on) Bit 7: Linear speed Bit 8: AC incoming current Bit 9: Frequency upper limit Bit10–Bit15: Reserved	0x0000	○
P07.07	Selection of parameters displayed in stopped state	0x0000–0xFFFF Bit0: Set frequency (Hz on, blinking slowly) Bit1: Bus voltage (V on) Bit2: Input terminal state Bit3: Output terminal state Bit4–Bit5: Reserved Bit6: Set torque (% on) Bit7: AI1 (V on) Bit8: AI2 (V on) Bit9: AI3 (V on) Bit10–Bit11: Reserved Bit 12: Count value Bit13: Reserved Bit 14: Frequency upper limit Bit15: Reserved	0x03CF	○

Function code	Name	Description	Default	Modify
P07.08	Frequency display coefficient	Setting range: 0.01–10.00 Display frequency = Running frequency * P07.08	1.00	○
P07.09	Rotation speed display coefficient	Setting range: 0.1–999.9% Mechanical rotation speed = 120 × (Displayed running frequency) × P07.09/(Number of motor pole pairs)	100.0%	○
P07.10	Linear speed display coefficient	Setting range: 0.1–999.9% Linear speed = (Mechanical rotation speed) × P07.10	1.0%	○
P07.11	Rectifier bridge module temperature	Setting range: -20.0–120.0°C	0.0°C	●
P07.12	Inverter module temperature	Setting range: -20.0–120.0°C	0.0°C	●
P07.13	Control board software version	Setting range: 1.00–655.35	Version depended	●
P07.14	Accumulative operating time	Setting range: 0–65535h	0h	●
P07.15	Drive electricity consumption MSB	The function code is used to display the electricity consumption of the drive. Drive electricity consumption = P07.15*1000 + P07.16 Setting range: 0–65535kkWh	0kkWh	●
P07.16	Drive electricity consumption LSB	The function code is used to display the electricity consumption of the drive. Drive electricity consumption = P07.15*1000 + P07.16 Setting range: 0.0–999.9kWh	0.0kWh	●
P07.17	Reserved	-	-	-
P07.18	Drive rated power	Setting range: 0.4–3000.0kW	Model depended	●
P07.19	Drive rated voltage	Setting range: 50–800V	Model depended	●
P07.20	Drive rated current	Setting range: 0.1–6000.0A	Model depended	●

Function code	Name	Description	Default	Modify
P07.21	Factory bar code 1	Setting range: 0x0000–0xFFFF	Model depended	●
P07.22	Factory bar code 2	Setting range: 0x0000–0xFFFF	Model depended	●
P07.23	Factory bar code 3	Setting range: 0x0000–0xFFFF	Model depended	●
P07.24	Factory bar code 4	Setting range: 0x0000–0xFFFF	Model depended	●
P07.25	Factory bar code 5	Setting range: 0x0000–0xFFFF	Model depended	●
P07.26	Factory bar code 6	Setting range: 0x0000–0xFFFF	Model depended	●
P07.27	Type of present fault	Setting range: 0–700 0: No fault 1: Inverter unit U-phase protection (E1) 2: Inverter unit V-phase protection (E2) 3: Inverter unit W-phase protection (E3) 4: Overcurrent during ACC (E4) 5: Overcurrent during DEC (E5) 6: Overcurrent during constant speed running (E6) 7: Overvoltage during ACC (E7) 8: Overvoltage during DEC (E8) 9: Overvoltage during constant speed running (E9) 10: DC bus undervoltage (E10) 11: Motor overload (E11) 12: Drive overload (E12) 13: Phase loss on input side (E13) 14: Phase loss on output side (E14) 15: Rectifier module overheat (E15) 16: Inverter module overheat (E16) 17: External fault (E17) 18: RS485 communication fault	0	●
P07.28	Last fault type		0	●
P07.29	2nd-last fault type		0	●
P07.30	3rd-last fault type		0	●
P07.31	4th-last fault type		0	●
P07.32	5th-last fault type		0	●

Function code	Name	Description	Default	Modify
		19: Current detection fault (E19) 20: Motor autotuning fault (E20) 21: EEPROM operation fault (E21) 22: Reserved 23: Braking unit fault (E23) 24: Running time reached (E24) 25: Electronic overload (E25) 26: Keypad communication error (E26) 27: Parameter upload error (E27) 28: Parameter download error (E28) 29: PROFIBUS communication fault (E29) 30: Ethernet communication fault (E30) 31: CANopen communication fault (E31) 32: To-ground short-circuit fault (E32) 33: To-ground short-circuit fault 2 (E33) 34: Speed deviation fault (E34) 35: Mal-adjustment fault (E35) 36: Underload fault (E36) 37: Encoder disconnection (E37) 38: Encoder reversal (E38) 39: Encoder Z-pulse disconnection (E39) 40–43: Reserved 44: Safety code FLASH CRC fault (E44) 45–54: Reserved 55: Duplicate expansion card type (E55) 56: Encoder UVW loss fault (E56) 57: PROFINET communication fault (E57) 58: CAN communication fault (E-CAN) 59: Motor overtemperature fault (E59)		

Function code	Name	Description	Default	Modify
		60: Failure to identify the card in slot 1 (E60) 61: Failure to identify the card in slot 2 (E61) 62: Reserved 63: Card communication timeout fault in slot 1 (E63) 64: Card communication timeout fault in slot 2 (E64) 65: Reserved 66: EtherCAT communication fault (E66) 67: Reserved 68: DeviceNet communication fault (E-DEV) 69: CAN slave fault in master/slave synchronization (E69) 70–81: Reserved 82–83: Reserved 84–91: Reserved 92: AI1 disconnection (E92) 93: AI2 disconnection (E93) 94: AI3 disconnection (E94) 95: EtherNet IP communication timeout (E95) 96: No upgrade bootloader (E96) 97: EAI3 disconnection (E97) 98: EAI5 disconnection (E98) 99: EAI6 disconnection (E99) 100: EAI7 disconnection (E100) 101: EAI overtemperature fault (E101) 102: EAI temperature sensor disconnection fault (E102) 103–620: Reserved 621: Overpressure in hydraulic system (E621) 622: Hydraulic pump stall (E622) 623: UVW phase reverse sequence		

Function code	Name	Description	Default	Modify
		fault (E623) 624: Motor temperature sensor disconnection (E624) 625–700: Reserved		
P07.33	Running frequency at present fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.34	Ramp reference frequency at present fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.35	Output voltage at present fault	Setting range: 0–1200V	0V	●
P07.36	Output current at present fault	Setting range: 0.0–6300.0A	0.0A	●
P07.37	Bus voltage at present fault	Setting range: 0.0–2000.0V	0.0V	●
P07.38	Temperature at present fault	Setting range: -20.0–120.0°C	0.0°C	●
P07.39	Input terminal state at present fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.40	Output terminal state at present fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.41	Pressure feedback value at present fault	0.0–500.0bar	0.00	●
P07.42	Running frequency at last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.43	Ramp reference frequency at last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.44	Output voltage at last fault	Setting range: 0–1200V	0V	●
P07.45	Output current at last fault	Setting range: 0.0–6300.0A	0.0A	●
P07.46	Bus voltage at last fault	Setting range: 0.0–2000.0V	0.0V	●
P07.47	Temperature at last fault	Setting range: -20.0–120.0°C	0.0°C	●
P07.48	Input terminal state at last fault	Setting range: 0x0000–0xFFFF	0x0000	●

Function code	Name	Description	Default	Modify
P07.49	Output terminal state at last fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.50	Pressure feedback value at last fault	0.0–500.0bar	0.00	●
P07.51	Running frequency at 2nd-last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.52	Ramp reference frequency at 2nd-last fault	Setting range: 0.00Hz–P00.03	0.00Hz	●
P07.53	Output voltage at 2nd-last fault	Setting range: 0–1200V	0V	●
P07.54	Output current at 2nd-last fault	Setting range: 0.0–6300.0A	0.0A	●
P07.55	Bus voltage at 2nd-last fault	Setting range: 0.0–2000.0V	0.0V	●
P07.56	Temperature at 2nd-last fault	Setting range: -20.0–120.0°C	0.0°C	●
P07.57	Input terminal state at 2nd-last fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.58	Output terminal state at 2nd-last fault	Setting range: 0x0000–0xFFFF	0x0000	●
P07.59	Pressure feedback value at 2nd-last fault	0.0–500.0bar	0.00	●

Group P08—Enhanced functions

Function code	Name	Description	Default	Modify
P08.00–P08.05	Reserved	-	-	-
P08.06	Running frequency of jogging	Specifies the reference frequency during jogging. Setting range: 0.00Hz–P00.03 (Max. output frequency)	5.00Hz	○

Function code	Name	Description	Default	Modify
P08.07	ACC time for jogging	Specifies the time needed for the drive to accelerate from 0Hz to the max. output frequency (P00.03). Setting range: 0.0–3600.0s	Model depended	○
P08.08	DEC time for jogging	Specifies the time needed for the drive to decelerate from the max. output frequency (P00.03) to 0Hz. Setting range: 0.0–3600.0s	Model depended	○
P08.09–P08.19	Reserved	-	-	-
P08.20	Frequency threshold of the start of droop control	Setting range: 0.00Hz–P00.03	0.00Hz	○
P08.21	Reference frequency of ACC/DEC time	Setting range: 0–2 0: Max. output frequency 1: Set frequency 2: 100Hz **Note:** Valid for straight ACC/DEC only.	0	◎
P08.22	Output torque display selection	Setting range: 0–1 0: Based on torque current 1: Based on output power	0	○
P08.23	Number of decimal places of frequency	Setting range: 0–1 0: Two decimal places 1: One decimal place	0	○
P08.24	Number of decimal places of linear speed	Setting range: 0–3 0: No decimal place 1: One decimal place 2: Two decimal places 3: Three decimal places	0	○
P08.25	Set counting value	Setting range: P08.26–65535	0	○
P08.26	Designated counting value	Setting range: 0–P08.25	0	○
P08.27	Set running time	Setting range: 0–65535min	0min	○
P08.28	Auto fault reset count	Specifies the number of automatic fault reset times when the drive uses automatic	0	○

Function code	Name	Description	Default	Modify
		fault reset. When the number of continuous reset times exceeds the value, the drive reports a fault and stops. After drive starts, if no fault occurred within 600s after the drive starts, the number of automatic fault reset times is cleared. Setting range: 0–10		
P08.29	Auto fault reset interval	Specifies the time interval from when a fault occurred to when automatic fault reset takes effect. Setting range: 0.1–3600.0s	1.0s	○
P08.30	Frequency decrease rate in droop control	Specifies the variation rate of the drive output frequency based on the load. It is mainly used in balancing the power when multiple motors drive the same load. Setting range: 0.00Hz–P00.03	0.00Hz	○
P08.31	Reserved	-	-	-
P08.32	FDT1 level detection value	Used to view the FDT1 level detection value. When the output frequency exceeds the corresponding frequency of FDT level, the multifunction digital output terminal continuously outputs the signal of "Frequency level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the frequency corresponding to (FDT level—FDT lagging detection value). Setting range: 0.00Hz–P00.03 (Max. output frequency)	50.00Hz	○
P08.33	FDT1 lagging detection value	The function code is used to view the FDT1 lagging detection value. When the output frequency exceeds the corresponding frequency of FDT level, the multifunction digital output terminal continuously outputs the signal of "Frequency level detection FDT". The signal is invalid only	5.0%	○

Function code	Name	Description	Default	Modify
		when the output frequency decreases to a value lower than the frequency corresponding to (FDT level—FDT lagging detection value). Setting range: 0.0–100.0% (FDT1 level)		
P08.34	FDT2 level detection value	Used to view the FDT2 level detection value. When the output frequency exceeds the corresponding frequency of FDT level, the multifunction digital output terminal continuously outputs the signal of "Frequency level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the frequency corresponding to (FDT level—FDT lagging detection value). Setting range: 0.00Hz–P00.03 (Max. output frequency)	50.00Hz	○
P08.35	FDT2 lagging detection value	Used to view the FDT2 lagging detection value. When the output frequency exceeds the corresponding frequency of FDT level, the multifunction digital output terminal continuously outputs the signal of "Frequency level detection FDT". The signal is invalid only when the output frequency decreases to a value lower than the frequency corresponding to (FDT level—FDT lagging detection value). Setting range: 0.0–100.0% (FDT2 level)	5.0%	○
P08.36	Detection value for frequency reached	When the output frequency is within the detection width of the set frequency, the multifunction digital output terminal outputs the signal of "Frequency reached". Setting range: 0.00Hz–P00.03 (Max. output frequency)	0.00Hz	○

Function code	Name	Description	Default	Modify
P08.37	Enabling energy-consumption braking	Setting range: 0–1 0: Disable 1: Enable	1	○
P08.38	Dynamic braking threshold voltage	Specifies the starting bus voltage of dynamic braking. Adjust this value properly to achieve effective braking for the load. The default value varies depending on the voltage class. Setting range: 200.0–2000.0V	For 380V: 700.0V	○
P08.39	Running mode of cooling fan	Setting range: 0–2 0: Normal running mode 1: The fan keeps running after power-on 2: Running mode 2	0	○
P08.40	PWM selection	0x0000–0x1221 Ones place: PWM mode selection 0: Switch from SVPWM to DPWM 1: SVPWM throughout the entire process Tens place: PWM low-speed carrier frequency limit 0: Low-speed carrier frequency limit mode 1 1: Low-speed carrier frequency limit mode 2 2: No limit on low-speed carrier frequency Hundreds place: Deadzone compensation selection 0: Compensation method 1 1: Compensation method 2 (only for vector control) 2: Compensation method 3 (only for vector control) Thousands place: SVPWM mode selection 0: SVPWM using third harmonic injection method 1: Traditional SVPWM	0x1121	◎

Function code	Name	Description	Default	Modify
P08.41	Overmodulation selection	Setting range: 0x0000–0x1111 Ones: Overmodulation enabling 0: Disable 1: Enable Tens place: Overmodulation mode 0: Disable deep overmodulation 1: Enable deep overmodulation Hundreds: Carrier frequency limit 0: Limit 1: No limit Thousands place: Reserved	0x0011	◎
P08.42	LED keypad control setting	0x0000–0x1223 Ones place: Frequency enabling selection 0: Reserved 1: Control via UP/ DOWN key only 2–3: Reserved Tens place: Frequency control selection 0: Valid only when P00.06=0 1: Valid for all frequency setting methods 2: Reserved Hundreds place: Action selection for stop 0: Setting is valid 1: Valid during operation; cleared after stop 2: Valid during operation; cleared upon receiving stop command Thousands place: Indicates whether to enable the integral function through the UP/DOWN key and digital potentiometer. 0: The integral function is valid 1: The integral function is invalid	0x0003	○
P08.43	Reserved	-	-	-
P08.44	UP/DOWN terminal control setting	Setting range: 0x000–0x221 Ones place: Whether the setting made through UP/DOWN is valid. 0: The setting made through UP/DOWN is valid.	0x000	○

Function code	Name	Description	Default	Modify
		1: The setting made through UP/DOWN is invalid. Tens place: Frequency control selection 0: Valid only when P00.06 = 0 1: Valid for all frequency setting methods 2: Reserved Hundreds place: Action selection for stop 0: Setting is valid 1: Valid during operation; cleared after stop 2: Valid during operation; cleared upon receiving stop command		
P08.45	Frequency incremental integral rate of the UP terminal	Setting range: 0.01Hz/s–P00.03 **Note:** The value is also used as the frequency increment or decrement that is made by pressing the UP/DOWN key on the LCD keypad.	0.50Hz/s	○
P08.46	Frequency integral rate of the DOWN terminal	Setting range: 0.01Hz/s–P00.03	0.50Hz/s	○
P08.47	Action selection at power-off during frequency setting	Setting range: 0x000–0x111 Ones place: Action selection at power-off during frequency adjusting through digitals 0: Save the setting at power-off. 1: Clear the setting at power-off. Tens place: Action selection at power-off during frequency adjusting through Modbus communication 0: Save the setting at power-off. 1: Clear the setting at power-off. Hundreds: Action selection at power-off during frequency setting through DP communication 0: Save the setting at power-off. 1: Clear the setting at power-off.	0x000	○

Function code	Name	Description	Default	Modify
P08.48	Initial electricity consumption MSB	Specifies the initial electricity consumption. Initial electricity consumption = P08.48*1000 + P08.49 Setting range: 0–59999kWh	0kWh	○
P08.49	Initial electricity consumption LSB	Specifies the initial electricity consumption. Initial electricity consumption = P08.48*1000 + P08.49 Setting range: 0.0–999.9kWh	0.0kWh	○
P08.50	Magnetic flux braking	Used to enable the magnetic flux braking. Magnetic flux braking can be used for motor stop, as well as for motor rotation speed change. The current of the stator other than the rotor increases during magnetic flux braking. Therefore, the cooling is better. 0: Disable 100–150: A greater coefficient indicates greater braking strength. Setting range: 0, 100–150	0	○
P08.51	Drive input power factor	Used to adjust the current display value on the AC input side. Setting range: 0.00–1.00	0.56	○
P08.52	Reserved	-	-	
P08.53	Upper limit frequency bias value in torque control	Setting range: 0.00Hz–P00.03 (Max. output frequency) **Note:** Valid for torque control only.	0.00Hz	○
P08.54	Upper limit frequency ACC/DEC selection in torque control	Setting range: 0–4 0: No limit 1: ACC/DEC time 1 2: ACC/DEC time 2 3: ACC/DEC time 3 4: ACC/DEC time 4	0	○

Function code	Name	Description	Default	Modify
P08.55	Enabling auto carrier frequency reduction	Setting range: 0–1 0: Disable 1: Enable **Note:** Automatic carrier frequency reduction indicates that the drive automatically reduces the carrier frequency when detecting the heat sink temperature exceeds the rated temperature. When the temperature decreases to a specified value, the carrier frequency restores to the setting. This function can reduce the likelihood of overheating alarms.	0	○
P08.56	Min. carrier frequency	Setting range: 1.0–8.0kHz	Model depended	●
P08.57	Temperature point of auto carrier frequency reduction	Setting range: 40.0–85.0°C	70.0°C	○
P08.58	Interval of carrier frequency reduction	Setting range: 0–30min	10min	○
P08.59	AI1 disconnection detection threshold	Setting range: 0–100%	0%	○
P08.60	AI2 disconnection detection threshold	Setting range: 0–100%	0%	○
P08.61	AI3 disconnection detection threshold (reserved)	Setting range: 0–4095	600	○
P08.62	Output current filter time	Setting range: 0.000–10.000s	0.000s	○

Function code	Name	Description	Default	Modify
P08.63	Output torque display filter times	Setting range: 0–8	8	○
P08.64	24V power supply card power-on delay	Setting range: 0.00–10.00s	0.00s	○
P08.65–P08.67	Reserved	-	-	-
P08.68	Random PWM depth	Setting range: 0.0–100.0%	0.0%	○
P08.69–P08.71	Reserved	-	-	-
P08.72	EAI5 disconnection detection threshold	Setting range: 0–100% **Note:** Relative to 10V.	0	○
P08.73	EAI6 disconnection detection threshold	Setting range: 0–100% **Note:** Relative to 10V.	0	○
P08.74	EAI7 disconnection detection threshold	Setting range: 0–100% **Note:** Relative to 10V.	0	○
P08.75	Grid voltage selection	0–2 0: 380V 1: 480V 2: 220V	0	◎
P08.76–P08.84	Reserved	-	-	-

Group P11—Protection parameters

Function code	Name	Description	Default	Modify
P11.00	Phase loss protection	Setting range: 0x000–0x111 Ones place: 0: Disable software input phase loss protection. 1: Enable software input phase loss protection. Tens place: 0: Disable output phase loss protection 1: Enable output phase loss protection Hundreds place: 0: Disable hardware input phase loss protection. 1: Enable Hardware input phase loss protection. **Note:** Hardware input phase loss protection is currently available only on 22kW, 30kW, and 37kW models	0x111	○
P11.01	Frequency decrease at sudden power loss	Setting range: 0–1 0: Disable 1: Enable	0	○
P11.02	Enabling dynamic braking in standby mode	Setting range: 0–1 0: Disable 1: Enable	1	◎
P11.03	Overvoltage stall protection	Setting range: 0–1 0: Disable 1: Enable	0	○
P11.04	Overvoltage stall protection voltage	120–150% (standard bus voltage) (380V)	136%	○
P11.05	Current limit selection	During acceleration, as the load is too heavy, the actual acceleration rate of motor is lower than that of output frequency. To prevent the drive trip due to overcurrent during acceleration, take the current limit measures. Setting range: 0x000–0x001 Ones place: Current limit action selection	0x001	◎

Function code	Name	Description	Default	Modify
		0: Invalid 1: Always valid Tens place: Reserved Hundreds place: Reserved		
P11.06	Auto current limit level	Setting range: 50.0–200.0% (of the drive rated output current)	180.0%	◎
P11.07	Frequency decrease rate in current limiting	Setting range: 0.00Hz/s–P00.03	10.00Hz/s	◎
P11.08	Pre-alarm selection for drive/motor overload/underload (OL/UL)	Setting range: 0x0000–0x1132 Ones place: OL pre-alarm detection method 0: Motor OL pre-alarm, relative to the motor rated current. 1: Drive OL pre-alarm, relative to the drive rated current. 2: Motor output torque OL pre-alarm, relative to motor rated torque. Tens place: Action selection after OL fault condition is triggered 0: The drive continues to work, while keeping the OL pre-alarm. 1: For a UL fault, the drive continues to work, while keeping the pre-alarm; for an OL fault, it reports the fault and stops. 2: The drive reports the OL fault and stops. 3: The drive reports the OL/UL fault and stops. Hundreds place: Detection method 0: Always detect 1: Detect during constant speed running. Thousands place: Drive overload current reference selection 0: Not related to the current correction coefficient 1: Related to the current correction coefficient	0x0011	○

Function code	Name	Description	Default	Modify
P11.09	Overload pre-alarm detection level	Overload pre-alarm signal will be output if the drive or motor output current exceeds the overload pre-alarm detection level (P11.09), and the duration exceeds the overload pre-alarm detection time (P11.10). Setting range: P11.11–200% (relative value determined by the ones place of P11.08)	180%	○
P11.10	Overload pre-alarm detection time	Setting range: 0.1–3600.0s	10.0s	○
P11.11	Underload pre-alarm detection level	Underload pre-alarm signal will be output if the output current of the drive or motor is lower than underload pre-alarm detection level (P11.11), and the duration exceeds underload pre-alarm detection time (P11.12). Setting range: 0–P11.09 (relative value determined by the ones place of P11.08)	50%	○
P11.12	Underload pre-alarm detection time	Underload pre-alarm signal will be output if the output current of the drive or motor is lower than underload pre-alarm detection level (P11.11), and the duration exceeds underload pre-alarm detection time (P11.12). Setting range: 0.1–3600.0s	1.0s	○
P11.13	Fault output terminal action upon fault occurring	Specifies the action of fault output terminals at undervoltage and fault reset. Setting range: 0x00–0x11 Ones place: Action selection for an underload fault 0: Act at undervoltage 1: Do not act at undervoltage Tens place: Action selection during automatic reset 0: Act during automatic reset 1: Do not act during automatic reset	0x00	○

Function code	Name	Description	Default	Modify
P11.14	Speed deviation detection value	Specifies the speed deviation detection value. Setting range: 0.0–50.0%	10.0%	○
P11.15	Speed deviation detection time	Specifies the speed deviation detection time. If the speed deviation detection time is less than the set value, the drive continues running. Setting range: 0.0–10.0s **Note:** Speed deviation protection is invalid when the value is 0.0.	2.0s	○
P11.16	Automatic frequency-reduction during voltage drop	Setting range: 0–1 0: Invalid 1: Valid	0	○
P11.17	Proportional coefficient of voltage regulator during undervoltage stall	Specifies the proportional coefficient of the bus voltage regulator during undervoltage stall. Setting range: 0–127	30	○
P11.18	Integral coefficient of voltage regulator during undervoltage stall	Specifies the integral coefficient of the bus voltage regulator during undervoltage stall. Setting range: 0–1000	40	○
P11.19	Proportional coefficient of current regulator during undervoltage stall	Specifies the proportional coefficient of the active current regulator during undervoltage stall. Setting range: 0–1000	25	○
P11.20	Integral coefficient of current regulator during undervoltage stall	Specifies the integral coefficient of the active current regulator during undervoltage stall. Setting range: 0–2000	150	○
P11.21	Proportional coefficient of voltage regulator during overvoltage stall	Specifies the proportional coefficient of the bus voltage regulator during overvoltage stall. Setting range: 0–127	60	○
P11.22	Integral coefficient of voltage regulator during overvoltage stall	Specifies the integral coefficient of the bus voltage regulator during overvoltage stall. Setting range: 0–1000	5	○

Function code	Name	Description	Default	Modify
P11.23	Proportional coefficient of current regulator during overvoltage stall	Specifies the proportional coefficient of the active current regulator during overvoltage stall. Setting range: 0–1000	60	○
P11.24	Integral coefficient of current regulator during overvoltage stall	Specifies the integral coefficient of the active current regulator during overvoltage stall. Setting range: 0–2000	250	○
P11.25	Enabling drive overload integral	Setting range: 0–1 0: Disable. The overload timer is reset to zero after the drive stops. In this case, it takes longer to detect a drive overload, and therefore the effective protection of the drive is weakened. 1: Enable. The overload timer is not reset and is accumulative. In this case, overload detection takes less time, and therefore effective protection of the drive is provided sooner.	0	◎
P11.26–P11.27	Reserved	-	-	-
P11.28	SPO detection delay time after start	Setting range: 0.0–60.0s **Note:** The SPO detection is started only after the drive runs for the delay time P11.28 to avoid false alarms caused by the unstable frequency. Once the frequency is stable, this delay will not be applied again (i.e., it executes only once at the moment of each run).	5.0s	○
P11.29	SPO unbalance factor	Setting range: 0–10	6	○
P11.30	Reserved	-	-	-
P11.31	Fault selection 1	Setting range: 11–9000	11	○
P11.32	Fault selection 2	Setting range: 11–9000	12	○
P11.33	Fault selection 3	Setting range: 11–9000	13	○
P11.34	Fault selection 4	Setting range: 11–9000	14	○

Function code	Name	Description	Default	Modify
P11.35	Fault level processing group 1	Setting range: 0x0000–0x6666 Ones place (P11.31 Fault selection 1): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Tens place (P11.32 Fault selection 2): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Hundreds place (P11.33 Fault selection 3): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Thousands place (P11.34 Fault selection 4): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved	0x0000	○
P11.36	Fault selection 5	Setting range: 11–9000	17	○
P11.37	Fault selection 6	Setting range: 11–9000	18	○

Function code	Name	Description	Default	Modify
P11.38	Fault selection 7	Setting range: 11–9000	22	○
P11.39	Fault selection 8	Setting range: 11–9000	23	○
P11.40	Fault level processing group 2	Setting range: 0x0000–0x6666 Ones place (P11.31 Fault selection 5): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Tens place (P11.32 Fault selection 6): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Hundreds place (P11.33 Fault selection 7): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Thousands place (P11.34 Fault selection 8): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved	0x0000	○

Function code	Name	Description	Default	Modify
P11.41	Fault selection 9	Setting range: 11–9000	25	○
P11.42	Fault selection 10	Setting range: 11–9000	26	○
P11.43	Fault selection 11	Setting range: 11–9000	29	○
P11.44	Fault selection 12	Setting range: 11–9000	30	○
P11.45	Fault level processing group 3	Setting range: 0x0000–0x6666 Ones place (P11.31 Fault selection 9): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Tens place (P11.32 Fault selection 10): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Hundreds place (P11.33 Fault selection 11): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Thousands place (P11.34 Fault selection 12): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved	0x0000	○
P11.46	Fault selection 13	Setting range: 11–9000	31	○

Function code	Name	Description	Default	Modify
P11.47	Fault selection 14	Setting range: 11–9000	34	○
P11.48	Fault selection 15	Setting range: 11–9000	35	○
P11.49	Fault selection 16	Setting range: 11–9000	36	○
P11.50	Fault level processing group 4	Setting range: 0x0000–0x6666 Ones place (P11.31 Fault selection 13): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Tens place (P11.32 Fault selection 14): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Hundreds place (P11.33 Fault selection 15): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved Thousands place (P11.34 Fault selection 16): 0: Report a fault 1: Report a fault after deceleration to stop 2: Pre-alarm, with the action executed according to P11.56 3: Mask the fault 4–6: Reserved	0x0000	○
P11.51	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P11.52	Fallback frequency upon exceptions	Setting range: 0.00Hz–P00.03	0.00Hz	○
P11.53–P11.55	Reserved	-	-	-
P11.56	Action for fault pre-alarm	0–4 0: Run at the set frequency 1: Run at the output frequency at the time of failure 2: Run at the frequency upper limit 3: Run at the frequency lower limit 4: Run at the fallback frequency upon exceptions	0	○
P11.57–P11.69	Reserved	-	-	-

Group P13—SM control

Function code	Name	Description	Default	Modify
P13.00	SM injected-current decrease rate	Specifies the reduction rate of the input reactive current. When the active current of the synchronous motor increases to some extent, the input reactive current can be reduced to improve the power factor of the motor. Setting range: 0.0–100.0% (of the motor rated current)	80.0%	○
P13.01	Initial pole detection method	Setting range: 0–2 0: Do not detect 1: High-frequency superposition 2: Pulse superposition	0	◎
P13.02	Pull-in current 1	Specifies the pole position orientation current. It is valid within the lower limit of pull-in current switching frequency threshold. If you need to increase the start torque, increase the value of this function parameter properly. Setting range: -100.0–100.0% (of the motor rated current)	30.0%	○

Function code	Name	Description	Default	Modify
P13.03	Pull-in current 2	Specifies the pole position orientation current. It is valid within the upper limit of pull-in current switching frequency threshold. You do not need to change the value in most cases. Setting range: -100.0–100.0% (of the motor rated current)	0.0%	○
P13.04	Pull-in current switching frequency	Setting range: 0.0–200.0% **Note:** The value is relative to the motor rated frequency.	20.0%	○
P13.05	Reserved	-	-	-
P13.06	Pulse current set value	Specifies the pulse current threshold when the initial magnetic pole position is detected in the pulse mode. The value is a percentage in relative to the rated current of the motor. Setting range: 0.0–300.0% (of the motor rated voltage)	10.0%	◎
P13.07	Control parameter 0	Setting range: 0.0–400.0	0.0	○
P13.08	Vector control optimization mode	Setting range: 0x0000–0xFFFF Bit 0: Enable counter-emf self-adaptation (only applicable to PM-SVC1) Bit 1: Enable SM weakening flux optimization (working with P03.22 to adjust the compensation) Bit 2: Enable current loop parameter optimization Bit 3: Enable SM counter-emf identifying optimization Bit 4: Enable SM MTPA Bit 5: Reserved Bit 6: Stator resistance online regulation Bit 7: Initial position identifying optimization Bit 8–Bit 15: Reserved	0x0010	○
P13.09	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P13.10	Initial compensation angle of SM	0.0–359.9	0.0	○
P13.11	Maladjustment detection time	Used to adjust the responsiveness of anti-maladjustment function. If the load inertia is large, increase the value of this parameter properly; however, the responsiveness may decrease accordingly. Setting range: 0.0–10.0s	0.5s	○
P13.12	Reserved	-	-	-
P13.13	High-frequency injection current	Setting range: 0.0–300.0% (of the rated drive output current)	20.0%	◎
P13.14	SVC speed feedback bandwidth	Setting range: 10.0–200.0rad/s	62.5rad/s	◎
P13.15	SM counter-emf adaptation bandwidth	Setting range: 1–100	1	○
P13.16	Observer adaptive coefficient 1	Setting range: 0–200	2	○
P13.17	Observer adaptive coefficient 2	Setting range: 0–200	8	○
P13.18	Observer adaptive coefficient 3	Setting range: 0–20.0	0.1	○
P13.19	Observer adaptive coefficient 4	Setting range: 0–500.0	0.0	○

Group P14—Serial communication

Function code	Name	Description	Default	Modify
P14.00	Local communication address	Setting range: 1–247 When the master writes the slave communication address to 0 indicating a broadcast address in a frame, all the slaves on the Modbus bus receive the frame but do not respond to it. The communication addresses on the communication network are	1	○

Function code	Name	Description	Default	Modify
		unique, which is the basis of the point-to-point communication between the host controller and the drive. **Note:** The slave address cannot be set to 0.		
P14.01	Communication baud rate setting	Specifies the data transmission rate between the host controller and the drive. Setting range: 0–6 0: 1200bps 1: 2400bps 2: 4800bps 3: 9600bps 4: 19200bps 5: 38400bps 6: 57600bps **Note:** The baud rate set on the drive must be consistent with that on the host controller. Otherwise, the communication fails. A greater baud rate indicates faster communication.	4	○
P14.02	Data bit check setting	Setting range: 0–5 0: No check (N, 8, 1) for RTU 1: Even check (E, 8, 1) for RTU 2: Odd check (O, 8, 1) for RTU 3: No check (N, 8, 2) for RTU 4: Even check (E, 8, 2) for RTU 5: Odd check (O, 8, 2) for RTU **Note:** The data format set on the drive must be consistent with that on the host controller. Otherwise, the communication fails.	1	○
P14.03	Communication response delay	Setting range: 0–200ms	5ms	○
P14.04	485 communication timeout period	Setting range: 0.0 (invalid)–60.0s	0.0s	○

Function code	Name	Description	Default	Modify
P14.05	Transmission error processing	Setting range: 0–3 0: Report an alarm and coast to stop 1: Keep running without reporting an alarm 2: Stop in enabled stop mode without reporting an alarm (applicable only to communication mode) 3: Stop in enabled stop mode without reporting an alarm (applicable to any mode)	0	○
P14.06	Modbus communication processing action selection	Setting range: 0x000–0x111 Ones place: 0: Respond to write operations 1: Not respond to write operations Tens place: 0: Communication password protection is invalid. 1: Communication password protection is valid. Hundreds place: 0: P14.07 and P14.08 user-defined addresses are invalid. 1: P14.07 and P14.08 user-defined addresses are valid.	0x000	○
P14.07	User-defined running command address	Setting range: 0x0000–0xFFFF	0x2000	○
P14.08	User-defined frequency setting address	Setting range: 0x0000–0xFFFF	0x2001	○
P14.09	Modbus TCP communication timeout time	Setting range: 0.0–60.0s	5.0s	○
P14.10	Enabling 485 program upgrade	Setting range: 0–1 0: Disable 1: Enable	0	◎
P14.11	Bootloader version	Setting range: 0.00–655.35	0.00	●
P14.12	Display of no upgrade bootloader fault	Setting range: 0–1 0: Display 1: Do not display	1	○
P14.13	Reserved	-	-	-
P14.14	Position set in digital mode (LSB)	Setting range: 0–65535	0	○
P14.15	Position set in digital mode (MSB)	Setting range: 0–65535	0	○

Function code	Name	Description	Default	Modify
P14.16–P14.46	Reserved	-	-	-
P14.47	PZD display selection	Setting range: 0x00–0xcc Ones place: Received PZD 0: CW 1: CW 2: PZD2 3: PZD3 4: PZD4 5: PZD5 6: PZD6 7: PZD7 8: PZD8 9: PZD9 A: PZD10 B: PZD11 C: PZD12 Tens place: Sent PZD 0: SW 1: SW 2: PZD2 3: PZD3 4: PZD4 5: PZD5 6: PZD6 7: PZD7 8: PZD8 9: PZD9 A: PZD10 B: PZD11 C: PZD12	0x00	○
P14.48	Channel selection for mapping between PZDs and function codes	Setting range: 0x00–0x12 Ones place: Channel for mapping function codes to PZDs 0: Reserved 1: Group P15 2: Group P16 Tens place: Save function at power-off 0: Disable 1: Enable	0x12	○
P14.49	Mapped function code of received PZD2	Setting range: 0x0000–0xFFFF	0x0000	○

Function code	Name	Description	Default	Modify
P14.50	Mapped function code of received PZD3	Setting range: 0x0000–0xFFFF	0x0000	○
P14.51	Mapped function code of received PZD4	Setting range: 0x0000–0xFFFF	0x0000	○
P14.52	Mapped function code of received PZD5	Setting range: 0x0000–0xFFFF	0x0000	○
P14.53	Mapped function code of received PZD6	Setting range: 0x0000–0xFFFF	0x0000	○
P14.54	Mapped function code of received PZD7	Setting range: 0x0000–0xFFFF	0x0000	○
P14.55	Mapped function code of received PZD8	Setting range: 0x0000–0xFFFF	0x0000	○
P14.56	Mapped function code of received PZD9	Setting range: 0x0000–0xFFFF	0x0000	○
P14.57	Mapped function code of received PZD10	Setting range: 0x0000–0xFFFF	0x0000	○
P14.58	Mapped function code of received PZD11	Setting range: 0x0000–0xFFFF	0x0000	○
P14.59	Mapped function code of received PZD12	Setting range: 0x0000–0xFFFF	0x0000	○
P14.60	Mapped function code of sent PZD2	Setting range: 0x0000–0xFFFF	0x0000	○
P14.61	Mapped function code of sent PZD3	Setting range: 0x0000–0xFFFF	0x0000	○
P14.62	Mapped function code of sent PZD4	Setting range: 0x0000–0xFFFF	0x0000	○
P14.63	Mapped function code of sent PZD5	Setting range: 0x0000–0xFFFF	0x0000	○
P14.64	Mapped function code of sent PZD6	Setting range: 0x0000–0xFFFF	0x0000	○
P14.65	Mapped function code of sent PZD7	Setting range: 0x0000–0xFFFF	0x0000	○
P14.66	Mapped function code of sent PZD8	Setting range: 0x0000–0xFFFF	0x0000	○
P14.67	Mapped function code of sent PZD9	Setting range: 0x0000–0xFFFF	0x0000	○
P14.68	Mapped function code of sent PZD10	Setting range: 0x0000–0xFFFF	0x0000	○
P14.69	Mapped function code of sent PZD11	Setting range: 0x0000–0xFFFF	0x0000	○
P14.70	Mapped function code of sent PZD12	Setting range: 0x0000–0xFFFF	0x0000	○

Group P15—Communication expansion card 1 functions

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P15.00</td><td>Reserved</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>P15.01</td><td>Module address</td><td>Setting range: 0–127</td><td>1</td><td>◎</td></tr>
<tr><td>P15.02</td><td>Received PZD2</td><td rowspan="11">Setting range: 0–31
0: Invalid
1: Set frequency (0–Fmax, unit: 0.01Hz)
2–3: Reserved
4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current)
5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01Hz)
6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01Hz)
7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)
8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current)
9: Virtual input terminal command. Range: 0x000–0x3FF
10: Virtual output terminal command. Range: 0x00–0x0F
11: Voltage setting (used when V/F separation is implemented) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage)
12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%)
13: AO2 output setting 2 (-1000–+1000, in which 1000 corresponds to 100.0%)
14: Position reference MSB (signed)
15: Position reference LSB (unsigned)
16: Position feedback MSB (signed)
17: Position feedback LSB (unsigned)
18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0)
19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59)</td><td>0</td><td>○</td></tr>
<tr><td>P15.03</td><td>Received PZD3</td><td>0</td><td>○</td></tr>
<tr><td>P15.04</td><td>Received PZD4</td><td>0</td><td>○</td></tr>
<tr><td>P15.05</td><td>Received PZD5</td><td>0</td><td>○</td></tr>
<tr><td>P15.06</td><td>Received PZD6</td><td>0</td><td>○</td></tr>
<tr><td>P15.07</td><td>Received PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P15.08</td><td>Received PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P15.09</td><td>Received PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P15.10</td><td>Received PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P15.11</td><td>Received PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P15.12</td><td>Received PZD12</td><td>0</td><td>○</td></tr>
</table>

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td></td><td></td><td>20: Flow setting (0.0–2400.0L/min, unit: 0.1L/min)
21: Pressure setting (0.0–250.0bar, unit: 0.1bar)
22: Hydraulic CW (Bit 0–2: Multi-step PID 0–3; Bit 3: 0: Flow splitting, 1: Flow combining; Bit 4–16: Reserved)
23: Hydraulic control mode (0 indicates that hydraulic control is invalid, and 1 indicates that hydraulic control is valid)
24: Speed reference (Non-hydraulic mode, -100.0–100.0%; 100.0% corresponds to P73.40 (Max. motor speed), -100.0% corresponds to negative P73.40)
25–27: Reserved
28: EAO3 output setting
29: EAO4 output setting
30–31: Reserved</td><td></td><td></td></tr>
<tr><td>P15.13</td><td>Sent PZD2</td><td rowspan="11">Setting range: 0–32
0: Invalid
1: Running frequency (×100, Hz)
2: Set frequency (×100, Hz)
3: Bus voltage (×10, V)
4: Output voltage (×1, V)
5: Output current (×10, A)
6: Actual output torque (×10, %)
7: Actual output power (×10, %)
8: Rotation speed of running (×1, rpm)
9: Linear speed of running (×1, m/s)
10: Ramp reference frequency
11: Fault code
12: AI1 input (×100, V)
13: AI2 input (×100, V)
14: Pressure feedback value (×10， bar)
15: Hydraulic SW
16: Terminal input state
17: Terminal output state
18–19: Reserved
20: Speed reference (×1, RPM, signed)
21: Position reference MSB (signed)
22: Position reference LSB (unsigned)
23: Position feedback MSB (signed)
24: Position feedback LSB (unsigned)
25: SW 2 (same as P18.23)
26: Hydraulic mode speed feedback</td><td>0</td><td>○</td></tr>
<tr><td>P15.14</td><td>Sent PZD3</td><td>0</td><td>○</td></tr>
<tr><td>P15.15</td><td>Sent PZD4</td><td>0</td><td>○</td></tr>
<tr><td>P15.16</td><td>Sent PZD5</td><td>0</td><td>○</td></tr>
<tr><td>P15.17</td><td>Sent PZD6</td><td>0</td><td>○</td></tr>
<tr><td>P15.18</td><td>Sent PZD7</td><td>0</td><td>○</td></tr>
<tr><td>P15.19</td><td>Sent PZD8</td><td>0</td><td>○</td></tr>
<tr><td>P15.20</td><td>Sent PZD9</td><td>0</td><td>○</td></tr>
<tr><td>P15.21</td><td>Sent PZD10</td><td>0</td><td>○</td></tr>
<tr><td>P15.22</td><td>Sent PZD11</td><td>0</td><td>○</td></tr>
<tr><td>P15.23</td><td>Sent PZD12</td><td>0</td><td>○</td></tr>
</table>

Function code	Name	Description	Default	Modify
		(×10, RPM) 27: MSB of PG card pulse feedback count 28: LSB of PG card pulse feedback count 29: EAI5 input (×100, V) 30: EAI6 input (×100, V) 31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70) 32: EAI7 input (×100, V)		
P15.24	Reserved	-	-	-
P15.25	DP communication timeout time	Setting range: 0.0 (invalid)–60.0s	5.0s	○
P15.26	CANopen communication timeout time	Setting range: 0.0 (invalid)–60.0s	5.0s	○
P15.27	CANopen communication baud rate	Setting range: 0–5 0: 1000kbps (Reserved) 1: 800kbps 2: 500kbps 3: 250kbps 4: 125kbps 5: 100kbps	3	◎
P15.28	CAN communication address (CAN master/slave communication card)	Setting range: 0–127	1	◎
P15.29	CAN communication baud rate selection (CAN master/slave communication card)	Setting range: 0–5 0: 50kbps 1: 100kbps 2: 125kbps 3: 250kbps 4: 500kbps 5: 1Mbps	2	◎
P15.30	Master/slave CAN communication timeout time (CAN master/slave communication card)	Setting range: 0.0 (invalid)–60.0s	5.0s	○
P15.31	Reserved	-	-	-
P15.32	Display node baud rate	Setting range: 0–65535	0	●
P15.33–P15.42	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P15.43	Communication CW and SW expression format	Setting range: 0–1 0: In decimal format 1: In binary format	1	◎
P15.44–P15.69	Reserved	-	-	-

Group P16—Communication expansion card 2 functions

Function code	Name	Description	Default	Modify
P16.00–P16.01	Reserved	-	-	-
P16.02	Ethernet monitoring card IP address 1	Setting range: 0–255	192	◎
P16.03	Ethernet monitoring card IP address 2	Setting range: 0–255	168	◎
P16.04	Ethernet monitoring card IP address 3	Setting range: 0–255	0	◎
P16.05	Ethernet monitoring card IP address 4	Setting range: 0–255	1	◎
P16.06	Ethernet monitoring card subnet mask 1	Setting range: 0–255	255	◎
P16.07	Ethernet monitoring card subnet mask 2	Setting range: 0–255	255	◎
P16.08	Ethernet monitoring card subnet mask 3	Setting range: 0–255	255	◎
P16.09	Ethernet monitoring card subnet mask 4	Setting range: 0–255	0	◎

Function code	Name	Description	Default	Modify
P16.10	Ethernet monitoring card gateway 1	Setting range: 0–255	192	◎
P16.11	Ethernet monitoring card gateway 2	Setting range: 0–255	168	◎
P16.12	Ethernet monitoring card gateway 3	Setting range: 0–255	0	◎
P16.13	Ethernet monitoring card gateway 4	Setting range: 0–255	1	◎
P16.14	Ethernet card monitoring variable address 1	Setting range: 0x0000–0xFFFF	0x0000	○
P16.15	Ethernet card monitoring variable address 2	Setting range: 0x0000–0xFFFF	0x0000	○
P16.16	Ethernet card monitoring variable address 3	Setting range: 0x0000–0xFFFF	0x0000	○
P16.17	Ethernet card monitoring variable address 4	Setting range: 0x0000–0xFFFF	0x0000	○
P16.18–P16.24	Reserved	-	-	-
P16.25	Time to identify expansion card in slot 1	Setting range: 0.0–600.0s **Note:** The value 0.0 indicates that an identification fault will not be detected.	0.0s	○
P16.26	Time to identify expansion card in slot 2	Setting range: 0.0–600.0s **Note:** The value 0.0 indicates that an identification fault will not be detected.	0.0s	○
P16.27	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P16.28	Communication timeout time of expansion card in card slot 1	Setting range: 0.0–600.0s **Note:** The value 0.0 indicates that an offline fault will not be detected.	0.0s	○
P16.29	Communication timeout time of expansion card in card slot 2	Setting range: 0.0–600.0s **Note:** The value 0.0 indicates that an offline fault will not be detected.	0.0s	○
P16.30	EtherCat communication timeout time	Setting range: 0.0–60.0s **Note:** The value 0.0 indicates that an offline fault will not be detected.	5.0s	○
P16.31	PROFINET communication timeout time	Setting range: 0.0–60.0s **Note:** The value 0.0 indicates that an offline fault will not be detected.	5.0s	○
P16.32	Received PZD2	Setting range: 0–31 0: Invalid 1: Set frequency (0–Fmax, unit: 0.01Hz) 2–3: Reserved 4: Torque setting (-3000–+3000, in which 1000 corresponds to 100.0% of the motor rated current) 5: Setting of the upper limit of forward running frequency (0–Fmax, unit: 0.01Hz) 6: Setting of the upper limit of reverse running frequency (0–Fmax, unit: 0.01Hz) 7: Upper limit of the electromotive torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 8: Upper limit of braking torque (0–3000, in which 1000 corresponds to 100.0% of the motor rated current) 9: Virtual input terminal command. Range: 0x000–0x3FF 10: Virtual output terminal command. Range: 0x00–0x0F 11: Voltage setting (used when V/F separation is implemented) (0–1000, in which 1000 corresponds to 100% of the motor rated voltage) 12: AO1 output setting 1 (-1000–+1000, in which 1000 corresponds to 100.0%) 13: AO2 output setting 2 (-1000–+1000, in	0	○
P16.33	Received PZD3		0	○
P16.34	Received PZD4		0	○
P16.35	Received PZD5		0	○
P16.36	Received PZD6		0	○
P16.37	Received PZD7		0	○
P16.38	Received PZD8		0	○
P16.39	Received PZD9		0	○
P16.40	Received PZD10		0	○
P16.41	Received PZD11		0	○
P16.42	Received PZD12		0	○

Function code	Name	Description	Default	Modify
		which 1000 corresponds to 100.0%) 14: Position reference MSB (signed) 15: Position reference LSB (unsigned) 16: Position feedback MSB (signed) 17: Position feedback LSB (unsigned) 18: Position feedback setting flag (position feedback can be set only after this flag is set to 1 and then to 0) 19: Function parameter mapping (PZD2–PZD12 correspond to P14.49–P14.59) 20: Flow setting (0.0–2400.0L/min, unit: 0.1L/min) 21: Pressure setting (0.0–250.0bar, unit: 0.1bar) 22: Hydraulic CW (Bit 0–2: Multi-step PID 0–3; Bit 3: 0: Flow splitting, 1: Flow combining; Bit 4–16: Reserved) 23: Hydraulic control mode (0 indicates that hydraulic control is invalid, and 1 indicates that hydraulic control is valid) 24: Speed reference (Non-hydraulic mode, -100.0–100.0%; 100.0% corresponds to P73.40 (Max. motor speed), -100.0% corresponds to negative P73.40) 25–27: Reserved 28: EAO3 output setting 29: EAO4 output setting 30–31: Reserved		
P16.43	Sent PZD2	Setting range: 0–32 0: Invalid 1: Running frequency (×100, Hz) 2: Set frequency (×100, Hz) 3: Bus voltage (×10, V) 4: Output voltage (×1, V) 5: Output current (×10, A) 6: Actual output torque (×10, %) 7: Actual output power (×10, %) 8: Rotation speed of running (×1, rpm) 9: Linear speed of running (×1, m/s) 10: Ramp reference frequency	0	○
P16.44	Sent PZD3		0	○
P16.45	Sent PZD4		0	○
P16.46	Sent PZD5		0	○
P16.47	Sent PZD6		0	○
P16.48	Sent PZD7		0	○
P16.49	Sent PZD8		0	○
P16.50	Sent PZD9		0	○
P16.51	Sent PZD10		0	○
P16.52	Sent PZD11		0	○

Function code	Name	Description	Default	Modify
P16.53	Sent PZD12	11: Fault code 12: AI1 input (×100, V) 13: AI2 input (×100, V) 14: Pressure feedback value (×10，bar) 15: Hydraulic SW 16: Terminal input state 17: Terminal output state 18–19: Reserved 20: Speed reference (×1, RPM, signed) 21: Position reference MSB (signed) 22: Position reference LSB (unsigned) 23: Position feedback MSB (signed) 24: Position feedback LSB (unsigned) 25: SW 2 (same as P18.23) 26: Hydraulic mode speed feedback (×10 RPM, signed) 27: MSB of PG card pulse feedback count 28: LSB of PG card pulse feedback count 29: EAI5 input (×100, V) 30: EAI6 input (×100, V) 31: Function parameter mapping (PZD2–PZD12 correspond to P14.60–P14.70) 32: EAI7 input (×100, V)	0	○
P16.54	EtherNet IP communication timeout time	Setting range: 0.0–60.0s	5.0s	○
P16.55	EtherNet IP communication rate	Setting range: 0–4 0: Self-adaptive 1: 100M full duplex 2: 100M half duplex 3: 10M full duplex 4: 10M half duplex	0	◎
P16.56–P16.57	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P16.58	Industrial Ethernet communication card IP address 1	Setting range: 0–255	192	◎
P16.59	Industrial Ethernet communication card IP address 2	Setting range: 0–255	168	◎
P16.60	Industrial Ethernet communication card IP address 3	Setting range: 0–255	0	◎
P16.61	Industrial Ethernet communication card IP address 4	Setting range: 0–255	20	◎
P16.62	Industrial Ethernet communication card subnet mask 1	Setting range: 0–255	255	◎
P16.63	Industrial Ethernet communication card subnet mask 2	Setting range: 0–255	255	◎
P16.64	Industrial Ethernet communication card subnet mask 3	Setting range: 0–255	255	◎
P16.65	Industrial Ethernet communication card subnet mask 4	Setting range: 0–255	0	◎

Function code	Name	Description	Default	Modify
P16.66	Industrial Ethernet communication card gateway 1	Setting range: 0–255	192	◎
P16.67	Industrial Ethernet communication card gateway 2	Setting range: 0–255	168	◎
P16.68	Industrial Ethernet communication card gateway 3	Setting range: 0–255	0	◎
P16.69	Industrial Ethernet communication card gateway 4	Setting range: 0–255	1	◎
P16.70–P16.79	Reserved	-	-	-
P16.80	EtherCAT slave address	Setting range: 0–255 **Note:** ● When this parameter is set to a non-zero value, the EtherCAT slave address is fixed to this value. It overrides any slave address setting from the PLC side. ● When P16.80 is set to 0, the EtherCAT slave address can be configured by the PLC side.	0	◎
P16.81–P16.84	Reserved	-	-	-

Group P17—Status viewing

Function code	Name	Description	Default	Modify
P17.00	Set frequency	Displays the present set frequency of the drive. Range: 0.00Hz–P00.03	0.00Hz	●

Function code	Name	Description	Default	Modify
P17.01	Output frequency	Displays the present output frequency of the drive. Range: 0.00Hz–P00.03	0.00Hz	●
P17.02	Ramp reference frequency	Displays the present ramp reference frequency of the drive. Range: 0.00Hz–P00.03	0.00Hz	●
P17.03	Output voltage	Displays the present output voltage of the drive. Range: 0–1200V	0V	●
P17.04	Output current	Displays the valid value of the present output current. Range: 0.0–5000.0A	0.0A	●
P17.05	Motor speed	Displays the present motor rotation speed. Range: 0–65535rpm	0rpm	●
P17.06	Torque current	Displays the present torque current of the drive. Range: -3000.0–3000.0A	0.0A	●
P17.07	Exciting current	Displays the present exciting current of the drive. Range: -3000.0–3000.0A	0.0A	●
P17.08	Motor power	Displays the present motor power. 100% corresponds to the motor rated power. Range: -300.0–300.0% (of the rated motor power)	0.0%	●
P17.09	Motor output torque	Displays the present output torque of the drive. 100% corresponds to the motor rated torque. Range: -250.0–250.0%	0.0%	●
P17.10	Estimated motor frequency	Used to indicate the estimated motor rotor frequency under the open-loop vector condition. Range: 0.00Hz–P00.03	0.00Hz	●
P17.11	DC bus voltage	Displays the present DC bus voltage of the drive. Range: 0.0–2000.0V	0.0V	●
P17.12	Digital input terminal state	Displays the present digital input terminal state of the drive. Display range: 0x00–0x3F Bit 0: DI1 Bit 1: DI2 Bit 2: DI3 Bit 3: DI4 Bit 4: DI5 Bit 5–Bit 6: Reserved	0x00	●

Function code	Name	Description	Default	Modify
P17.13	Digital output terminal state	Displays the present digital output terminal state of the drive. Display range: 0x00–0x0F Bit0: DO1 Bit1: DO2 Bit2: RO1 Bit3: Reserved	0x00	●
P17.14	Digital adjustment value	Displays the adjustment on the drive through the UP/DOWN terminal. Range: 0.00Hz–P00.03	0.00Hz	●
P17.15	Torque reference value	Indicates the percentage of the rated torque of the present motor, displaying the torque reference. Range: -300.0–300.0% (of the motor rated current)	0.0%	●
P17.16	Linear speed	Range: 0–65535	0	●
P17.17	Reserved	-	-	-
P17.18	Count value	Range: 0–65535	0	●
P17.19	AI1 input voltage	The function code is used to display the AI1 input signal. Range: 0.00–10.00V	0.00V	●
P17.20	AI2 input voltage	The function code is used to display the AI2 input signal. Range: -10.00V–10.00V	0.00V	●
P17.21	AI3 input voltage	The function code is used to display the AI3 input signal. Range: 0.00–10.00V	0.00V	●
P17.22–P17.24	Reserved	-	-	-
P17.25	Motor power factor	Displays the power factor of the present motor. Range: -1.00–1.00	0.00	●
P17.26	Duration of this run	Displays the duration of this run of the drive. Range: 0–65535min	0min	●
P17.27	Reserved	-	-	-
P17.28	Motor ASR controller output	Displays the ASR controller output value as a percentage relative to the rated motor torque under the vector control mode. Range: -300.0–300.0% (of the motor rated current)	0.0%	●
P17.29	Open-loop SM pole angle	Displays the initial identification angle of SM. Range: 0.0–360.0°	0.0°	●

Function code	Name	Description	Default	Modify
P17.30	Phase compensation of SM	Displays the phase compensation of SM. Range: -180.0–180.0	0.0	●
P17.31	High-frequency superposition current of SM	Range: 0.0–200.0% (of the motor rated current)	0.0%	●
P17.32	Motor flux linkage	Range: 0.0–200.0%	0.0%	●
P17.33	Exciting current reference	Displays the exciting current reference value under the vector control mode. Range: -3000.0–3000.0A	0.0A	●
P17.34	Torque current reference	Displays the torque current reference value under the vector control mode. Range: -3000.0–3000.0A	0.0A	●
P17.35	AC incoming current	The function code is used to display the valid value of incoming current on AC side. Range: 0.0–5000.0A	0.0A	●
P17.36	Output torque	Displays the output torque value. During forward running, the positive value is the motoring state while the negative value is generating state. During reverse running, the positive value is the generating state while the negative value is the motoring state. Range: -3000.0–3000.0N・m	0.0N・m	●
P17.37	Motor overload count value	Range: 0–65535	0	●
P17.38	Reserved	-	-	-
P17.39	Function codes in parameter download error	Range: 0.00–99.99	0.00	●
P17.40	Motor control mode	Display range: 0x000–0x123 Ones place: Control mode 0: Vector 0 1: Vector 1 2: V/F control 3: Closed-loop vector control Tens place: Control state 0: Speed control 1. Torque control 2: Position control Hundreds place: Motor number 0: Motor 1 1: Reserved	0x000	●

Function code	Name	Description	Default	Modify
P17.41	Electromotive torque upper limit	Range: 0.0–300.0% (of the motor rated current)	0.0%	●
P17.42	Braking torque upper limit	Range: 0.0–300.0% (of the motor rated current)	0.0%	●
P17.43	Forward rotation frequency upper limit in torque control	Range: 0.00Hz–P00.03	0.00Hz	●
P17.44	Reverse rotation frequency upper limit in torque control	Range: 0.00Hz–P00.03	0.00Hz	●
P17.45	Inertia compensation torque	Range: -100.0–100.0%	0.0%	●
P17.46	Friction compensation torque	Range: -100.0–100.0%	0.0%	●
P17.47	Number of pole pairs	Range: 0–65535	0	●
P17.48	Drive OL count value	Range: 0–65535	0	●
P17.49	A source frequency reference	Range: 0.00Hz–P00.03	0.00Hz	●
P17.50–P17.57	Reserved	-	-	-
P17.58	Actual carrier frequency	Range: 0.000–8.000kHz	0.000kHz	●
P17.59	SM signal to noise ratio	Range: 0.0–1000.0	0.0	●
P17.60	Counter-emf of SM	Range: 0–1200V	0V	●
P17.61	Present motor speed display MSB	Setting range: 0–30 (10kRPM)	0 (10krpm)	●
P17.62	Stator resistance	Range: 0.000–60.000Ω	0.000Ω	●
P17.63	Reserved	-	-	-
P17.64	Drive SW 3	Display range: 0x0000–0xFFFF Bit 0: Running protection flag Bit 1: Running Bit 2: Running direction (1=REV, 0=FWD) Bit 3: Jogging Bit 4: Pre-alarming	0x0000	●

Function code	Name	Description	Default	Modify
		Bit 5: In fault Bit 6: Running paused Bit 7: In sleep Bit 8: In PoFF state Bit 9: Undervoltage due to transient power loss Bit 10: Overvoltage stall Bit 11: Pre-exciting Bit 12: DC braking Bit 13: Identifying parameters Bit14: Reserved Bit15: Reserved		
P17.65–P17.71	Reserved	-	-	-
P17.72	Local CANopen communication status	0x00–0xFF	0x00	●
P17.73–P17.74	Reserved	-	-	-

Group P18—Status viewing in closed-loop control

Function code	Name	Description	Default	Modify
P18.00	Encoder detected frequency	The function code is used to indicate the actual-measured encoder frequency. The value of forward running is positive; the value of reverse running is negative. Range: -999.9–3276.7Hz	0.0Hz	●
P18.01	Encoder position count value	The function code is used to indicate the encoder count value, quadruple frequency. Range: 0–65535	0	●
P18.02	Encoder Z pulse count value	The function code is used to indicate the count value of the encoder Z pulse. Range: 0–65535	0	●
P18.03	Position reference value MSB	The function code is used to indicate the MSB of position reference value. It is cleared after stop. Range: 0–30000	0	●

Function code	Name	Description	Default	Modify
P18.04	Position reference value LSB	The function code is used to indicate the LSB of position reference value. It is cleared after stop. Range: 0–65535	0	●
P18.05	Position feedback value MSB	The function code is used to indicate the MSB of position feedback value. It is cleared after stop. Range: 0–30000	0	●
P18.06	Position feedback value LSB	The function code is used to indicate the LSB of position feedback value. It is cleared after stop. Range: 0–65535	0	●
P18.07	Position deviation	The function code is used to indicate the deviation between the reference position and actual running position. Range: -32768–32767	0	●
P18.08	Position of position reference point	The function code is used to indicate the position of reference point of Z pulse when the spindle stops accurately. Range: 0–65535	0	●
P18.09	Spindle present position setting	Present position setting of spindle accurate stop. Range: 0.00–359.99	0.00	●
P18.10	Present position of spindle accurate stop	Present position of spindle accurate stop. Range: 0–65535	0	●
P18.11	Encoder Z pulse direction	Z pulse direction display. During spindle accurate stop, there may be a few pulses of error in the stop positions of the forward and reverse directions, which can be eliminated by adjusting Z pulse direction of P20.02 or swapping the encoder A/B phases. Range: 0–1 0: Forward 1: Reverse	0	●

Function code	Name	Description	Default	Modify
P18.12	Encoder Z pulse angle	Reserved. Range: 0.00–359.99	0.00	●
P18.13	Encoder Z pulse error times	Reserved. Range: 0–65535	0	●
P18.14	PG card pulse feedback count MSB	The function code is used to indicate the encoder pulse count value. The count value is accumulated only if the drive is powered on. Range: 0–65535	0	●
P18.15	PG card pulse feedback count LSB	The function code is used to indicate the encoder pulse count value. The count value is accumulated only if the drive is powered on. Range: 0–65535	0	●
P18.16	Main control board measured value	Range: -3276.8–3276.7Hz	0.0Hz	●
P18.17	Pulse command frequency	The pulse command (A2/B2 terminal) is converted to the set frequency, and it is valid under the pulse position mode and pulse speed mode. Range: -3276.8–3276.7Hz	0.0Hz	●
P18.18	Pulse command feed-forward	The pulse command (A2/B2 terminal) is converted to the set frequency, and it is valid under the pulse position mode and pulse speed mode. Range: -3276.8–3276.7Hz	0.0Hz	●
P18.19	Position regulator output	Range: -327.68–327.67Hz	0.00Hz	●
P18.20	Resolver count value	The function code is used to indicate the count value of the resolver. Range: 0–65535	0	●
P18.21	Resolver angle	The function code is used to indicate the pole position angle read by the resolver-type encoder. Range: 0.00–359.99	0.00	●

Function code	Name	Description	Default	Modify
P18.22	Closed-loop SM pole angle	The function code is used to indicate the present pole position. Range: 0.00–359.99	0.00	●
P18.23	SW 2	Range: 0–65535	0	●
P18.24	PG card pulse reference count MSB	Indicates the pulse command (A2, B2) count value. The count value is accumulated only if the drive is powered on. Range: 0–65535	0	●
P18.25	PG card pulse reference count LSB	Indicates the pulse command (A2, B2) count value. The count value is accumulated only if the drive is powered on. Range: 0–65535	0	●
P18.26	PG card speed measured value	Range: -3276.8–3276.7Hz	0.0Hz	●
P18.27	Encoder UVW sector	Range: 0–7	0	●
P18.28	Encoder PPR display	Range: 0–65535	0	●
P18.29	SM angle compensation value	Range: -180.0–180.0°	0.0°	●
P18.30	SM Z-pulse angle	Range: 0.00–655.35°	0.00°	●
P18.31	Z pulse value of pulse reference	Range: 0–65535	0	●
P18.32	Main control board measured value of pulse reference	Range: -3276.8–3276.7Hz	0.0Hz	●
P18.33	PG card measured value of pulse reference	Range: -3276.8–3276.7Hz	0.0Hz	●

Function code	Name	Description	Default	Modify
P18.34	Present encoder filter width	Range: 0–63	0	●
P18.35	CPU load rate	Range: 0.0–100.0%	0.0%	●

Group P19—Expansion card status viewing

<table>
<tr><th>Function code</th><th>Name</th><th>Description</th><th>Default</th><th>Modify</th></tr>
<tr><td>P19.00</td><td>Expansion card type of card slot 1</td><td rowspan="3">Range: 0–100
0: No card
1: Reserved
2: I/O card
3: Incremental PG card
4: Incremental PG card with UVW
5: Ethernet communication card
6: DP communication card
7–8: Reserved
9: CANopen communication card
10: Reserved
11: PROFINET communication card
12: Sin/Cos PG card without CD signal
13: Sin/Cos PG card with CD signal
14: Absolute encoder PG card
15: CAN master/slave communication card
16: Modbus TCP communication card
17: EtherCAT communication card
18: Reserved
19: DeviceNet communication card
20: PT100/PT1000 temperature detection card
21: EtherNet IP card
22–27: Reserved
28: I/O 4 card
29–100: Reserved</td><td>0</td><td>●</td></tr>
<tr><td>P19.01</td><td>Expansion card type of card slot 2</td><td>0</td><td>●</td></tr>
<tr><td>P19.02</td><td>Reserved</td><td>-</td><td>-</td></tr>
<tr><td>P19.03</td><td>Software version of expansion card in slot 1</td><td>Range: 0.00–655.35</td><td>0.00</td><td>●</td></tr>
</table>

Function code	Name	Description	Default	Modify
P19.04	Software version of expansion card in slot 2	Range: 0.00–655.35	0.00	●
P19.05	Reserved	-	-	-
P19.06	Terminal input state of I/O card	Display range: 0x0000–0xFFFF	0x0000	●
P19.07	Terminal output state of I/O card	Display range: 0x0000–0xFFFF	0x0000	●
P19.08	Reserved	-	-	-
P19.09	EAI3 input voltage of I/O card	Range: 0.00–10.00V	0.00V	●
P19.10–P19.14	Reserved	-	-	-
P19.15	Drive communication CW	Display range: 0x0000–0xFFFF	0x0000	●
P19.16	Drive communication SW	Display range: 0x0000–0xFFFF	0x0000	●
P19.17	Ethernet monitoring variable 1	Range: 0–65535	0	●
P19.18	Ethernet monitoring variable 2	Range: 0–65535	0	●
P19.19	Ethernet monitoring variable 3	Range: 0–65535	0	●
P19.20	Ethernet monitoring variable 4	Range: 0–65535	0	●
P19.21–P19.23	Reserved	-	-	-
P19.24	Function code version	Range: 0.00–655.35	0.00	●
P19.25	Performance version	Range: 0.00–655.35	0.00	●
P19.26	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P19.27	EAI5 input voltage	-10.00–10.00V	0.00	●
P19.28	EAI6 input voltage	-10.00–10.00V	0.00	●
P19.29	EAI7 input voltage	-10.00–10.00V	0.00	●
P19.30	EAI detected temperature	-20.0–200.0°C	0.0	●
P19.31	EAI PTC detected resistance	0–60000	0	●
P19.32	AD sampling value of EAI-Pt temperature measurement input	0–4095	0	●
P19.33–P19.39	Reserved	-	-	-

Group P20—Encoder functions of motor 1

Function code	Name	Description	Default	Modify
P20.00	Encoder type display	Setting range: 0–3 0: Incremental encoder 1: Resolver encoder 2: Sin/Cos encoder 3: Reserved	1	●
P20.01	Encoder pulse count	The function code is used to indicate the number of pulses generated when the encoder revolves for one circle. Setting range: 0–16000	1024	◎
P20.02	Encoder direction	Setting range: 0x000–0x111 Ones place: AB direction 0: Forward 1: Reverse Tens place: Reserved Hundreds place: CD/UVW pole signal direction 0: Forward 1: Reverse	0x000	◎

Function code	Name	Description	Default	Modify
P20.03	Encoder disconnection fault detection time	Setting range: 0.0–10.0s	0.3s	○
P20.04	Encoder reversal fault detection time	Setting range: 0.0–100.0s	0.8s	○
P20.05	Filter times of encoder detection	Setting range: 0x00–0x99 Ones place: Low-speed filter times, corresponding to 2^(0–9)×125μs Tens place: High-speed filter times, corresponding to 2^(0–9)×125μs	0x00	○
P20.06	Speed ratio between motor and encoder mounting shaft	When the encoder is not installed on the motor shaft and the drive ratio is not 1, you need to set this parameter. Setting range: 0.000–65.535	1.000	○
P20.07	SM control parameter	Setting range: 0x0000–0xFFFF Bit 0: Enable Z pulse calibration Bit 1: Enable encoder angle calibration Bit 2: Enable SVC speed measurement Bit3–Bit5: Reserved Bit 6: Enable the CD signal calibration Bit7: Reserved Bit 8: Do not detect encoder faults during autotuning Bit 9: Enable Z pulse detection optimization Bit 10: Enable the initial Z pulse calibration optimization Bit 11: Update the initial angle Bit 12: Clear the Z pulse arrival signal after stop Bit13: Enable encoder direction identification Bit 14: Detect Z pulse after one rotation Bit 15: Reserved	0x2007	○

Function code	Name	Description	Default	Modify
P20.08	Enable Z pulse offline detection	Setting range: 0x00–0x11 Ones place: Z pulse 0: Do not detect 1: Enable Tens place: UVW pulse (for synchronous motors) 0: Do not detect 1: Enable	0x10	○
P20.09	Initial angle of Z pulse	Relative electrical angle between encoder Z pulse and motor pole position. Setting range: 0.00–359.99	0.00	○
P20.10	Initial pole angle	Relative electrical angle between encoder position and motor pole position. Setting range: 0.00–359.99	0.00	○
P20.11	Initial pole position autotuning	Setting range: 0–3 0: No operation 1: Rotary autotuning (DC braking) 2: Static autotuning (suitable for resolver encoders or sin/cos encoders with CD signal feedback) 3: Rotary autotuning 2 (initial angle identification)	0	◎
P20.12	Speed measurement optimization selection	Setting range: 0–3 0: No optimization 1: Optimization mode 1 2: Optimization mode 2 3: Optimization mode 3 (observe disturbance)	2	◎
P20.13	CD signal zero offset gain	Setting range: 0–65535	0	○
P20.14	Encoder type selection	Setting range: 0x00–0x11 Ones place: Incremental encoder 0: Without UVW 0: With UVW Tens place: Sin/Cos encoder 0: Without CD signal 1: With CD signal	0x00	◎

Function code	Name	Description	Default	Modify
P20.15	Speed measurement method	Setting range: 0–2 0: PG card 1: Reserved 2: Built-in resolver	2	◎
P20.16	Frequency division coefficient	Setting range: 0–255 When the function parameter is set to 0 or 1, the frequency division of 1:1 is implemented.	0	○
P20.17	Pulse filter handling selection	Setting range: 0x0000–0xFFFF Bit 0: Indicates whether to enable encoder P-channel input filter 0: Disable 1: Enable Bit 1: Encoder signal filter mode 0: Self-adaptive filter 1: Use P20.18 as the filter parameter Bit 2: Indicates whether to enable encoder P-channel frequency-division output filter 0: Disable 1: Enable Bit 3: Indicates whether to enable filter for pulse reference F-channel frequency-division output 0: Disable 1: Enable Bit 4: Indicates whether to enable pulse reference F-channel filter 0: Disable 1: Enable Bit 5: Pulse reference F-channel filter method 0: Self-adaptive filter 1: Use P20.19 as the filter parameter Bit 6: Frequency-divided output source selection (valid only for incremental encoders) 0: Encoder 1: Pulse reference Bit7–Bit15: Reserved	0x0033	○

Function code	Name	Description	Default	Modify
P20.18	Encoder P-channel filter width	Setting range: 0–63 The filter time is P20.18*0.25µs. The value 0 or 1 indicates 0.25µs.	2	○
P20.19	Pulse reference F-channel filter width	Setting range: 0–63 The filter time is P20.19*0.25µs. The value 0 or 1 indicates 0.25µs.	2	○
P20.20	Pulse reference F-channel pulse count	Setting range: 0–16000	1024	◎
P20.21	Enabling SM angle compensation	Setting range: 0–1	1	○
P20.22	Frequency point of speed measurement mode switchover	Setting range: 0.00Hz–P00.03 **Note:** Valid only when P20.12=0.	1.00Hz	○
P20.23	Angle compensation coefficient	Setting range: -200.0–200.0%	100.0%	○
P20.24	Motor rotation turns in initial pole angle autotuning	Setting range: 1–128	2	◎

Group P21—Position control

Function code	Name	Description	Default	Modify
P21.00	Positioning mode selection	Setting range: 0x0000–0x7221 Ones place: Control mode selection (only for closed-loop vector control) 0: Speed control 1: Position control Tens place: Position command source 0: Pulse train. The pulse giving signals from PG card terminals A2 and B2 are used for position control. 1: Digital position. The setting of P21.17 is used for positioning, while the positioning mode can be set through P21.16. 2: Positioning of photoelectric switch during stop. When a terminal receives a photoelectric switch signal (terminal function 43 selected), the drive starts positioning for stop, and the stop distance can be set through P21.17. Hundreds place: Position feedback source 0: Main control board resolver signal 1: P-channel pulse of PG card 2: Reserved Thousands place: Servo mode (reserved) 0: Disable servo, without position deviation 1: Disable servo, with position deviation 2: Enable servo, without position deviation 3: Enable servo, with position deviation 4–7: Reserved	0x0000	○

Function code	Name	Description	Default	Modify
P21.01	Pulse command mode	Setting range: 0x0000–0x3133 Ones place: Pulse mode 0: A/B quadrature pulse; A precedes B 1: A is PULSE and B is SIGN If channel B is of low electric level, the edge counts up; if channel B is of high electric level, the edge counts down. 2: A is positive PULSE Channel A is positive pulse; channel B needs no wiring. 3: A/B dual-channel pulse. Channel A pulse edge counts up, but channel B pulse edge counts down. Tens place: Pulse direction selection 0: Pulse direction setting: forward 1: Pulse direction setting: reverse 2: Pulse direction set by running direction 3: Pulse direction set by running direction Hundreds place: Frequency-multiplication selection for pulse + direction (reserved) 0: No frequency-multiplication 1: Frequency-multiplication Thousands place: Pulse control selection 0: Inertia filter, without overspeed control 1: Average moving filter, without overspeed control 2: Inertia filter, with overspeed control 3: Average moving filter, with overspeed control	0x0000	◎
P21.02	Position-loop gain 1	The two position-loop gains are switched based on the switching mode set through P21.04. When the spindle accurate stop function is used, the gains are switched automatically, regardless of the setting of P21.04. P21.03 is used for dynamic running, and P21.02 is used for maintaining the locked state. Setting range: 0.0–400.0	20.0	○

Function code	Name	Description	Default	Modify
P21.03	Position-loop gain 2	The two position-loop gains are switched based on the switching mode set through P21.04. When the spindle accurate stop function is used, the gains are switched automatically, regardless of the setting of P21.04. P21.03 is used for dynamic running, and P21.02 is used for maintaining the locked state. Setting range: 0.0–400.0	30.0	○
P21.04	Position-loop gain switchover mode	Setting range: 0–5 0: No switchover 1: Torque command 2: Speed command 3–5: Reserved	0	○
P21.05	Position gain switchover threshold in torque command	Setting range: 0.0–100.0% (of the motor rated torque)	10.0%	○
P21.06	Position gain switchover threshold in speed command	Setting range: 0.0–100.0% (of the motor rated speed)	10.0%	○
P21.07	Smooth filter coefficient during gain switchover	The function code is used to indicate the smooth filter coefficient for position gain switchover. Setting range: 0–15	5	○
P21.08	Position regulator output limit	Setting range: 0.0–100.0% (of max. output frequency P00.03)	20.0%	○
P21.09	Completion range of positioning	Setting range: 0–1000	10	○
P21.10	Detection time for positioning completion	Setting range: 0.0–1000.0ms	10.0ms	○

Function code	Name	Description	Default	Modify
P21.11	Numerator of position command ratio	Setting range: 1–65535	1000	○
P21.12	Denominator of position command ratio	Setting range: 1–65535	1000	○
P21.13	Position feedforward gain	Setting range: 0.00–120.00% For pulse train reference only (in position control)	100.00%	○
P21.14	Position feedforward filter time constant	Setting range: 0.0–3200.0ms For pulse train reference only (in position control)	3.0ms	○
P21.15	Position command filter time constant	Setting range: 0.0–3200.0ms	0.0ms	◎
P21.16	Digital positioning mode	Setting range: 0x0000–0xFFFF Bit 0: Positioning mode selection 0: Relative position 1: Absolute position (Origin mode. This function is reserved.) Bit 1: Positioning cycle selection 0: Terminal-based cyclic positioning 1: Automatic cyclic positioning Bit 2: Cyclic mode 0: Continuous 1: Reciprocating (Only supported during automatic cyclic positioning) Bit 3: P21.17 digital setting mode 0: Incremental 1: Position type (does not support continuous mode) Bit 4: Origin searching mode. This function is reserved.	0x0000	○

Function code	Name	Description	Default	Modify
		0: Search for the origin only once 1: Search for the origin in every time of running Bit 5: Origin calibration mode. This function is reserved. 0: Real-time calibration 1: Single calibration Bit 6: Positioning completion signal selection 0: Valid in the positioning completion signal holding time (P21.25) 1: Always valid Bit 7: Initial positioning selection 0: Invalid 1: Valid Bit 8: Positioning enable signal selection 0: Pulse signal 1: Electrical level signal Bit 9: Position source 0: P21.17 1: PROFIBUS/CANopen communication Bit10: Indicates whether to save encoder pulse count value at power failure 0: Do not save 1: Save Bit 11: Reserved Bit 12: Positioning curve selection (Reserved) 0: Linear 1: S curve Bit 13–Bit 15: Reserved		
P21.17	Position reference for digital positioning	Used to set the position for digital positioning. Setting range: 0–65535	0	○

Function code	Name	Description	Default	Modify
P21.18	Positioning speed setting selection	Setting range: 0–8 0: Setting of P21.19 1: AI1 2: AI2 3: EAI3 4: Reserved 5: Reserved 6: EAI5 7: EAI6 8: EAI7	0	○
P21.19	Positioning speed digits	Setting range: 0.0–100.0% (of the max. output frequency)	20.0%	○
P21.20	Positioning ACC time	The function code is used to set the ACC/DEC time in the positioning process. Positioning ACC time means the time needed if the drive speeds up from 0Hz to the max. output frequency (P00.03). Setting range: 0.00–300.00s	3.00s	○
P21.21	Positioning DEC time	The function code is used to set the ACC/DEC time in the positioning process. Positioning DEC time means the time needed if the drive speeds down from the max. output frequency (P00.03) to 0Hz. Setting range: 0.00–300.00s	3.00s	○
P21.22	Hold time of positioning reached	The function code is used to set the holding time after the destination position is reached. Setting range: 0.000–60.000s	0.100s	○
P21.23	Origin search speed	Setting range: 0.00Hz–P00.03	2.00Hz	○
P21.24	Origin position offset	Setting range: 0–65535	0	○
P21.25	Hold time of positioning completion signal	Time for holding the positioning completion signal. This parameter is also valid for the positioning completion signal of spindle accurate stop. Setting range: 0.000–60.000s	0.200s	○

Function code	Name	Description	Default	Modify
P21.26	Pulse superposition value	The function is valid in the pulse speed reference (P00.06=12) or pulse position mode (P21.00=1). 1. Input terminal function 68 (Pulse superposition enable) When the rising edge of the terminal is detected, add the value set in P21.26 to the set pulse value, and compensate to the pulse reference channel based on the pulse superposition speed set in P21.27. 2. Input terminal function 67 (Pulse increment) When the terminal is valid, superpose the pulse value to the pulse reference channel based on the pulse superposition speed set in P21.27. **Note:** Terminal filter P05.09 may affect the actual superposed value. 3. Input terminal function 69 (Pulse decrement) The timing sequence of this value is the same as that of the previous value, with the only difference that the number is negative. **Note:** The pulses mentioned above are superposed to A2 and B2 of pulse reference channel. Functions such as filtering and electronic gear are still valid for superposed pulses. 4. Output terminal function 28 (In pulse superposition) The output terminal is valid during pulse superposition, but it is invalid after pulse superposition is completed. Setting range: 0–65535	0	○
P21.27	Pulse superposition speed	Setting range: 0.0–6553.5pulse/ms	8.0 pulse/ms	○
P21.28	ACC/DEC time after pulse inhibition	Setting range: 0.0–3000.0s	5.0s	○

Function code	Name	Description	Default	Modify
P21.29	Speed feedforward filter time constant (pulse train speed mode)	Filter time constant detected by the pulse train when the speed reference source is set to the pulse train (P00.06=12 or P00.07=12). Setting range: 0.0–3200.0ms	10.0ms	○
P21.30	Numerator of the 2nd command ratio	Setting range: 1–65535	1000	○
P21.31	Pulse reference speed measuring method	Setting range: 0–2 0: Main control board 1: PG card 2: Hybrid	0	○
P21.32	Pulse reference feedforward source	Setting range: 0x0–0x1	0x0	◎
P21.33	Clear encoder counting Setting	Setting range: 0–65535	0	◎
P21.34–P21.35	Reserved	-	-	-

Group P23—Vector control group 2

Function code	Name	Description	Default	Modify
P23.00	Group 2 speed-loop proportional gain 1	Setting range: 0.0–200.0	8.0	○
P23.01	Group 2 speed-loop integral time 1	Setting range: 0.000–10.000s	0.200s	○
P23.02	Low-point frequency for switching	Setting range: 0.00Hz–P23.05	10.00Hz	○

Function code	Name	Description	Default	Modify
P23.03	Group 2 speed-loop proportional gain 2	Setting range: 0.0–200.0	8.0	○
P23.04	Group 2 speed-loop integral time 2	Setting range: 0.000–10.000s	0.200s	○
P23.05	High-point frequency for switching	Setting range: P23.02–P00.03(Hz)	10.00Hz	○
P23.06	Speed-loop output filter	Setting range: 0–8	0	○
P23.07	Electromotive slip compensation coefficient of vector control	Setting range: 50–200%	100%	○
P23.08	Braking slip compensation coefficient of vector control	Setting range: 50–200%	100%	○
P23.09	Reserved	-	-	-
P23.10	Group 2 current-loop bandwidth	Setting range: 0–2000	400	○
P23.11	Group 2 speed-loop differential gain	Setting range: 0.00–10.00	0.00	○
P23.12	Reserved	-	-	-
P23.13	Group 2 speed-loop overshoot suppression gain	Setting range: 0–700	100	◎
P23.14–P23.19	Reserved	-	-	-

Group P25—I/O card input functions

Function code	Name	Description	Default	Modify
P25.00	Reserved	-	-	-
P25.01	Function of EDI5	Same as the description for P05.01.	0	◎
P25.02	Function of EDI6		0	◎
P25.03	Function of EDI7		0	◎
P25.04	Function of EDI8		0	◎
P25.05	Function of EDI9		0	◎
P25.06	Function of EDI10		0	◎
P25.07	Reserved		-	-
P25.08	Expansion card input terminal polarity selection	Setting range: 0x00–0x7F Bit0: EDI5 Bit1: EDI6 Bit2: EDI7 Bit3: EDI8 Bit4: EDI9 Bit5: EDI10 Bit6: Reserved	0x00	○
P25.09	Expansion card virtual terminal setting	Setting range: 0x00–0x7F (0: disable; 1: enable) Bit0: EDI5 Bit1: EDI6 Bit2: EDI7 Bit3: EDI8 Bit4: EDI9 Bit5: EDI10 Bit6: Reserved	0x00	◎
P25.10–P25.11	Reserved	The function code is used to define the delay time corresponding to the electrical level changes when the programmable input terminals switch on or switch off. Setting range: 0.000–50.000s	-	-
P25.12	EDI5 switch-on delay		0.000s	○
P25.13	EDI5 switch-off delay		0.000s	○
P25.14	EDI6 switch-on delay		0.000s	○
P25.15	EDI6 switch-off delay		0.000s	○
P25.16	EDI7 switch-on delay		0.000s	○
P25.17	EDI7 switch-off delay		0.000s	○
P25.18	EDI8 switch-on delay		0.000s	○
P25.19	EDI8 switch-off delay		0.000s	○
P25.20	EDI9 switch-on delay		0.000s	○

Function code	Name	Description	Default	Modify
P25.21	EDI9 switch-off delay		0.000s	○
P25.22	EDI10 switch-on delay		0.000s	○
P25.23	EDI10 switch-off delay		0.000s	○
P25.24	EAI3 lower limit	Setting range: 0.00V–P25.26	0.00V	○
P25.25	Corresponding setting of EAI3 lower limit	Setting range: -300.0–300.0%	0.0%	○
P25.26	EAI3 upper limit	Setting range: P25.24–10.00V	10.00V	○
P25.27	Corresponding setting of EAI3 upper limit	Setting range: -300.0–300.0%	100.0%	○
P25.28	EAI3 input filter time	Setting range: 0.000–10.000s	0.030s	○
P25.29	EAI4 lower limit	Setting range: 0.00V–P25.31	0.00V	○
P25.30	Corresponding setting of EAI4 lower limit	Setting range: -300.0–300.0%	0.0%	○
P25.31	EAI4 upper limit	Setting range: P25.29–10.00V	10.00V	○
P25.32	Corresponding setting of EAI4 upper limit	Setting range: -300.0–300.0%	100.0%	○
P25.33	EAI4 input filter time	The function code is used to adjust the sensitivity of analog input. Increasing the value properly can enhance analog input anti-interference but may reduce the sensitivity of analog input. Setting range: 0.000s–10.000s	0.030s	○
P25.34–P25.39	Reserved	-	-	-
P25.40	EAI3 input signal type selection	Setting range: 0–1 0: Voltage 1: Current	0	○
P25.41	EAI4 input signal type selection	Setting range: 0–1 0: Voltage 1: Current	0	○
P25.42	EAI5 lower limit	Setting range: -10.00V–P25.44	-10.00V	○
P25.43	Corresponding setting of EAI5 lower limit	Setting range: -300.0–300.0%	-100.0%	○
P25.44	EAI5 middle value 1	P25.42–P25.46 (V)	0.00V	○

Function code	Name	Description	Default	Modify
P25.45	Corresponding setting of EAI5 middle value 1	Setting range: -300.0–300.0%	0.0%	○
P25.46	EAI5 middle value 2	Setting range: P25.44–P25.48(V)	0.00V	○
P25.47	Corresponding setting of EAI5 middle value 2	Setting range: -300.0–300.0%	0.0%	○
P25.48	EAI5 upper limit	Setting range: P25.46–10.00V	10.00V	○
P25.49	Corresponding setting of EAI5 upper limit	Setting range: -300.0–300.0%	100.0%	○
P25.50	EAI5 input filter time	Setting range: 0.000–10.000s	0.030s	○
P25.51	EAI6 lower limit	Setting range: -10.00V–P25.53	-10.00V	○
P25.52	Corresponding setting of EAI6 lower limit	Setting range: -300.0–300.0%	-100.0%	○
P25.53	EAI6 middle value 1	Setting range: P25.51–P25.55(V)	0.00V	○
P25.54	Corresponding setting of EAI6 middle value 1	Setting range: -300.0–300.0%	0.0%	○
P25.55	EAI6 middle value 2	Setting range: P25.53–P25.57(V)	0.00V	○
P25.56	Corresponding setting of EAI6 middle value 2	Setting range: -300.0–300.0%	0.0%	○
P25.57	EAI6 upper limit	Setting range: P25.55–10.00V	10.00V	○
P25.58	Corresponding setting of EAI6 upper limit	Setting range: -300.0–300.0%	100.0%	○
P25.59	EAI6 input filter time	Setting range: 0.000–10.000s	0.030s	○
P25.60	EAI7 lower limit	Setting range: -10.00V–P25.62	-10.00V	○
P25.61	Corresponding setting of EAI7 lower limit	Setting range: -300.0–300.0%	-100.0%	○
P25.62	EAI7 middle value 1	Setting range: P25.60–P25.64(V)	0.00V	○
P25.63	Corresponding setting of EAI7 middle value 1	Setting range: -300.0–300.0%	0.0%	○

Function code	Name	Description	Default	Modify
P25.64	EAI7 middle value 2	Setting range: P25.62–P25.66(V)	0.00V	○
P25.65	Corresponding setting of EAI7 middle value 2	Setting range: -300.0–300.0%	0.0%	○
P25.66	EAI7 upper limit	Setting range: P25.64–10.00V	10.00V	○
P25.67	Corresponding setting of EAI7 upper limit	Setting range: -300.0–300.0%	100.0%	○
P25.68	EAI7 input filter time	Setting range: 0.000–10.000s	0.030s	○
P25.69	EAI5 input signal type selection	Setting range: 0–1 0: Voltage 1: Current	0	○
P25.70	EAI6 input signal type selection	Setting range: 0–1 0: Voltage 1: Current	0	○
P25.71	EAI7 input signal type selection	Setting range: 0–1 0: Voltage 1: Current	0	○

Group P26—I/O card output functions

Function code	Name	Description	Default	Modify
P26.00	Reserved	-	-	-
P26.01	Reserved	Same as the description for P06.01	-	-
P26.02	EY2 output selection		0	○
P26.03	EY3 output selection		0	○
P26.04	ERO3 output		0	○
P26.05	ERO4 output		0	○
P26.06	ERO5 output		0	○
P26.07	ERO6 output		0	○
P26.08	ERO7 output		0	○
P26.09	ERO8 output		0	○
P26.10	ERO9 output		0	○
P26.11	ERO10 output		0	○
P26.12	Expansion card output terminal polarity selection	Setting range: 0x0000–0x1FFF Bit0: EY2 Bit1: EY3 Bit2: Reserved	0x0000	○

Function code	Name	Description	Default	Modify
		Bit3: ERO3 Bit4: ERO4 Bit5: ERO5 Bit6: ERO6 Bit7: ERO7 Bit8: ERO8 Bit9: ERO9 Bit10: ERO10 Bit11: ERO11 Bit12: ERO12		
P26.13	Reserved	-	-	-
P26.14	Reserved	-	-	-
P26.15	EY2 switch-on delay	The function code is used to define the delay time corresponding to the electrical level changes when the programmable output terminals switch on or switch off. Setting range: 0.000–50.000s	0.000s	○
P26.16	EY2 switch-off delay		0.000s	○
P26.17	EY3 switch-on delay		0.000s	○
P26.18	EY3 switch-off delay		0.000s	○
P26.19	ERO3 switch-on delay		0.000s	○
P26.20	ERO3 switch-off delay		0.000s	○
P26.21	ERO4 switch-on delay		0.000s	○
P26.22	ERO4 switch-off delay	The function code is used to define the delay time corresponding to the electrical level changes when the programmable output terminals switch on or switch off. Setting range: 0.000–50.000s	0.000s	○
P26.23	ERO5 switch-on delay		0.000s	○
P26.24	ERO5 switch-off delay		0.000s	○
P26.25	ERO6 switch-on delay		0.000s	○
P26.26	ERO6 switch-off delay		0.000s	○
P26.27	ERO7 switch-on delay		0.000s	○
P26.28	ERO7 switch-off delay		0.000s	○
P26.29	ERO8 switch-on delay		0.000s	○
P26.30	ERO8 switch-off delay		0.000s	○
P26.31	ERO9 switch-on delay		0.000s	○
P26.32	ERO9 switch-off delay		0.000s	○
P26.33	ERO10 switch-on delay		0.000s	○
P26.34	ERO10 switch-off delay		0.000s	○
P26.35	EAO2 output selection	Same as the description for P06.14	0	○
P26.36	EAO3 output selection		0	○
P26.37	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P26.38	EAO2 output lower limit	Setting range: -300.0%–P26.40	0.0%	○
P26.39	EAO2 output corresponding to lower limit	Setting range: 0.00–10.00V	0.00V	○
P26.40	EAO2 output upper limit	Setting range: P26.38–300.0%	100.0%	○
P26.41	EAO2 output corresponding to upper limit	Setting range: 0.00–10.00V	10.00V	○
P26.42	EAO2 output filter time	Setting range: 0.000–10.000s	0.000s	○
P26.43	EAO3 output lower limit	Setting range: -300.0%–P26.45	0.0%	○
P26.44	EAO3 output corresponding to lower limit	Setting range: 0.00–10.00V	0.00V	○
P26.45	EAO3 output upper limit	Setting range: P26.43–300.0%	100.0%	○
P26.46	EAO3 output corresponding to upper limit	Setting range: 0.00–10.00V	10.00V	○
P26.47	EAO3 output filter time	Setting range: 0.000–10.000s	0.000s	○
P26.48	EAO4 output selection	Same as the description for P06.14.	0	○
P26.49	EAO4 output lower limit	Setting range: -300.0%–P26.51	0.0%	○
P26.50	EAO4 output corresponding to lower limit	Setting range: 0.00–10.00V	0.00V	○
P26.51	EAO4 output upper limit	Setting range: P26.49–300.0%	100.0%	○
P26.52	EAO4 output corresponding to upper limit	Setting range: 0.00–10.00V	10.00V	○
P26.53	EAO4 output filter time	Setting range: 0.000–10.000s	0.000s	○

Group P28—Master/slave control functions (CAN master/slave expansion card)

Function code	Name	Description	Default	Modify
P28.00	Master/slave mode selection	Setting range: 0–2 0: Master/slave control is invalid. 1: The local device is the master. 2: The local device is the slave.	0	◎
P28.01	Master/slave communication data selection	Setting range: 0–1 0: CAN 1: Reserved	0	◎
P28.02	Master/slave control mode	Setting range: 0x000–0x112 Ones place: Master/slave running mode selection 0: Master/slave mode 0 1: Master/slave mode 1 2: Master/slave mode 2 Tens place: Slave start command source 0: Starts with the master 1: Determined by P00.01 Hundreds place: Slave transmitting/master receiving data 0: Enable 1: Disable	0x001	◎
P28.03	Slave speed gain	Setting range: 0.0–500.0%	100.0%	○
P28.04	Slave torque gain	Setting range: 0.0–500.0%	100.0%	○
P28.05	Frequency point for switching between speed mode and torque mode in master/slave mode 2	Setting range: 0.00Hz–P00.03	5.00Hz	○
P28.06	Number of slaves	Setting range: 0–15	1	◎
P28.07–P28.08	Reserved	-	-	-
P28.09	CAN slave torque offset	Setting range: -100.0–100.0%	0.0%	○

Function code	Name	Description	Default	Modify
P28.10–P28.29	Reserved	-	-	-
P28.30	EAI temperature detection channel selection	0–3 0: No temperature sensor 1: EAI5 2: EAI6 3: EAI7	0	○
P28.31	Type of sensor for EAI to detect motor temperature	0–7 0: No temperature sensor 1: PT100 2: PT1000 (single resistor) 3: Reserved 4: KTY84-130 (single resistor) 5: Reserved 6: PTC130 (single resistor) 7: PTC130 (three resistors)	0	○
P28.32	EAI detected OT protection threshold	0.0–200.0°C	130.0	○
P28.33	EAI detected OT pre-alarm threshold	0.0–200.0°C	90.0	○
P28.34	EAI PTC alarm threshold resistance	0–60000	1315	○
P28.35	EAI PTC alarm recovery resistance	0–60000	170	○
P28.36	EAI PT temperature measurement input filter time	0.000–10.000(s)	0.000	○
P28.37	EAI PT temperature compensation	-60.0–60.0°C	0.0	○
P28.38–P28.39	Reserved	-	-	-

Group P73—Electro-hydraulic basic control functions

Function code	Name	Description	Default	Modify
P73.00	Hydraulic control mode	Setting range: 0–1 0: Non-hydraulic mode 1: Hydraulic mode	0	◎
P73.01	Pressure and flow command source selection	Setting range: 0–10 0: Keypad 1: Analog setting 1 (AI1 for pressure, AI2 for flow) 2: Analog setting 2 (AI2 for pressure, AI1 for flow) 3: Internal multi-step 4: Modbus communication 5: Profinet/CANopen/EtherCAT communication 6–8: Reserved 9: Analog setting 3 (EAI5 for pressure, EAI6 for flow) 10: Analog setting 4 (EAI6 for pressure, EAI5 for flow)	2	◎
P73.02	Keypad pressure set value	Setting range: 0.0–750.0bar	0.0bar	○
P73.03	Keypad flow set value	Setting range: 0.0–2400.0L/min	0.0L/min	○
P73.04	Max. local reference pressure	Setting range: 0.0bar–P73.71	250.0bar	○
P73.05	Max. local output flow	Setting range: 0.0–P73.36L/min	250.0L/min	○
P73.06	Full-scale reference pressure	Setting range: 0.0–750.0bar	175.0bar	○
P73.07	Full-scale reference flow	Setting range: 0.0–2400.0L/min	200.0L/min	○
P73.08	Pressure command 1 rise time	Setting range: 0.000–60.000s	0.100s	○
P73.09	Pressure command 1 fall time		0.120s	○
P73.10	Rise time of low-speed flow command 1		0.060s	○
P73.11	Fall time of low-speed flow command 1		0.060s	○
P73.12	High-speed flow threshold 1	Setting range: 0.0–100.0%	100.0%	○

Function code	Name	Description	Default	Modify
P73.13	Rise time of high-speed flow command 1	Setting range: 0.000–60.000s	0.000s	○
P73.14	Fall time of high-speed flow command 1		0.000s	○
P73.15	Rising S-curve filter time of pressure command 1		0.050s	○
P73.16	Falling S-curve filter time of pressure command 1		0.050s	○
P73.17	Rising S-curve filter time of flow command 1		0.000s	○
P73.18	Falling S-curve filter time of flow command 1		0.000s	○
P73.19	Delay time of flow and pressure command 1		0.000s	○
P73.20	Pressure command 2 rise time	Setting range: 0.000–60.000s	0.100s	○
P73.21	Pressure command 2 fall time		0.120s	○
P73.22	Rise time of low-speed flow command 2		0.060s	○
P73.23	Fall time of low-speed flow command 2		0.060s	○
P73.24	High-speed flow threshold 2	Setting range: 0.0–100.0%	100.0%	○
P73.25	Rise time of high-speed flow command 2	Setting range: 0.000–60.000s	0.000s	○
P73.26	Fall time of high-speed flow command 2		0.000s	○
P73.27	Rising S-curve filter time of pressure command 2		0.050s	○
P73.28	Falling S-curve filter time of pressure command 2		0.050s	○
P73.29	Rising S-curve filter time of flow command 2		0.000s	○
P73.30	Falling S-curve filter time of flow command 2		0.000s	○
P73.31	Delay time of flow and pressure command 2		0.000s	○
P73.32	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P73.33	Base flow enabling	Setting range: 0–1 0: Disable 1: Enable	0	○
P73.34	Base flow pressure	Setting range: 0.0–500.0bar	3.0bar	○
P73.35	Base flow rate	Setting range: 0.0–2400.0L/min	3.6L/min	○
P73.36	Max. local output flow	Setting range: 0.0–2400.0L/min	250.0L/min	●
P73.37	Pump displacement	Setting range: 0.0–3000.0mL/r	100.0mL/r	○
P73.38	Pump displacement coefficient	Setting range: 0.0–100.0%	100.0%	○
P73.39	Min. pump speed	Setting range: -2000rpm–P73.40 (a negative value indicates reverse rotation)	-300rpm	○
P73.40	Max. motor speed	Setting range: 0–6000rpm	2500rpm	◎
P73.41–P73.42	Reserved	-	-	-
P73.43	Swash plate switching speed	Setting range: 0.0–3000.0rpm	400.0rpm	○
P73.44	Swash plate switching pressure	Setting range: 0.0–750.0bar	150.0bar	○
P73.45	Decision delay for swash plate displacement switching	Setting range: 0.000–30.000s	0.100s	○
P73.46–P73.48	Reserved	-	-	-
P73.49	Hydraulic circuit pressure relief method	Setting range: 0–1 0: Reverse rotation pressure relief 1: Hydraulic circuit pressure relief	0	○
P73.50	Reserved	-	-	-
P73.51	Opening speed of hydraulic valve during pressure relief	Setting range: -300.0–300.0rpm	25.0rpm	○
P73.52	Opening pressure deviation of hydraulic valve during pressure relief	Setting range: 0.0–500.0bar	30.0bar	○

Function code	Name	Description	Default	Modify
P73.53	Closing pressure deviation of hydraulic valve during pressure relief	Setting range: 0.0bar–P73.52	27.0bar	○
P73.54	Low-pressure opening pressure deviation of hydraulic valve during pressure relief	Setting range: 0.0–500.0bar	10.0bar	○
P73.55	Low-pressure closing pressure deviation of hydraulic valve during pressure relief	Setting range: 0.0bar–P73.54	5.0bar	○
P73.56	Opening delay of hydraulic valve during pressure relief	Setting range: 0.000–30.000s	0.000s	○
P73.57	Closing delay of hydraulic valve during pressure relief		0.000s	○
P73.58–P73.63	Reserved	-	-	-
P73.64	Servo motor model MSB	Setting range: 0.00–655.35	0.00	◎
P73.65	Servo motor model LSB		0.00	◎
P73.66	Servo motor direction selection	Setting range: 0–1 0: Forward 1: Reverse	0	◎
P73.67	Reserved	-	-	-
P73.68	Motor temperature sensor type	Setting range: 0–7 0: No temperature sensor 1: Reserved 2: PT1000 (single resistor, approximately 1.1kΩ at 25°C) 3: PT1000 (three resistors, approximately 3.2kΩ at 25°C) 4: KTY84-130 (single resistor, approximately 0.6kΩ at 25°C) 5: KTY84-130 (three resistors, approximately 1.8kΩ at 25°C) 6: PTC130 (single resistor) 7: PTC130 (three resistors)	4	◎

Function code	Name	Description	Default	Modify
P73.69	Detected motor OT protection threshold	Setting range: 0–150°C	130°C	○
P73.70	Detected motor OT pre-alarm threshold		90°C	○
P73.71	Pressure sensor range	Setting range: 0.0–750.0bar	250.0bar	◎
P73.72	Pressure sensor type	Setting range: 0–3 0: 0.00–10.00V (voltage type) 1: 0–20mA (current type) 2: 1.00–5.00V (voltage type) 3: 4–20mA (current type)	0	◎
P73.73	Pressure sensor disconnection action	Setting range: 0–2 0: Report a fault and stop 1: Alarm and switch to speed mode 2: Reserved	0	○
P73.74	Speed selection for pressure–speed mode switching	Setting range: 0–2 0: Run at speed corresponding to base flow 1: Run at speed set by P73.75 2: Reserved	0	○
P73.75	Speed setting for pressure–speed mode switching	Setting range: 0–P73.40(rpm)	1500rpm	○
P73.76	Hydraulic overpressure time	Setting range: 0.0–60.0s	0.5s	○
P73.77	Hydraulic overpressure set value	Setting range: 0.0–750.0bar	230.0bar	○
P73.78	Threshold for hydraulic pressure reached	Setting range: 0.0–100.0%	90.0%	○
P73.79	Threshold for hydraulic pressure not reached	Setting range: 0.0–100.0%	40.0%	○
P73.80	Stop pressure threshold 1	Setting range: 0.0%–P73.82	1.6%	○
P73.81	Stop speed threshold	Setting range: 0.0–50.0%	0.3%	○
P73.82	Stop pressure threshold 2	Setting range: P73.80–100.0%	6.0%	○
P73.83	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P73.84	Hydraulic pump stall fault detection	Setting range: 0–1 0: Disable 1: Enable	0	○
P73.85	Hydraulic pump stall fault detection time	Setting range: 3.500–20.000s	5.000s	○
P73.86–P73.94	Reserved	-	-	-

Group P74—Electro-hydraulic dedicated PID functions

Function code	Name	Description	Default	Modify
P74.00	Enabling speed-loop multi-step PI	Setting range: 0x00–0x11 Ones place: Pressure relief speed-loop switchover selection 0: Disable 1: Enable Tens place: Hydraulic mode speed-loop switchover selection 0: Disable 1: Enable	0x00	◎
P74.01	Pressure multi-step PI selection	Setting range: 0x000–0x111 Ones place: High/low pressure PI switchover selection 0: Disable 1: Enable Tens place: Pressure build-up and pressure holding PI switchover selection 0: Disable 1: Enable Hundreds place: Reserved 0: Reserved 1: Reserved	0x000	◎

Function code	Name	Description	Default	Modify
P74.02	Pressure-loop proportional gain 1	Proportional gain setting range: 0.000–40.000 Integral gain setting range: 0.001–10.000	10.000	○
P74.03	Pressure-loop integral gain 1		0.100	○
P74.04	Pressure-loop proportional gain 2		10.000	○
P74.05	Pressure-loop integral gain 2		0.100	○
P74.06	Pressure-loop proportional gain 3		10.000	○
P74.07	Pressure-loop integral gain 3		0.100	○
P74.08	Pressure-loop proportional gain 4		10.000	○
P74.09	Pressure-loop integral gain 4		0.100	○
P74.10	Low pressure threshold 1	Setting range: 0.0bar–P74.11	50.0bar	○
P74.11	High pressure threshold 1	Setting range: 0.0–500.0bar	100.0bar	○
P74.12	Low-pressure pressure-loop proportional gain 1	Proportional gain setting range: 0.000–40.000 Integral gain setting range: 0.001–10.000	10.000	○
P74.13	Low-pressure pressure-loop integral gain 1		0.100	○
P74.14	High-pressure pressure-loop proportional gain 1		10.000	○
P74.15	High-pressure pressure-loop integral gain 1		0.100	○
P74.16	Reserved	-	-	-
P74.17	Pressure feedback filter time for pressure holding judgment	Setting range: 0.000–5.000s	0.005s	○
P74.18	Pressure deviation threshold for pressure holding judgment	Setting range: 0.0–20.0bar	3.0bar	○

Function code	Name	Description	Default	Modify
P74.19	Speed threshold for pressure holding judgment	Setting range: 0–1000r/min	200r/min	○
P74.20	Reserved	-	-	-
P74.21	Pressure-holding pressure-loop proportional gain 1	Proportional gain setting range: 0.000–40.000 Integral time setting range: 0.001–10.000	10.000	○
P74.22	Pressure-holding pressure-loop integral gain 1		0.100	○
P74.23	Pressure-holding pressure-loop proportional gain 2		10.000	○
P74.24	Pressure-holding pressure-loop integral gain 2		0.100	○
P74.25	Pressure-holding pressure-loop proportional gain 3		10.000	○
P74.26	Pressure-holding pressure-loop integral time 3		0.100	○
P74.27–P74.28	Reserved	-	-	-
P74.29	Pressure relief speed-loop proportional gain 1	Proportional gain setting range: 0.0–200.0 Integral time setting range: 0.020–10.000s	8.0	○
P74.30	Pressure relief speed-loop integral time 1		0.200s	○
P74.31	Pressure relief speed-loop proportional gain 2		8.0	○
P74.32	Pressure relief speed-loop integral time 2		0.200s	○
P74.33	Pressure overshoot suppression gain	0.00–400.00	0.00	○
P74.34–P74.66	Reserved	-	-	-

Function code	Name	Description	Default	Modify
P74.67	Internal reference pressure 1	Internal reference pressure setting range: 0.0bar–P73.04 Internal reference flow setting range: 0.0L/min–P73.05	20.0bar	○
P74.68	Internal reference flow 1		20.0L/min	○
P74.69	Internal reference pressure 2		40.0bar	○
P74.70	Internal reference flow 2		40.0L/min	○
P74.71	Internal reference pressure 3		60.0bar	○
P74.72	Internal reference flow 3		60.0L/min	○
P74.73	Internal reference pressure 4		80.0bar	○
P74.74	Internal reference flow 4		80.0L/min	○
P74.75	Internal reference pressure 5		100.0bar	○
P74.76	Internal reference flow 5		100.0L/min	○
P74.77	Internal reference pressure 6		120.0bar	○
P74.78	Internal reference flow 6		120.0L/min	○
P74.79	Internal reference pressure 7		140.0bar	○
P74.80	Internal reference flow 7		140.0L/min	○
P74.81	Internal reference pressure 8		160.0bar	○
P74.82	Internal reference flow 8		160.0L/min	○

Group P75—Electro-hydraulic enhanced functions

Function code	Name	Description	Default	Modify
P75.00	Local CAN function switching	Setting range: 0–2 0: Local CAN communication is invalid 1: CAN master/slave 2: CANopen communication	0	◎
P75.01	Reserved	-	-	-
P75.02	Local CAN master/slave address	Setting range: 0–15	0	◎

Function code	Name	Description	Default	Modify
P75.03	Multi-pump slave node count	Setting range: 0–15	0	◎
P75.04	Flow combining type	Setting range: 0–4 0: Single pump 1: Hybrid 2: Multiple pumps 3: Communication with two modes 4: Communication with four modes	1	○
P75.05	Local CAN network enabling	Setting range: 0–1 0: Disable 1: Enable	0	○
P75.06	Local CAN baud rate	Same as the description for P15.29.	4	◎
P75.07	Local CAN timeout time	Setting range: 0.0–60.0s	0.5s	○
P75.08	Multi-pump flow cut-in threshold	Setting range: 0.0–100.0%	0.0%	○
P75.09	Multi-pump flow cut-in hysteresis upper limit	Setting range: 0.0–100.0%	8.0%	○
P75.10	Multi-pump flow cut-in hysteresis lower limit	Setting range: 0.0%–P75.09	5.0%	○
P75.11	Multi-pump slave flow splitting and combining 1	Setting range: 0x0000–0xFFFF	0x0000	○
P75.12	Multi-pump slave flow splitting and combining 2	Setting range: 0x0000–0xFFFF	0x0000	○
P75.13	Multi-pump slave flow splitting and combining 3	Setting range: 0x0000–0xFFFF	0x0000	○
P75.14	Multi-pump slave flow splitting and combining 4	Setting range: 0x0000–0xFFFF	0x0000	○
P75.15	Master action selection on multi-pump slave fault	Setting range: 0x00–0x11 Ones place: slave offline 0: Report an alarm 1: Report a fault Tens place: slave fault 0: Report an alarm 1: Report a fault	0x11	○

Function code	Name	Description	Default	Modify
P75.16	Multi-pump speed gain	0.1–3000.0	100.0	○
P75.17–P75.21	Reserved	-	-	-
P75.22	Stall overload time	0.0–10.0s **Note:** Valid only for synchronous motors in FVC mode.	0.2s	○
P75.23	Pressure feedback filter time	0.000–10.000s	0.000	○
P75.24	Analog channel zero-drift autotuning	Setting range: 0–4 0: Invalid 1: AI1–AI3 zero-drift autotuning 2: AI1 zero-drift autotuning 3: AI2 zero-drift autotuning 4: AI3 zero-drift autotuning	0	◎
P75.25	Pressure feedback zero-drift calibration value	Setting range: -5000–5000	0	○
P75.26	Low-frequency overload coefficient	Setting range: 1–250% **Note:** The larger the value, the longer the overload time.	100%	○
P75.27	Speed/frequency LED display switch	Setting range: 0–1 0: Display frequency during standby and operation 1: Display speed during standby and operation	0	○
P75.28	Look-up table selection	Setting range: 0–1 0: Disable 1: Enable	0	◎
P75.29	Flux weakening voltage margin	0.0–10.0%	2.0	○
P75.30	Voltage loop filter count	0–15	2	○
P75.31	Uq filter count	0–15	5	○
P75.32	Voltage loop integral gain	0.00–100.00%	10.00	○
P75.33	Reserved	-	-	●
P75.34	Resolver filter time	0.000–2.000s	0.000	○

Function code	Name	Description	Default	Modify
P75.35	Resolver filter threshold	0.0–5.0	2.0	○
P75.36	Hydraulic pressure load torque compensation coefficient	0.0–150.0%	0.0	○
P75.37	Group 1 pressure fluctuation suppression	0–60000	0	○
P75.38	Pressure fluctuation suppression filter count 1	0–15	0	○
P75.39	Pressure fluctuation suppression filter count 2	0–15	0	○
P75.40	Group 2 pressure fluctuation suppression	0–60000	0	○
P75.41–P75.51	Reserved	-	-	-

Group P76—Electro-hydraulic status viewing

Function code	Name	Description	Default	Modify
P76.00	Local flow set value	Displays the current flow set value of the drive. Range: 0.0–2400.0L/min	0.0L/min	●
P76.01	Local flow command value	Displays the current flow command value of the drive. Range: -2400.0–2400.0L/min	0.0L/min	●
P76.02	Local pressure set value	Displays the current pressure set value of the drive. Range: 0.0–750.0bar	0.0bar	●
P76.03	Local pressure command value	Displays the current pressure set value of the drive. Range: 0.0–750.0bar	0.0bar	●

Function code	Name	Description	Default	Modify
P76.04	Local pressure feedback value	Displays the current pressure feedback value of the drive. Range: 0.0–750.0bar	0.0bar	●
P76.05	Multi-pump system maximum pressure	Displays the current maximum pressure of the multi-pump system. Range: 0.0–750.0bar	0.0bar	●
P76.06	Multi-pump system maximum flow	Displays the current maximum flow of the multi-pump system. Range: 0.0–2400.0L/min	0.0L/min	●
P76.07	Present PID step	Displays the current PID step of the drive. Range: 0–3	0	●
P76.08	Present internal multi-step reference	Displays the current internal multi-step reference value of the drive. Range: 0–8	0	●
P76.09	Flow combining type	Displays the current flow combining type of the drive. Range: 0–3	0	●
P76.10	Multi-pump communication state	Displays the current multi-pump communication state of the drive. Range: 0–15	0	●
P76.11	CAN communication sent count	Displays the current CAN transmit count of the drive. Range: 0–65535	0	●
P76.12	CAN communication receive count	Displays the current CAN receive count of the drive. Range: 0–65535	0	●
P76.13	Motor temperature	Displays the current motor temperature of the drive. Range: -40–150°C	0°C	●
P76.14	AI1 input voltage	The function code is used to display the AI1 input signal. 0.00–10.00V	0.00V	-
P76.15	AI2 input voltage	The function code is used to display the AI2 input signal. -10.00–10.00V	0.00V	●
P76.16	AI3 input voltage	The function code is used to display the AI3 input signal. 0.00–10.00V	0.00V	●

Function code	Name	Description	Default	Modify
P76.17	Encoder detected speed	The function code is used to indicate the actual-measured encoder speed. The value of forward running is positive; the value of reverse running is negative. -30000–30000rpm	0rpm	●
P76.18	Look-up table actual frequency	-300.00–300.00Hz	0.00Hz	●
P76.19	Voltage loop output	-3000.0–3000.0%	0.0%	●
P76.20	Motor control method	Displays the current motor control method of the drive. Range: 0–2	0	●
P76.21	Electromotive torque limit	Range: 0.0–3000.0N・m	0.0N・m	●
P76.22	Power-generated torque limit	Range: 0.0–3000.0N・m	0.0N・m	●
P76.23	Motor rated torque	Range: 0.0–3000.0N・m	0.0N・m	●
P76.24	Torque reference	Range: -3000.0–3000.0N・m	0.0N・m	●
P76.25	Exciting current reference	Range: -3000.0–3000.0A	0.0A	●
P76.26	Torque current reference	Range: -3000.0–3000.0A	0.0A	●
P76.27	DC bus voltage utilization	Displays the current DC bus voltage utilization of the drive. Range: 0.0–150.0%	0.0%	●
P76.28	CAN slave online state in M/S mode	Displays the currently online slaves on the CAN network. Range: 0x0000–0xFFFF	0x0000	●
P76.29	Electro-hydraulic alarm code	0–65535	0	●
P76.30	Test version number	Displays the current test version number of the drive. Range: 100–65535	100	●
P76.31	AI3 AD sampling value	Displays the current AI3 AD sampling value of the drive. Range: 0–4095	0	●

Function code	Name	Description	Default	Modify
P76.32	Pressure feedback value after zero-drift calibration	Displays the current pressure feedback value after zero-drift calibration. Range: 0–32768	0	●
P76.33	U-phase current (transient value)	Displays the U-phase current transient value. Range: -3000.0–3000.0A	0.0A	●
P76.34	V-phase current (transient value)	Displays the V-phase current transient value. Range: -3000.0–3000.0A	0.0A	●
P76.35	W-phase current (transient value)	Displays the W-phase current transient value. Range: -3000.0–3000.0A	0.0A	●
P76.36	Reserved	-	-	-
P76.37	Hydraulic pressure control performance display	0.0–6553.5	0.0	●
P76.38	AD sampling value from AI1 zero drift detection	Displays the AD sampling value from AI1 zero drift detection. Range: 0–1000	0	●
P76.39	AD sampling error value from AI2 zero drift detection	Displays the AD sampling error value from AI2 zero drift detection. Range: -1000–1000	0	●
P76.40	AD sampling error value from AI3 zero drift detection	Displays the AD sampling error value from AI3 zero drift detection. Range: -1000–1000	0	●
P76.41	Resolver angle error cumulative value	Range: 0–65535	0	●
P76.42	Resolver disconnection cumulative value	Range: 0–65535	0	●
P76.43	Resolver filter cumulative value	0–65535	0	●

Function code	Name	Description	Default	Modify
P76.44	Max. resolver continuous disconnection signal	0–65535	-	●
P76.45	Local resolver type	0–1	0	●
P76.46–P76.49	Reserved	-	-	-

Appendix G Motor model and code table

No.	Series	Motor model	Rated power (kW)	Rated speed (rpm)	P73.64 Manufacturer series. Frame code	P73.65 Power. Speed
1	B series	IMS20B-20M63C15C	6.3	1500	01.20	6.15
2		IMS20B-20M94C15C	9.4	1500	01.20	9.15
3		IMS20B-20M13D15C	12.6	1500	01.20	13.15
4		IMS20B-20M16D15C	15.7	1500	01.20	16.15
5		IMS20B-20M19D15C	18.9	1500	01.20	19.15
6		IMS20B-20M22D15C	22	1500	01.20	22.15
7		IMS20B-20M25D15C	25.1	1500	01.20	25.15
8		IMS20B-20M28D15C	28.3	1500	01.20	28.15
9		IMS20B-26M28D15C	28	1500	01.26	28.15
10		IMS20B-26M35D15C	34.6	1500	01.26	35.15
11		IMS20B-26M41D15C	41	1500	01.26	41.15
12		IMS20B-26M47D15C	47	1500	01.26	47.15
13		IMS20B-26M53D15C	53.4	1500	01.26	53.15
14		IMS20B-26M60D15C	60	1500	01.26	60.15
15		IMS20B-26M78D15C	78	1500	01.26	78.15
16	B series	IMS20B-20M71C17C	7.1	1700	01.20	7.17
17		IMS20B-20M11D17C	10.7	1700	01.20	11.17
18		IMS20B-20M14D17C	14.2	1700	01.20	14.17
19		IMS20B-20M18D17C	17.8	1700	01.20	18.17
20		IMS20B-20M21D17C	21.4	1700	01.20	21.17
21		IMS20B-20M25D17C	24.9	1700	01.20	25.17
22		IMS20B-20M29D17C	28.5	1700	01.20	29.17
23		IMS20B-20M32D17C	32.1	1700	01.20	32.17
24		IMS20B_20M44D25C	44	2500	01.20	44.25
25		IMS20B-26M32D17C	32	1700	01.26	32.17
26		IMS20B-26M39D17C	39	1700	01.26	39.17
27		IMS20B-26M46D17C	46	1700	01.26	46.17
28		IMS20B-26M53D17C	53	1700	01.26	53.17
29		IMS20B-26M61D17C	60.5	1700	01.26	61.17
30		IMS20B-26M68D17C	67.6	1700	01.26	68.17
31		IMS20B-26M86D17C	86	1700	01.26	86.17

No.	Series	Motor model	Rated power (kW)	Rated speed (rpm)	P73.64 Manufacturer series. Frame code	P73.65 Power. Speed
32	B series	IMS20B-20M80C20C	8	2000	01.20	8.20
33		IMS20B-20M12D20C	12.2	2000	01.20	12.20
34		IMS20B-20M17D20C	16.8	2000	01.20	17.20
35		IMS20B-20M20D20C	20	2000	01.20	20.20
36		IMS20B-20M24D20C	24.1	2000	01.20	24.20
37		IMS20B-20M27D20C	27.4	2000	01.20	27.20
38		IMS20B-20M32D20C	31.5	2000	01.20	32.20
39		IMS20B-20M36D20C	35.6	2000	01.20	36.20
40		IMS20B-20M40D20C	40	2000	01.20	40.20
41		IMS20B-26M37D20C	37	2000	01.26	37.20
42		IMS20B-26M45D20C	45	2000	01.26	45.20
43		IMS20B-26M50D20C	49.8	2000	01.26	50.20
44		IMS20B-26M56D25C	56	2500	01.26	56.25
45		IMS20B-26M58D20C	58	2000	01.26	58.20
46		IMS20B-26M65D20C	65	2000	01.26	65.20
47		IMS20B-26M65D25C	65	2500	01.26	65.25
48		IMS20B-26M74D20C	74	2000	01.26	74.20
49		IMS20B-26M82D20C	82	2000	01.26	82.20
50		IMS20B-26M90D20C	90	2000	01.26	90.20
51	A series	IMS20A-36H12E15C	120	1500	02.36	120.15
52		IMS20A-36H13E15C	139	1500	02.36	139.15
53		IMS20A-36H16E15C	160	1500	02.36	160.15
54		IMS20A-26H77D15C	77.3	1500	02.26	77.15
55		IMS20A-26H86D15C	85.6	1500	02.26	86.15
56		IMS20A-26H76D17C	76	1700	02.26	76.17
57		IMS20A-26H86D17C	86.3	1700	02.26	86.17
58		IMS20A-26H96D17C	96.1	1700	02.26	96.17
59		IMS20A-26H89D20C	88.6	2000	02.26	89.20
60	Express series	E01004F153	7.9	1500	08.20	8.15
61		E01005F153	12	1500	08.20	12.15
62		E01007F153	16	1500	08.20	16.15
63		E01008F153	20	1500	08.20	20.15
64		E01010F153	23	1500	08.20	23.15
65		E01012F153	27	1500	08.20	27.15
66		E01013F153	30	1500	08.20	30.15

No.	Series	Motor model	Rated power (kW)	Rated speed (rpm)	P73.64 Manufacturer series. Frame code	P73.65 Power. Speed
67	Express series	E01215F153	32	1500	08.26	32.15
68		E01220F153	40	1500	08.26	40.15
69		E01225F153	47	1500	08.26	47.15
70		E01230F153	55	1500	08.26	55.15
71		E01235F153	62	1500	08.26	62.15
72		E01240F153	69	1500	08.26	69.15
73		E01004F173	9	1700	08.20	9.17
74		E01005F173	13	1700	08.20	13.17
75		E01007F173	18	1700	08.20	18.17
76		E01008F173	22	1700	08.20	22.17
77		E01010F173	26	1700	08.20	26.17
78		E01012F173	30	1700	08.20	30.17
79		E01013F173	34	1700	08.20	34.17
80		E01215F173	36	1700	08.26	36.17
81		E01220F173	45	1700	08.26	45.17
82		E01225F173	52	1700	08.26	52.17
83		E01230F173	61	1700	08.26	61.17
84		E01235F173	69	1700	08.26	69.17
85		E01004F203	10	2000	08.20	10.20
86		E01005F203	15	2000	08.20	15.20
87		E01007F203	20	2000	08.20	20.20
88		E01008F203	25	2000	08.20	25.20
89		E01010F203	30	2000	08.20	30.20
90		E01012F203	34	2000	08.20	34.20
91		E01013F203	39	2000	08.20	39.20
92		E01215F203	41	2000	08.26	41.20
93		E01220F203	51	2000	08.26	51.20
94		E01225F203	60	2000	08.26	60.20
95		E01230F203	70	2000	08.26	70.20
96		E01235F203	79	2000	08.26	79.20
97		E01240F203	89	2000	08.26	89.20

Motor model table description:

Manufacturer series	01: B series; 02: A series; 08: Express series
Frame code	20: 200-frame; 26: 263-frame; 30: 300-frame; 36: 360-frame
Power	Power class: Unit: 1 kW; rounded to the nearest whole number based on the actual rated power.
Speed	Rated speed: Unit: 100rpm

Note:

- When B series motor models from the table above are selected in P73.64 and P73.65, set P75.28 to 1. This allows skipping the motor parameter tuning and proceeding directly to commissioning.
- When A series or E series motor models from the table above are selected in P73.64 and P73.65, manual entry of Group P02 motor parameters is not required. You can directly use P00.15 and P20.11 for motor parameter autotuning.

Appendix H CANopen object dictionary

Index (hex)	Sub-index	Description	Access	Data type	Default
1000	0	Device type	RO	Unsigned32	0x0000 0000
1001	0	Error register	RO	Unsigned8	-
1003	Error code register				
	0	Number of subentries	RW	-	-
	1	Error code	RO	Unsigned32	-
1005	0	COB-ID SYNC	RW	Unsigned32	-
1006	0	Communication cycle time	RW	Unsigned32	-
1007	0	Synchronization window length	RW	Unsigned32	-
1008	0	Manufacturer device name	CONST	String	INVT CANopen
1009	0	Manufacturer hardware version	CONST	String	V1.00
100A	0	Manufacturer software version	CONST	String	V1.00
100C	0	Guard time	RW	Unsigned16	0
100D	0	Life time factor	RW	Unsigned16	0
100E	0	COB-ID guard	RW	Unsigned32	700H + Node ID
1016	Consumer heartbeat time				
	0	Number of subentries	RO	Unsigned8	-
	1	Consumer heartbeat time	RW	Unsigned32	-
1017	0	Producer heartbeat time	RW	Unsigned16	0
1018	Identity object				
	0	Number of subentries	RO	Unsigned8	4
	1	Vendor ID	RO	Unsigned32	0x0000 0000
	2	Product code	RO	Unsigned32	0x0000 0000
	3	Revision number	RO	Unsigned32	0x0000 0000
	4	Serial number	RO	Unsigned32	0x0000 0000
1200	SDO server				
	0	Number of subentries	RO	Unsigned8	-
	1	COB-ID Client → server (Rx)	RO	Unsigned32	600H + Node ID
	2	COB-ID Server → client (Tx)	RO	Unsigned32	580H + Node ID

Index (hex)	Sub-index	Description	Access	Data type	Default
1400	PDO1 Rx communication parameters				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	-
	3	-	-	Unsigned16	-
	4	-	-	Unsigned8	-
	5	Event timer	RW	Unsigned16	-
1401	PDO2 Rx communication parameter				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	-
	3	-	-	Unsigned16	-
	4	-	-	Unsigned8	-
	5	Event timer	RW	Unsigned16	-
1402	PDO3 Rx communication parameter				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	-
	3	-	-	Unsigned16	-
	4	-	-	Unsigned8	-
	5	Event timer	RW	Unsigned16	-
1403	PDO4 Rx communication parameter				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	-
	3	-	-	Unsigned16	-
	4	-	-	Unsigned8	-
	5	Event timer	RW	Unsigned16	-
1600	PDO1 Rx mapping parameters				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	3
	1	First mapping object	RW	Unsigned32	0x21000010
	2	Second mapping object	RW	Unsigned32	0x21000110
	3	Third mapping object	RW	Unsigned32	0x21000210

Index (hex)	Sub-index	Description	Access	Data type	Default
1601		PDO2 Rx mapping parameters			
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapping object	RW	Unsigned32	0x21010010
	2	Second mapping object	RW	Unsigned32	0x21000310
	3	Third mapping object	RW	Unsigned32	0x21000410
	4	Fourth mapping object	RW	Unsigned32	0x21000510
1602		PDO3 Rx mapping parameters			
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapping object	RW	Unsigned32	0x21000610
	2	Second mapping object	RW	Unsigned32	0x21000710
	3	Third mapping object	RW	Unsigned32	0x21000810
	4	Fourth mapping object	RW	Unsigned32	0x21000910
1603		PDO4 Rx mapping parameters			
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapping object	RW	Unsigned32	0x21000a10
	2	Second mapping object	RW	Unsigned32	0x21000b10
	3	Third mapping object	RW	Unsigned32	0x21000c10
	4	Fourth mapping object	RW	Unsigned32	0x21000d10
1800		PDO1 Tx communication parameter			
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	255
	3	Inhibit time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	-
	5	Event timer	RW	Unsigned16	0

Index (hex)	Sub-index	Description	Access	Data type	Default
1801	PDO2 Tx communication parameter				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	254
	3	Inhibit time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	-
	5	Event timer	RW	Unsigned16	0
1802	PDO3 Tx communication parameter				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	254
	3	Inhibit time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	-
	5	Event timer	RW	Unsigned16	0
1803	PDO4 Tx communication parameter				
	0	Highest sub-index supported	RO	Unsigned8	-
	1	COB-ID used by PDO	RW	Unsigned32	-
	2	Transmission type	RW	Unsigned8	254
	3	Inhibit time	RW	Unsigned16	500
	4	Reserved	RW	Unsigned8	-
	5	Event timer	RW	Unsigned16	0
1A00	PDO1 Tx mapping parameter				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	3
	1	First mapping object	RW	Unsigned32	0x20000010
	2	Second mapping object	RW	Unsigned32	0x20000110
	3	Third mapping object	RW	Unsigned32	0x20000210
1A01	PDO2 Tx mapping parameter				
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapping object	RW	Unsigned32	0x20010010
	2	Second mapping object	RW	Unsigned32	0x20000310
	3	Third mapping object	RW	Unsigned32	0x20000410
	4	Fourth mapping object	RW	Unsigned32	0x20000510

Index (hex)	Sub-index	Description	Access	Data type	Default
1A02		PDO3 Tx mapping parameter			
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapping object	RW	Unsigned32	0x20000610
	2	Second mapping object	RW	Unsigned32	0x20000710
	3	Third mapping object	RW	Unsigned32	0x20000810
	4	Fourth mapping object	RW	Unsigned32	0x20000910
1A03		PDO4 Tx mapping parameter			
	0	Number of application program objects mapped in PDO	RW	Unsigned8	4
	1	First mapping object	RW	Unsigned32	0x20000a10
	2	Second mapping object	RW	Unsigned32	0x20000b10
	3	Third mapping object	RW	Unsigned32	0x20000c10
	4	Fourth mapping object	RW	Unsigned32	0x20000d10
2000		PDO Tx process data			
	0	CO_RWResp	RO	Unsigned16	-
	1	CO_RWErrResp	RO	Unsigned16	-
	2	CO_RdData	RO	Unsigned16	-
	3	PZD2_Tx	RO	Unsigned16	-
	4	PZD3_Tx	RO	Unsigned16	-
	5	PZD4_Tx	RO	Unsigned16	-
	6	PZD5_Tx	RO	Unsigned16	-
	7	PZD6_Tx	RO	Unsigned16	-
	8	PZD7_Tx	RO	Unsigned16	-
	9	PZD8_Tx	RO	Unsigned16	-
	10	PZD9_Tx	RO	Unsigned16	-
	11	PZD10_Tx	RO	Unsigned16	-
	12	PZD11_Tx	RO	Unsigned16	-
	13	PZD12_Tx	RO	Unsigned16	-

Index (hex)	Sub-index	Description	Access	Data type	Default
2001	PDO Tx process data				
	0	Statusword	RO	Unsigned16	-
2100	PDO Rx process data				
	0	CO_RWSel	RW	Unsigned16	-
	1	CO_FnCodeIdx	RW	Unsigned16	-
	2	CO_WrData	RW	Unsigned16	-
	3	PZD2_Rx	RW	Unsigned16	-
	4	PZD3_Rx	RW	Unsigned16	-
	5	PZD4_Rx	RW	Unsigned16	-
	6	PZD5_Rx	RW	Unsigned16	-
	7	PZD6_Rx	RW	Unsigned16	-
	8	PZD7_Rx	RW	Unsigned16	-
	9	PZD8_Rx	RW	Unsigned16	-
	10	PZD9_Rx	RW	Unsigned16	-
	11	PZD10_Rx	RW	Unsigned16	-
2100	12	PZD11_Rx	RW	Unsigned16	-
	13	PZD12_Rx	RW	Unsigned16	-
2101	PDO Rx process data				
	0	Controlword	RW	Unsigned16	-

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