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ES680 Series Servo Drive

User Guide

Industrial Automation | New Energy Vehicle | Intelligent Elevator | Intelligent Robot | Digital Energy | Rail Transit

Data code PS00014715A04

Legal Information

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Waste Disposal

The storage, use, and disposal of this product (including optional accessories) must comply with local laws and regulations.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel can identify the risks of the product/system and prevent possible dangers.

Proper Use of the Product

Proper transportation, storage, assembly, installation, commissioning, operation, and maintenance are required to ensure the safe operation of the product without any problems. The required ambient conditions must be met. All operations must follow the guidelines provided in this documentation.

Preface

Introduction

The ES680 series servo drive, a high-performance hydraulic servo drive developed especially for permanent magnet synchronous motors, aims to achieve high-performance vector control on permanent magnet synchronous motors. The tuning-free function is available when an MEG series motor is used together with the drive.

The ES680 series servo drive mainly applies to industries including plastic molding, pipe extrusion, shoes making, rubber, and metal injection molding, hydraulic press, and bending machine.

This user guide provides information about model selection, installation, wiring, commissioning, function description, communication, troubleshooting, and routine maintenance.

More documents

Document	Code	Description
ES680 Series Servo Drive User Guide (this guide)	PS00014715	This guide provides information about model selection, installation, wiring, commissioning, functions, communication, fault handling, and routine maintenance.
ES680 Series Servo Drive Hardware Guide	19011590	Presents system structure, technical data, components, mechanical design, electrical design, optional parts, common EMC problems and solutions, routine maintenance, certifications, and standards.
ES680 Series Servo Drive Installation Guide	19011589	Presents unpacking inspection and transportation, mounting procedure, and wiring instructions.
ES680 Series Servo Drive Function Guide	19011601	Presents the software tool, commissioning process/procedure, function application, troubleshooting, fault codes, and parameters.

Revision History

Date	Document version	Software version	Revision
July 2026	A04	Software code: 03025173 Version: F01.02 Version tag: F7-10=U01.10/ F7-11=U04.50/ F7-12=000.00/ F7-13=000.00	• Added protection class and short circuit rated values in *"2.1.3 Technical Specifications" on page 20*. • Added the check item "Ensure correct wiring when multiple motors are connected to the AC drive" in *"7.9 Post-Wiring Inspection" on page 119*. • Modified the function 48 of the DI to "Servo oil pump PID selection terminal 1" in *"20.5 Group F4 Input Terminal Parameters" on page 283* and *"11.5.1 Digital Input (DI) Terminal Functions" on page 170*. • Added the following note in *"19.3 Parameter Auto-tuning" on page 273*: After re-installing and re-wiring the synchronous motor on the field, perform motor parameter auto-tuning to prevent abnormal motor control by the drive. • Updated and section. Changed the operating panel model to SOP-20-880 and SOP-20-810 in *"2.5 List of Options" on page 53* and *"9.1 Operating panel" on page 152*. • Updated the installation and wiring in *"1.1 Safety Precautions" on page 13*.
January 2026	A03	Software code: 03025173 Version: F01.02 Version tag: F7-10=U01.10/ F7-11=U04.50/ F7-12=000.00/ F7-13=000.00	• Updated *" Front Cover" on page 1*, *" Preface" on page 1*, and *" Back Cover" on page 337*. • Deleted PROFIBUS from the technical specifications in *"2.1.3 Technical Specifications" on page 20*. • Changed the signal definition for terminal pin 9 to PT1000+ and for terminal pin 5 to PT1000- in *"7.5 Connecting the Encoder" on page 98*. • Changed the jumper J5 for AI3/AI4 to DIP switches S4/S5, and added the note "A 24 V external power supply is not supported" in *"7.6.1 Descriptions of Control Circuit Terminals" on page 99*. • Added the rated short-circuit current for the European standard-compliant fuses in *"8.1.1 Fuse, Contactor, and Circuit Breaker" on page 121*. • Added the note "The backend software is connected via a Type-C data cable" in *"9.1 Operating panel" on page 152*. • Added U0-07 and U0-08, and the correspondence between binary values converted from digital values and DI/DO in *"11.5.1 Digital Input (DI) Terminal Functions" on page 170* and *"11.5.2 Digital Output (DO) Terminal Function" on page 172*. • Updated the fault code list in *"15.3 List of Fault Codes" on page 221*. • Updated the parameter list and added detailed guidance for viewing parameter descriptions in *" Parameter List" on page 276*.

Date	Document version	Software version	Revision
December 2024	A02	-	• Updated "*Front Cover*" *on page 1*, "*Preface*" *on page 1*, and "*Back Cover*" *on page 337*. • Updated *"2.2.2.2 Components of the Motor Junction Box" on page 28*. • Updated the rated frequency in *"2.2.3.1 Electrical Specifications" on page 29*. • Updated *"2.2.3.2 Mechanical Characteristics" on page 35*. • Updated the servo motor dimensions and weight in *"2.2.4 Product Dimensions" on page 36*. • Updated the rated speed table in *"2.2.5 Torque-Speed Characteristics" on page 43*. • Updated the servo motor model table in *"2.3 Servo System Configurations" on page 49*. • Updated the IT grid system application description in *"7.3.5 Protection Requirements" on page 95*. • Updated the European standard-compliant fuse selection table in *"8.1.1 Fuse, Contactor, and Circuit Breaker" on page 121*. • Updated "F0-28=1" to "FD-00=0" in *"8.2.2 PROFINET Expansion Card (MD500-PN1)" on page 137*. • Added parameters in "*Parameter List*" *on page 276*.
October 2024	A01	-	• Updated "*Front Cover*" *on page 1* and "*Preface*" *on page 1*. "*Back Cover*" *on page 337* • Updated the technical specifications in *"2.1.3 Technical Specifications" on page 20*. • Updated the system component diagram in *"2.4 System Composition" on page 51*. • Updated the table of recommended main circuit cables in *"7.3.2 Main Circuit Terminal Dimensions and Cable Selection" on page 86*. • Added a European standard-compliant fuse selection table in *"8.1.1 Fuse, Contactor, and Circuit Breaker" on page 121*. • Updated the units in *"8.1.6 Output Reactor" on page 131*. • Updated fault codes 69.00 in *"15.3 List of Fault Codes" on page 221*. • Updated parameters in *"19.3 Parameter Auto-tuning" on page 273*. • Updated parameters in "*Parameter List*" *on page 276*.
March 2024	A00	-	First release.

Access to the guide

This guide is not delivered with the product. You can download the PDF version in the following ways:

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Warranty disclaimer

Inovance provides warranty service within the warranty period (as specified in your order) for any fault or damage that is not caused by improper operation of the user. Maintenance will be charged after the warranty expires.

Even within the warranty period, maintenance can be charged for the following product damage:

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, or abnormal voltage
- Damage caused by using the product for unintended functions
- Damage caused by using the product outside the specified scope
- Damage or secondary damage caused by force majeure (natural disaster, earthquake, and lightning strike)

When applicable, relevant maintenance fee will be charged according to the latest Price List of Inovance. If otherwise agreed upon, the agreed terms and conditions shall prevail.

For details, see the Warranty Card.

Table of Contents

Legal Information 1
Preface 1
Product Model List 12
1 Fundamental Safety Instructions 13
1.1 Safety Precautions 13
1.2 Industrial Information Security 18
2 Product Information 19
2.1 Introduction to the Servo Drive 19
2.1.1 Product Features 19
2.1.2 Model Number and Nameplate 20
2.1.3 Technical Specifications 20
2.1.4 Components 24
2.2 Introduction to the Servo Motor 26
2.2.1 Model and Nameplate 26
2.2.2 Components 27
2.2.2.1 Motor Components 27
2.2.2.2 Components of the Motor Junction Box 28
2.2.3 Technical Specifications 29
2.2.3.1 Electrical Specifications 29
2.2.3.2 Mechanical Characteristics 35
2.2.4 Product Dimensions 36
2.2.5 Torque-Speed Characteristics 43
2.3 Servo System Configurations 49
2.4 System Composition 51
2.5 List of Options 53
3 Unpacking and Handling 54
3.1 Pre-unpacking Handling 54
3.1.1 Packing Dimensions and Weight (with Package) 54
3.1.2 Handling Requirements 54
3.2 Unpacking Inspection 55
3.3 Handling and Hoisting After Unpacking 57
3.4 Storage 58

4 Installation Preparation 59
4.1 Installation Flowchart 59
4.2 Installation Site Inspection 59
4.2.1 Installation Environment 59
4.2.2 Installation Clearance 60
4.2.3 Installation Direction 62
4.3 Installation Tools 63
4.3.1 Tools for Mechanical Installation 63
4.3.2 Tools for Wiring 64
4.3.3 Cable Preparations 64
5 Mechanical Installation 65
5.1 Precautions for Drive Installation 65
5.2 Drive Installation Method 65
5.2.1 Backplate Mounting 65
5.2.2 Through-Hole Mounting 66
5.3 Drive Cover Removal and Installation 69
5.3.1 Removing the Cover 69
5.3.2 Installing the Cover 71
5.4 Installing the Motor 72
5.5 Installation Options 73
5.5.1 Grounding Bracket for Cable Shield 73
5.5.2 EMC Filter 74
5.5.3 Simple Filter 75
5.5.4 Magnetic Ring 75
6 Mechanical Design 77
6.1 Dimensions and Weight of the Drive 77
6.2 Cabinet Design 78
6.2.1 In-Cabinet Clearance 78
6.2.2 Mounting Backplate Requirements 79
6.2.3 Cabinet Heat Dissipation 79
7 Electrical Installation and Design 84
7.1 Electrical Wiring 84
7.2 Inspection Before Wiring 84
7.3 Main Circuit Wiring 85
7.3.1 Descriptions of Main Circuit Terminals 85

7.3.2 Main Circuit Terminal Dimensions and Cable Selection 86
7.3.3 Terminal selection 90
7.3.4 Wiring Requirements of Main Circuit 93
7.3.5 Protection Requirements 95
7.4 Connecting the Motor 96
7.5 Connecting the Encoder 98
7.6 Control Circuit Wiring 99
7.6.1 Descriptions of Control Circuit Terminals 99
7.6.2 Requirements for Control Circuit Wiring 102
7.6.3 Wiring of Control Circuit Terminals 104
7.6.4 Grounding Requirements for Control Circuits 107
7.7 Communication Connection 108
7.7.1 RS485 Communication Connection 108
7.7.2 CAN Communication Connection 111
7.7.3 Wiring of PROFINET Communication 113
7.7.4 PROFIBUS DP Communication Connection 114
7.8 Grounding 116
7.8.1 Main Circuit Grounding Requirements 116
7.8.2 Grounding Requirements for the Control Circuit 118
7.9 Post-Wiring Inspection 119
8 Models of Options 121
8.1 Electrical Peripherals 121
8.1.1 Fuse, Contactor, and Circuit Breaker 121
8.1.2 AC Input Reactor 122
8.1.3 EMC Filter 125
8.1.4 Simple Filter 128
8.1.5 Braking Components 129
8.1.6 Output Reactor 131
8.1.7 Magnetic Ring and Ferrite Clamp 135
8.2 Expansion Card 137
8.2.1 CAN Communication Expansion Card (MD38CAN1) 137
8.2.2 PROFINET Expansion Card (MD500-PN1) 137
8.2.3 PROFIBUS DP Expansion Card (MD38DP2) 139
8.2.4 RS485 Communication Expansion Card 141
8.3 Through-Hole Mounting Bracket 141
8.4 Grounding Bracket of Cable Shield 148

8.5 External Operating Panel 151
9 Commissioning Tool 152
9.1 Operating panel 152
9.2 Local Operating Panel 152
9.3 Setting parameters 154
9.4 Parameter view 155
9.5 Status parameter display 156
10 Quick Commissioning Guide 157
10.1 Commissioning Preparation 157
10.2 Quick Commissioning Flowchart 157
10.3 Application Commissioning of Servo Oil Pump 159
10.3.1 AI Zero Drift Auto Correction 159
10.3.2 Oil Pressure Mode Selection and Parameter Setting 160
10.3.3 Oil Pressure Parameter Setting 161
10.3.4 Adjustment of Oil Pressure Loop PID Response 163
10.3.5 Pressure Holding Stability Test 164
11 Function Description 167
11.1 Parameters Initialization 167
11.2 Running Command Setting 167
11.3 Start/Stop Method 168
11.4 Setting of Acceleration/Deceleration Time 169
11.5 Control Interface 170
11.5.1 Digital Input (DI) Terminal Functions 170
11.5.2 Digital Output (DO) Terminal Function 172
11.6 Speed loop 173
12 Communication 176
12.1 Introduction to Parameters 176
12.2 Parameter Address Expression Rules 179
12.3 Modbus Communication 182
12.3.1 Communication 182
12.3.2 Hardware Interface and Specifications 183
12.3.3 Network Topology 184
12.3.4 Communication transmission mode 185

12.3.5 Communication Data Frame Structure 185
12.3.6 Parameter Setting 189
12.4 PROFINET Communication 190
12.4.1 Communication 190
12.4.2 Hardware Interface and Specification Parameters 190
12.4.3 Network Topology 191
12.4.4 Data Transmission Format 193
12.4.5 Data Description 193
12.4.6 Parameter Setting 195
12.5 CANopen Communication 195
12.5.1 Introduction 195
12.5.2 Hardware Interface and Specifications 196
12.5.3 Network Topology 197
12.5.4 Parameter Setting 198
12.5.5 Default RPDO Configuration 198
12.5.6 Application example 200
12.5.7 PLC Parameter Configuration 201
13 Routine Maintenance 203
13.1 Daily Maintenance 203
13.1.1 Daily Checklist 203
13.1.2 Daily Cleaning Items 203
13.2 Periodic Maintenance 204
13.2.1 Periodic Checklist 204
13.2.2 Regular Maintenance 205
13.3 Components Replacement 206
13.3.1 Replacing the Cooling Fan 206
13.3.2 Replacing the Electrolytic Capacitor 211
13.3.3 Removing the Motor Flat Key 211
13.3.4 Removing the Motor Oil Seal 212
13.4 Main Circuit Insulation Test 212
13.5 Storage and Repair 213
14 Solutions to Common EMC Problems 214
14.1 Leakage Current Suppression 214
14.2 Residual Current Device (RCD) 214
14.3 Harmonic Suppression 216
14.4 Control Circuit Interference 216

14.4.1 High-Speed Pulse Interference....216
14.5 Communication Interference 217
14.5.1 RS485 and CAN Communication Interference....217
14.5.2 PROFINET Communication Interference....217
14.6 Encoder Feedback Signal Error 218
15 Troubleshooting....219
15.1 Drive Restart upon Faults 219
15.2 Solutions to Common Faults 220
15.3 List of Fault Codes.... 221
16 Certification and Standard....250
16.1 Certifications, Directives, and Standards 250
16.2 CE Certification 250
16.2.1 Introduction to CE Certification....250
16.2.2 Requirements for Compliance with EMC 250
16.2.3 Requirements for Compliance with LVD....252
16.3 UL/cUL Certification.... 253
17 Appendix A: Multi-pump Mode of Injection Molding Machine....256
17.1 Parallel Servo Oil Pump Control 256
17.2 Multi-Pump Control Mode.... 257
17.2.1 Description 257
17.2.2 Wiring 258
17.2.3 Parameter Settings for Slave Pump Response to Master Pump Commands 262
17.3 Setting of Master Drive 263
17.4 Setting of Slave Drive 265
17.5 Multi-Pump Convergent and Shunt Flow Control.... 265
17.6 Faults 270
18 Appendix B: Motor Codes and Models 271
19 Appendix C: Motor Parameters and Parameter Auto-tuning 272
19.1 Overview 272
19.2 Motor Parameters.... 272
19.3 Parameter Auto-tuning.... 273
19.4 Running Status Observation 275

20 Appendix D Parameter List.....276
20.1 Group F0 Basic Control Parameters.....276
20.2 Group F1 Motor Parameters.....277
20.3 Group F2 Vector Control Parameters.....279
20.4 Group F3 Torque Control Parameters.....282
20.5 Group F4 Input Terminal Parameters.....283
20.6 Group F5 Output Terminal Parameter List.....288
20.7 Group F6 Start/Stop Control Parameters.....290
20.8 Group F7 Operating Panel and Display Parameters.....291
20.9 Group F8 Auxiliary Function Parameter List.....292
20.10 Group F9 Protection and Fault Parameters.....293
20.11 Group FA Business Timed Operation Parameters.....301
20.12 Group Fd Communication Parameters.....302
20.13 Group FE User-defined Parameters.....304
20.14 Group FF Manufacturer Parameters.....305
20.15 Group FP User Parameters.....306
20.16 Group A0 Flux Weakening Control Parameters.....306
20.17 Group A1 Encoder Parameters.....308
20.18 Group A2 CAN Communication Parameters.....308
20.19 Group A3 Oil Pressure Basic Parameters.....309
20.20 Groups A4 and A5 Oil Pressure Optimization Parameters.....315
20.21 Group A6 Multi-reference and Multi-torque Limit Parameters.....319
20.22 Group A7 Reserved Parameter Overview.....321
20.23 Group B0 Custom Parameter Mappings.....321
20.24 Group B1 Custom Parameter Values.....324
20.25 Group B2 Custom Display Parameter Mappings.....326
20.26 Group B3 Custom Display Parameter Numeric Values.....328
20.27 Group AF Communication Process Data Parameters.....329
20.28 Group U0 Operation Monitoring Parameters.....332
20.29 Group U1 Oil Pressure Monitoring Parameters.....334
Service and Support.....336

Product Model List

The drive model is consistent with the model indicated by the nameplate of the drive. The T model is dependent on the drive structures. The relationship between the drive model and T model is shown in the following table.

Table –1 Relationship between the drive model and T model

Product model	Power (kW)	T model	Structure
ES680-4T025-C1	11	T3	Plastic structure
ES680-4T032-C1	15	T4	
ES680-4T037-C1	18.5		
ES680-4T044-C1	22		
ES680-4T060-C1	30	T5	
ES680-4T075-C1	37	T6	
ES680-4T091-C1	45		
ES680-4T112-C1	55	T7	Sheet metal structure
ES680-4T150-C1	75		
ES680-4T176-C1	90	T8	Sheet metal structure
ES680-4T210-C1	110		
ES680-4T253-C1	132		

1 Fundamental Safety Instructions

1.1 Safety Precautions

Safety disclaimer

- This chapter provides essential safety instructions for proper use of the product. Before using this product, read through the guide and comprehend all the safety instructions. Failure to comply with the safety instructions may result in death, severe injury, or equipment damage.
- "DANGER", "WARNING", and "CAUTION" signs in this guide are only supplements to the safety instructions, and do not reflect all safety instructions to be followed.
- Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
- Inovance shall take no responsibility for any personal injury or property damage caused by improper use.

Safety levels and definitions



Indicates that failure to comply with the notice can result in death or severe personal injury.



Indicates that failure to comply with the notice may result in severe personal injury or death.



Indicates that failure to comply with the notice may result in minor or moderate injury or equipment damage.

Safety Precautions

- Drawings in the user guide are sometimes shown without covers or protective guards. Install the covers or protective guards as specified, and then perform operations in accordance with the instructions.
- The drawings in the guide are shown for illustration only and may be different from the product you purchased.
- Operators must take mechanical protection measures to protect their safety. For example, they must wear safety shoes, safety clothing, safety glasses, protective gloves and sleeves, or other protective equipment.

Unpacking



- Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking.
- Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking.
- Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.



- Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking.
- Unpack the package by following the unpacking sequence. Do not strike the package violently.
- Check for damage, rust, or dents on the surfaces of the product and accessories upon unpacking.
- After unpacking, check the contents against the packing list to ensure that the equipment and accessories are in the correct quantities, and that all documentation is complete.

Storage and transportation



- Large or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply could result in personal injury or equipment damage.
- Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely connected components may fall off and result in personal injury or equipment damage.
- Do not stand or stay below the product which is being hoisted.
- When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply could result in personal injury or equipment damage.



- Handle the equipment with care and mind your step during transportation to prevent personal injury or equipment damage.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply could result in personal injury.
- Store and transport the equipment based on the storage and transportation requirements. Failure to comply could result in equipment damage.
- Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration.
- Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time.
- Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation.
- Do not transport the equipment with other devices or items that may impact or cause harm to the equipment.

Installation
DANGER • Ensure peripheral power distribution requirements are met, and select air switches, fuses, cables, and cable terminals correctly. • Use standard torque to fasten screws, and use appropriate terminal crimping tools to crimp terminals. • Ensure heat dissipation requirements are met and design inlet and outlet airflow duct properly. • Avoid environments with dripping water, conductive foreign objects (such as carbon fiber filaments, conductive metal dust, metal chips), and salt spray. **Failure to follow the above instructions will pose a fire risk.** • This equipment must be operated only by trained and qualified electrical personnel. Operations can be performed by professionals only.
WARNING • Read through the guide and safety instructions before installation. • Do not install this equipment in places with strong electric or magnetic field. • Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply may result in mechanical hazards. • Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock. • When installing the equipment in an enclosed environment (such as a cabinet or case), use cooling devices (such as fans or air conditioners) to cool the space and meet the installation environment requirements. Failure to do so can result in equipment overtemperature or fire accidents. • Do not retrofit the equipment. • Do not fiddle with the bolts used to fix equipment components or the bolts marked in red. • When the equipment is installed in a cabinet or terminal device, appropriate guard devices (guards for fire, electrical, and mechanical protection) meeting applicable IEC standards and local laws and regulations must be provided. • Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction. • Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply may result in a fire. **The edges of the equipment metal enclosure are sharp. Note the following precautions during installation to avoid personal injury or cable damage:** • When performing installation, handling, or maintenance operations, always wear cut-resistant gloves. • Avoid direct skin contact with enclosure edges and cut surfaces during operation.
Caution • Cover the top of the product with a piece of cloth or paper during installation. This is to prevent unwanted objects such as metal chippings, oil, and water from falling into the product and causing faults. After installation, remove the cloth or paper on top of the product to prevent over-temperature caused by poor ventilation due to blocked ventilation holes. • Resonance may occur when the equipment operating at a constant speed executes variable speed operations. In this case, install the vibration-proof rubber under the motor frame or use the vibration suppression function to reduce resonance.

Wiring

DANGER

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Before wiring, switch off all power supplies of the device. Wait for at least the time designated on the warning label before further operations because residual voltage still exists after power-off. After waiting for the designated time, measure the DC voltage in the main circuit to ensure the DC voltage is within the safe voltage range. Failure to comply can result in electric shock.
- Do not perform wiring, remove the equipment cover, or touch the circuit board with power ON. Failure to comply could result in electric shock.
- Make sure that the equipment and product are grounded properly. Failure to comply can result in the risk of electric shock.

WARNING

- Do not connect the power cable to output terminals of the equipment or product. Failure to comply may cause equipment damage or even a fire.
- When connecting a drive with the motor, make sure that the phase sequences of the drive and motor terminals are consistent to prevent reverse motor rotation.
- Cables used must comply with corresponding cross-sectional area and shielding requirements. The shield of the shielded cable must be grounded at one end properly.
- Tighten the terminal screws with the torque specified in the user guide. Insufficient or excessive torque may cause overheating and damage to the joint, which could result in fire.
- After wiring is done, ensure that all cables are connected properly and no screws, washers or exposed cables are left inside the equipment. Failure to comply could result in electric shock or equipment damage.
- Avoid direct skin contact with enclosure edges and cut surfaces during operation.
- Route cables carefully during wiring. Keep them away from sharp edges to prevent squeezing or cutting. It is recommended to use protective sleeves.
- If the enclosure is covered with a protective film, do not remove it until all installation is completed and any further contact with sharp edges is no longer required.

Caution

- Follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap to perform wiring. Failure to comply may result in damage to the equipment or to the internal circuit of the product.
- Use the shielded twisted pair cable to wire the control circuit, and connect the shield to the grounding terminal of the equipment. Failure to comply may result in equipment malfunction.

Power-on

DANGER

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Do not touch any terminals, or remove any part of the equipment at power-on. Failure to comply will result in an electric shock.

WARNING

- Perform a trial run after wiring and parameter setting to ensure that the equipment operates safely. Failure to comply may result in personal injuries or equipment damage.
- Before power-on, check that the rated voltage of the equipment is consistent with that of the power supply. Failure to comply may result in a fire. Using an incorrect supply voltage may cause a fire.
- Before power-on, check that no one is near the equipment, motor, or other mechanical parts. Failure to comply may result in personal injury or even death.

Operation
 • The equipment must be operated only by professionals. Failure to comply can result in injury or death. • Do not touch any connecting terminals or disassemble any unit or component of the equipment during operation. Failure to comply could result in electric shock.
 • Do not touch the enclosure, fan, or resistor with bare hands. Failure to comply may result in burns. • Prevent metal or other objects from falling into the equipment during operation. Failure to comply may result in a fire or equipment damage.

Maintenance
 • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. • Do not perform maintenance on the equipment with power-on. Failure to comply may result in an electric shock. • Before maintenance, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label. • When using a permanent magnet (PM) motor, do not touch the motor terminals while the motor is rotating, because induced voltage may be present at the terminals even after the product is powered off. Failure to comply may result in electric shocks.
 • Perform routine and periodic inspection and maintenance on the equipment according to maintenance requirements and keep a maintenance record.

Repair
 • Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals. • Do not repair the equipment with power-on. Failure to comply may result in electric shock. • Before inspection or repair, disconnect all the power supplies of the equipment and wait for at least the time specified on the warning label.
 • Submit a request for repair based on the warranty agreement. • When the fuse is blown or the circuit breaker or earth leakage circuit breaker (ELCB) trips, wait for at least the time designated on the equipment warning label before power-on or further operations. Failure to comply could result in equipment damage, personal injury, or death. • Troubleshooting and repair of a faulty or damaged equipment must be performed by professionals based on the repair instructions, with the repair records kept properly. • Replace quick-wear parts of the equipment according to the replacement instructions. • Do not use damaged equipment. Failure to comply can result in death, personal injury, or severe equipment damage. • Recheck the wiring and reset the parameters after equipment replacement.

Disposal
WARNING • Dispose of the retired equipment in accordance with applicable national regulations and standards. Failure to comply can result in property damage, personal injury, or death. • Recycle retired equipment in accordance with industry waste disposal standards to avoid environmental pollution.

Safety Label

To ensure safe operation, comply with safety labels on the equipment and do not damage or remove the labels. The following table describes the meanings of the safety labels.

Safety Label	Description
	• Before using the equipment, read the guide and safety precautions carefully. Failure to comply may result in personal injury, death, or equipment damage. • Do not touch the terminals or remove the cover with power-on or within 10 min after power-off. Failure to comply may result in electric shock.

1.2 Industrial Information Security

The product provides interfaces for network connection and data transmission. To protect factories, systems, machines, and networks from cyberattacks, it is essential to implement proper protection mechanism for industrial security.

Customers are responsible for providing and maintaining a secure connection between the product and their network or any other network to protect their factories, systems, machines, and networks from unauthorized access. Such systems or machines can be connected to an enterprise network or the Internet only when a secure connection is established and appropriate security measures (such as using antivirus software or installing firewalls) are in place.

Inovance continuously develops and improves products and solutions to enhance safety. It is strongly recommended that you update the product promptly and always use the latest version.

Caution

Malware (such as viruses, Trojans, and worms) can bring the device into an unsafe operating state, resulting in death, serious injury, and property damage. Observe the following precautions:

- Always use the latest software version. If the product version is no longer supported or the latest version is not used, you will be exposed to increased risk of cyber attacks.
- Develop and maintain appropriate protective measures (including but not limited to antivirus software, firewalls, WAF, IPS/IDS, situational awareness system, identity authentication, and data encryption) to prevent the files in mobile storage devices from being damaged by malware, and to protect the products, networks, systems, and interfaces from unauthorized access, tampering, hacking, data leakage, or information theft.
- Check all safety-related interfaces and settings after commissioning.

2 Product Information

2.1 Introduction to the Servo Drive

2.1.1 Product Features

The ES680 series servo drive is developed especially for high-performance vector control of permanent magnet synchronous motors. It adopts high-performance vector control technology in which process action characteristics of the injection molding machine during driving are optimized, such as the injection speed, pressure-hold precision control, mold-opening positioning control, and stability control during working with the injection molding machine controller. The ES680 series servo drive is also equipped with software monitoring and communication bus functions to allow flexible function combinations and stable performance.

The ES680 series servo drive mainly applies to industries including plastic molding, pipe extrusion, shoemaking, rubber, and metal injection molding. It adopts servo control platform together with MEG series motors to achieve the tuning-free function, with oil pressure control performance, pressure and speed fluctuation, and mold opening precision and smoothness optimized to allow quick field-weakening response, high torque output, and small size.

Function highlights:

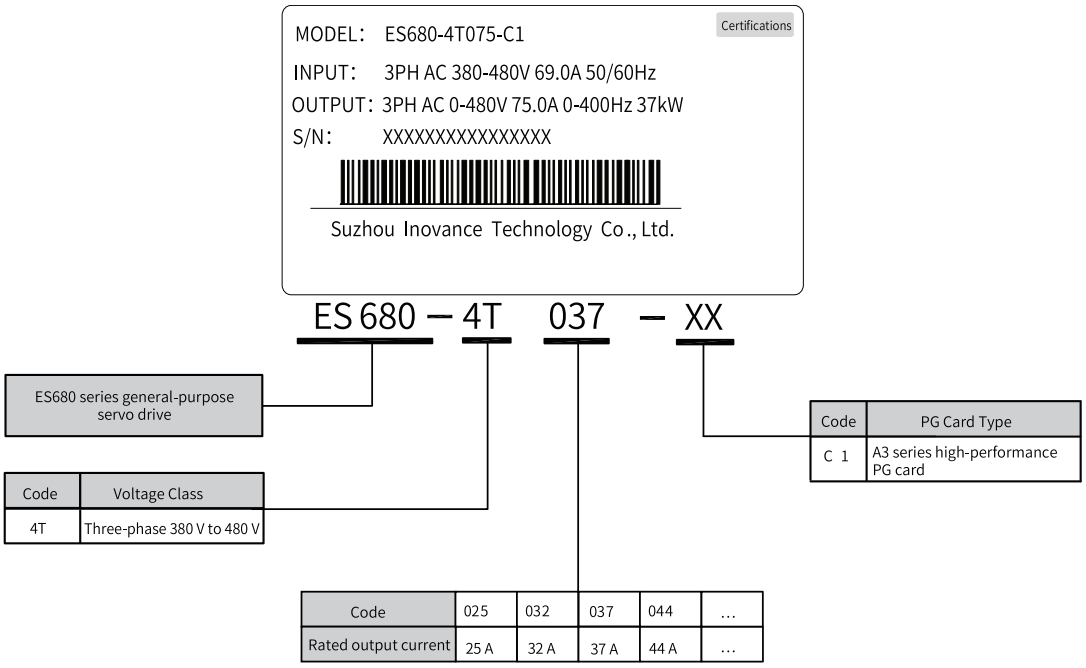
1. Small size and high power density
   Compared with IS580 series drives, the overall power density of ES680 series servo drives is improved by over 30%.
2. Wide voltage range
   Rated input: three-phase 380 VAC to 480 VAC, voltage fluctuation range: -15% to +10%
3. Built-in DC reactor
   The built-in DC reactor is available in models of 37 kW and above for easy installation.
4. Comprehensive built-in braking unit and protective functions
   The models that carry a built-in braking unit are extended to 132 kW. The braking unit is equipped with protective functions against short circuit and overcurrent and supports fault prompts.
5. Long service life
   The bus capacitor has a long service life with high standard configurations.
6. Protection of the fan drive circuit
   The fan drive circuit comes into rescue when the fan is short-circuited due to blockage or damage.
7. Comprehensive protective functions
   Protections against output short-circuited to ground and pre-charge relay (contactor) close fault are available in all series of ES680 servo drives.
8. Optimized EMC configuration solution
   A whole set of solutions based on actual application needs and certification needs are available.
9. Applicable to A3 (23-bit) series high-performance encoder and supporting tuning-free function
   All series of ES680 servo drives are integrated with 23-bit encoder decoding circuit to support a resolution up to 8,000,000 PPR and motor parameter packing, enabling the tuning-free function

and improving the software usability. The PT1000 motor temperature sensor is included in the standard configuration. (The drive matches the MEG series motors only. Resolvers and PTC temperature detection are not supported.)

10. UVW phase sequence auto-tuning

The drive supports auto-tuning of UVW phase sequence, which is enabled upon power-on to prevent motor operation faults caused by wrong UVW phase sequence.

2.1.2 Model Number and Nameplate



Note

- The preceding nameplate is for reference purpose only. Actual nameplates may vary.

2.1.3 Technical Specifications

Electrical Specifications

Table 2–1 Electrical Specifications

Item		Specifications											
Model: ES680-4TXXX-C1		025	032	037	044	060	075	091	112	150	176	210	253
Applicable motor capacity (kW)		11	15	18.5	22	30	37	45	55	75	90	110	132
Input	Rated input current (A)	29	36	42	48	57	69	89	106	139	164	196	240

Item		Specifications											
Model: ES680-4TXXX-C1		025	032	037	044	060	075	091	112	150	176	210	253
Output	Rated output current (A)	25	32	37	44	60	75	91	112	150	176	210	253
	Output voltage	Three-phase 0 V to 480 V (≤ input voltage)											
	Maximum output frequency	300 Hz											
	Carrier frequency	2.0 kHz to 8.0 kHz											
Power supply	Rated voltage and frequency	Three-phase 380 VAC to 480 VAC, 50/60 Hz											
	Allowable voltage fluctuation range	-15% to +10%, or 323 VAC to 528 VAC											
	Allowable frequency fluctuation range	±5%											
	Power capacity (kVA)	30	39	45	54	52	63	81	97	127	150	179	220
Power dissipation (kW)		0.45	0.55	0.65	0.81	1.01	1.2	1.51	1.8	1.84	2.14	2.85	3.56
Short-circuit current rating (SCCR)		5 kA						10 kA					

Technical Specifications

Table 2–2 Technical Specifications

Item		Technical Specifications
Basic functions	Resolution of input frequency	Digital setting: 0.01 Hz Analog setting: Maximum frequency x 0.025%
	Control mode	Feedback vector control (FVC)
	Starting torque	0 Hz/180% (FVC)
	Speed regulation range	1:1000 (FVC)
	Stable and accurate speed	±0.02% (FVC)
	Torque control accuracy	FVC: ±3%
	Torque boost	Automatic torque boost; Customized torque boost: 0.1% to 30.0%
	Acceleration/Deceleration curve	Straight-line acceleration/deceleration S-curve acceleration/deceleration Four groups of acceleration/deceleration time ranging from 0.0 to 6500.0s
	DC braking	Starting frequency of DC braking: 0.00 Hz to the maximum frequency Braking time: 0.0s to 36.0s Injection action current value: 0.0%–100.0%
	Built-in PID	Implements a closed-loop process control system.
	Auto voltage regulation (AVR)	Keeps constant output voltage automatically when the mains voltage changes.
	Overvoltage/Overcurrent stall control	Limits the current and voltage automatically during operation to prevent frequent tripping caused by overvoltage/overcurrent.
Custom functions	Supported field buses	Modbus, CANopen, PROFINET
	Integrated with 23-bit encoder decoding circuit	Integrated with 23-bit encoder decoding circuit, and supports motor tuning-free function.
	Advanced software tool	Supports parameter settings and virtual oscilloscope. Internal drive status can be monitored through the virtual oscilloscope.
Operation	Operation command	Three command sources available: operating panel, control terminal, and serial communication port You can perform switch the command source in multiple ways.
	Frequency source	There are ten frequency sources in total, including digital setting (retentive/non-retentive at power failure), analog setting (AI1, AI2, or AI3), pulse input (DI5), multi-reference, simple PLC, PID, and communication setting. You can perform switch the command source in multiple ways.
	Input terminal	Standard: Five DIs and four AIs Among the four AI terminals, two of which support ±10 V voltage input and the other two of which support 0 V to 10 V voltage input or 0 mA to 20 mA current input.
	Output terminals	Standard: Two DOs and two AOs The DOs support 0 mA to 20 mA current output or 0 V to 10 V voltage output.
Display and operation on the operation panel	Display	Displays parameters.
	LCD display	Optional; displays operation prompts in Chinese or English
	Parameter clone	Allows quick parameter copy through the external operating panel (LCD).

Item		Technical Specifications
Protective functions	Open-phase protection	Input and output phase loss protection
	Overcurrent protection	The drive stops when the current exceeds 2.5 times the rated current.
	Overvoltage protection	The drive stops when the DC voltage of the main circuit is above 820 V
	Undervoltage protection	The drive stops when the DC voltage of the main circuit is below 350 V
	Over-temperature protection	Triggers protection when the inverter bridge overheats
	Brake protection	Provides protection in case of short circuit of the braking resistor and long-term operation of the braking transistor.
	Short-circuit protection	Protection against output interphase short circuit and output short circuit to ground
	Motor over-temperature protection	Provides protection when the motor stator temperature exceeds the setpoint.
Environment	Applicable scenarios	Indoors and free from direct sunlight, dusts, corrosive gases, combustible gases, oil mists, vapors, water drips, and salty elements.
	Altitude	1000 m and below: no derating. 1000 m to 3000 m: Derate by 1% for every additional 100 m. Above 3000 m: Contact Inovance.
	Ambient temperature	-10℃ to +50℃(For temperatures between -10℃ to +40℃, derating is not required. For temperatures above 40℃, derate 1.5% for every additional 1℃.)
	Storage/Operating humidity	≤ 95% RH, non-condensing
	Vibration	Operation scenario: Tested according to IEC 60068-2-6. Vibration amplitude of 3.5 mm at 5 Hz to 8.4 Hz; acceleration rate of 1·g at 8.4 Hz to 200 Hz; 10 sweeps in each axial direction Transportation scenario: Tested according to IEC 60068-2-64. Power spectral density of 0.01 g^2/Hz at 5 Hz to 100 Hz and of 0.001 g^2/Hz at 200 Hz; Grms of 1.14 g
	Storage temperature	-20℃ to +60℃ (temperature change less than 1℃/min)
Overvoltage category	OVC III	
Pollution degree	PD2	
Protection class	Class I	
IP rating	IP20 (open type, for IEC-certified products)	
Grid type	TN, TT	

2.1.4 Components

Components of T3 to T6 models

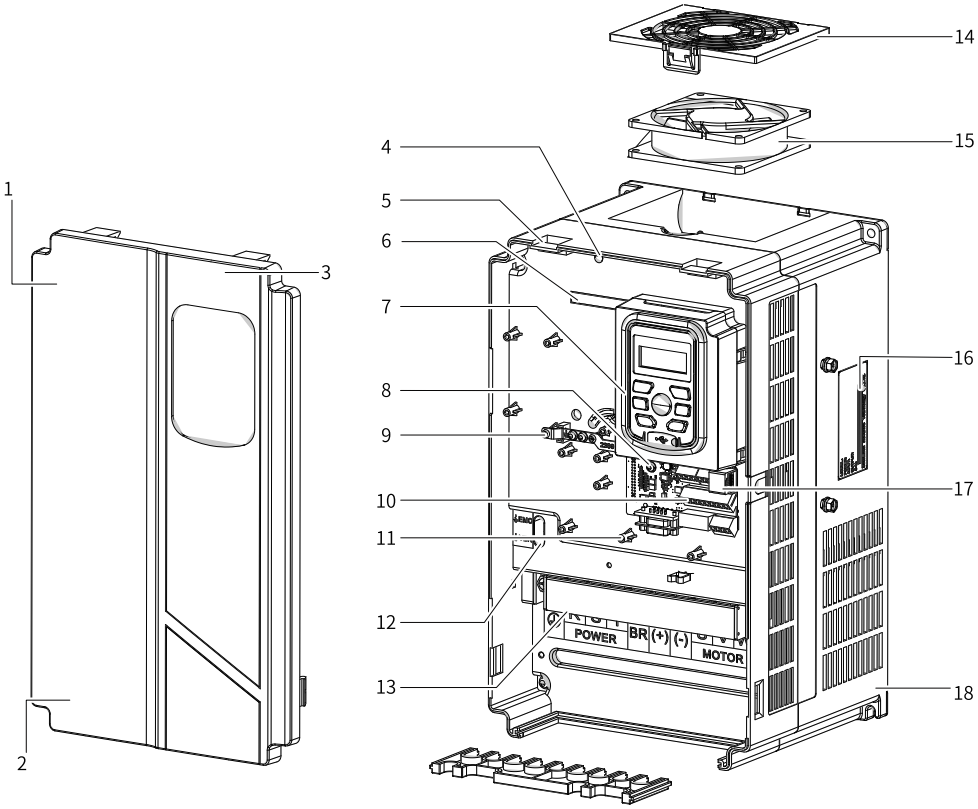


Figure 2-1 Components of T3 to T6 models

No.	Component	No.	Component	No.	Component
1	Logo	7	Operating panel	13	Main circuit terminal and grounding terminal
2	Equipment label Symbol / Description Note: Read through the user guide before installation and operation. Danger: Do not remove the upper cover with power ON or within 10 min after power-off.	8	Grounding screw of the control board The control board is not grounded by default. When the control board needs to be grounded, tighten the M3 x 8 SEMS screw on the grounding threaded hole of the control board.	14	Fan cover
3	Cover	9	Grounding sheet metal Used to ground the extension board and the shield of the encoder cable.	15	Cooling fan
4	Main circuit power supply indicator Do not disassemble the machine or perform wiring when this indicator is ON.	10	Control circuit terminal	16	Nameplate

No.	Component	No.	Component	No.	Component
5	Barcode (T3) Indicates the code and model of the equipment.	11	Base for fixing the expansion card	17	External operating panel interface
6	Barcode (T4 to T6) Indicates the code and model of the equipment.	12	Grounding screws for safety capacitor and voltage dependent resistor	18	Enclosure

Note

- There are two cooling fans on top of T3 and T4 models.
- There is one cooling fan on top of T5 and T6 models.

Components of T7 and T8 models

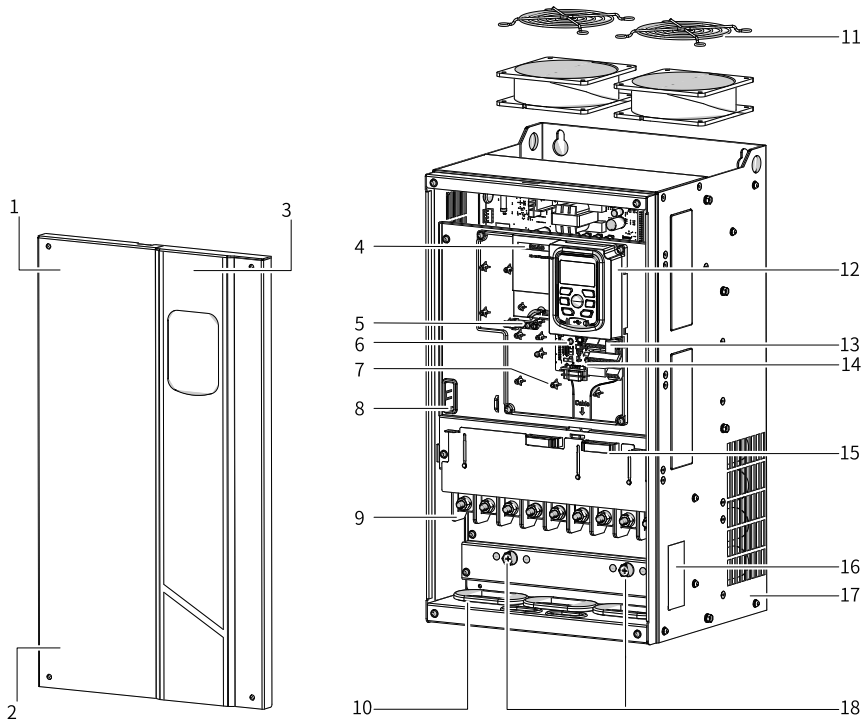


Figure 2-2 Components of T7 and T8 models

No.	Component	No.	Component	No.	Component
1	Logo	7	Base for fixing the expansion card	13	External operating panel interface
2	Equipment label Symbol / Description Note: Read through the user guide before installation and operation. Danger: Do not remove the upper cover with power ON or within 10 min after power-off.	8	Grounding screws for safety capacitor and voltage dependent resistor	14	Control circuit terminal
3	Cover	9	Main circuit terminals	15	Cable tie It is used to fix the signal cable.

No.	Component	No.	Component	No.	Component
4	Equipment bar code Indicates the code and model of the equipment.	10	Protective ring	16	Nameplate
5	Grounding sheet metal Used to ground the extension board and the shield of the encoder cable.	11	Cooling fan	17	Enclosure
6	Grounding screw of the control board The control board is not grounded by default. When the control board needs to be grounded, tighten the M3 x 8 SEMS screw on the grounding threaded hole of the control board.	12	Operating panel	18	Terminal block

Note

The number of cooling fans on top of T7 models is shown as follows:

- 55 kW: one cooling fan
- 75 kW: two cooling fans

There are two cooling fans on top of T8 models.

2.2 Introduction to the Servo Motor

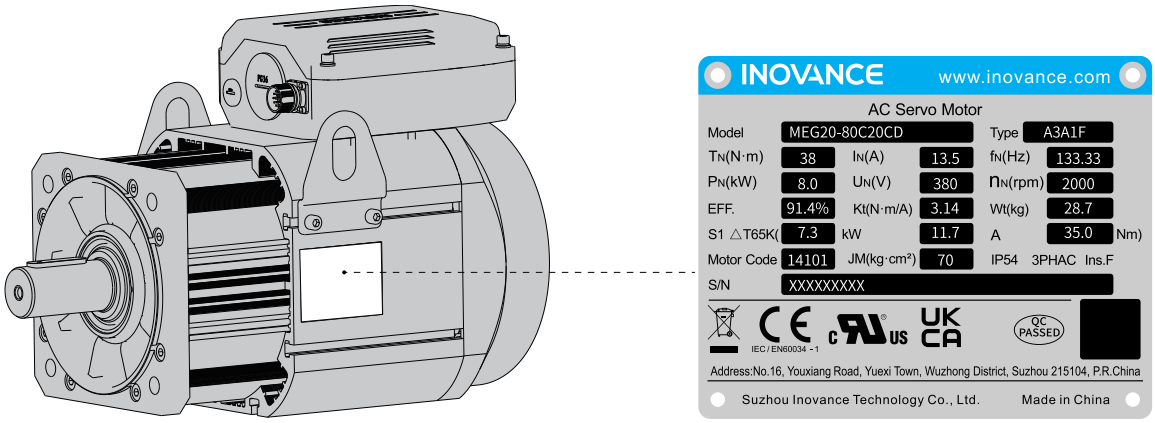
2.2.1 Model and Nameplate

Model

MEG ① 20 ② - 13D ③ 22C ④ D ⑤ - ** ⑥ * ⑦ * ⑧ * ⑨ - * ⑩

① **Product series** MEG: Servo motor for hydraulic servo drives ② **Frame size** 20: 200 x 200 23: 266 x 266	④ **Rated speed** (comprised of two digits and a letter) A: x 1 B: × 10 C: × 100 D: x 1000 E: x 10000 Example: 22C: 2,200 rpm	⑦ **Shaft connection mode** 1: Plain shaft 2: Hollow cone shaft 3: Solid, with key and tapped hole A: Solid, with key and threaded hole, built-in rotor
③ **Rated power** (comprised of two digits and a letter) A: x 1 B: × 10 C: × 100 D: x 1000 E: x 10000 Example: 13D: 13000 W	⑤ **Voltage class** D: 380 V ⑥ **Encoder type** (comprised of a letter and a digit) A3: 23-bit high performance encoder	⑧ **Brake, reducer and oil seal** 0: None 1: Oil seal ⑨ **Cooling method** F: Forced air cooling ⑩ **Customized** _: Standard K: Narrow foot

Description of nameplate



2.2.2 Components

2.2.2.1 Motor Components

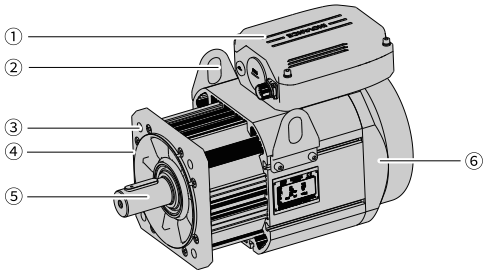


Figure 2-3 Components of the motor

No.	Part name	Description
①	Junction box	Used to connect motor drive cables and protect cables.
②	Eyebolt	Used to lift the motor to help move the motor.
③	Mounting screw on the user side	Used to fix the motor.
④	Mounting flange face on the user side	Used to support motors, and fix and protect the bearing.
⑤	Shaft extension (keyed)	Used to connect the driven parts.
⑥	Rear cover of the fan	Used to protect the fan and avoid safety accidents.

2.2.2.2 Components of the Motor Junction Box

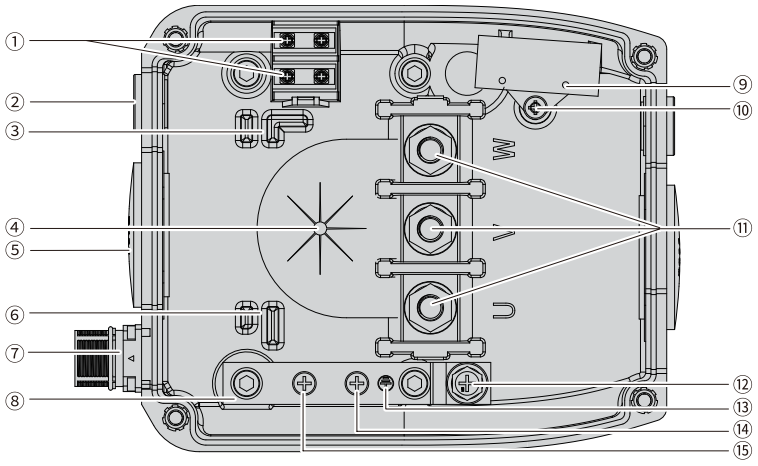


Figure 2-4 Internal structure of the motor junction box

No.	Component	No.	Component	No.	Component
①	220 V fan, 2 x M4 cross screw	⑥	Routing sealing duct	⑪	M10 bolt for U, V, and W power cables Applicable to standard M10 nuts
②	2 x PG11 sealing plug	⑦	M23 aviation connector	⑫	M8 grounding screw
③	Routing sealing duct	⑧	4-M6 spring/flat washer screw that connected to the junction box and enclosure	⑬	Grounding mark
④	Motor cable outlet (Take measures to prevent falling of small components.)	⑨	Fan capacitor	⑭	Internal grounding screw of the fan
⑤	2 x PG36 sealing cap	⑩	M4 screw	⑮	Grounding screw of the fan power supply cable (customer side)

2.2.3 Technical Specifications

2.2.3.1 Electrical Specifications

Table 2–3 Motor performance (flange size 200 x 200 at 2200 rpm)

Item		Unit	Model: MEG20-XXXXXX-A3A1F							
			85C22CD	13D22CD	20D22CD	23D22CD	27D22CD	31D22CD	33D22CD	39D22CD
Rated voltage	U_N	V	380							
Rated current	I_N	A	15.7	21.6	33.8	38.9	45.8	54.8	57.3	65.8
Rated speed	n_N	rpm	2200	2200	2200	2200	2200	2200	2200	2200
Rated frequency	f_N	Hz	146.67	146.67	146.67	146.67	146.67	146.67	146.67	146.67
Rated torque	T_N	N·m	37	58	83	96	116	135	142	165
Rated power	P_N	kW	8.5	13.4	19.1	22.1	26.7	31.1	32.7	38.0
Rated point efficiency	η	%	91.6	92.3	93.1	93.2	93.6	93.7	94.3	95.1
Power of 65k	P (65k)	kW	7.8	10.7	13.0	16.4	21.0	26.0	/	/
65k torque	T (65k)	N·m	34.0	46.5	56.5	71.0	91.0	113.0	/	/
65k current	I (65 k)	A	13.60	16.90	21.70	27.70	35.40	44.80	/	/
Max. current	$I_{max.}$	A	48.0	48.0	55.5	66	84.0	84.0	112.5	135.0
Max. speed	N_{max}	rpm	3000							
Torque corresponding to max. speed	$T_{N·max}$	N·m	54.3	72.9	108.5	138.0	163	165.5	215.0	263.6
Peak current at rated speed	$I_{N·max}$	A	48	48	55.5	66	84	84	112.5	135
Peak torque at rated speed	$T_{N·max}$	N·m	77	101.7	138.5	173.7	208.2	210.4	284	334.5
D-axis incremental inductance	L_d	mH	6.301	4.901	2.633	2.042	1.79	1.481	1.786	1.2
Q-axis incremental inductance	L_q	mH	13.3	11.12	6.134	4.551	4.254	3.483	4.063	2.863
Line resistance at 20℃	R_w	Ω	1.133	0.6811	0.3764	0.2724	0.2072	0.1728	0.1897	0.1296
Torque constant at 20℃	K_t	N·m/A	2.7	2.88	2.7	2.62	2.65	2.61	2.93	2.61
Back EMF constant at 20℃	K_e	V/krpm	163.0	174.0	163.0	158	161	158.0	177.0	158.0
Back EMF temperature coefficient	dK_e/dT	%/℃	-0.1							

Item		Unit	Model: MEG20-XXXXXX-A3A1F							
			85C22CD	13D22CD	20D22CD	23D22CD	27D22CD	31D22CD	33D22CD	39D22CD
Stall current	I_o	A	19.6	26.2	42.5	46.0	55.0	63.0	68.0	79.3
Stall torque	T_o	N·m	46.3	70.4	104.4	114.2	139.1	155.3	168.9	199
Motor weight	M	kg	48.0	56.0	64.0	72.0	80.0	88.0	96.0	106.0
Rotor moment of inertia	J_m	kg·cm ^{2}	70.0	90.0	111.0	132.0	152.0	173.0	194.0	215.0

Table 2–4 Motor performance (flange size 200 x 200 at 2000 rpm)

Item		Unit	Model: MEG20-XXXXXX-A3A1F							
			80C20CD	13D20CD	18D20CD	22D20CD	25D20CD	30D20CD	32D20CD	35D20CD
Rated voltage	U_N	V	380							
Rated current	I_N	A	13.5	21.1	28.5	32.2	41.1	49.0	52.8	56.6
Rated speed	n_N	rpm	2000	2000	2000	2000	2000	2000	2000	2000
Rated frequency	f_N	Hz	133	133	133	133	133	133	133	133
Rated torque	T_N	N·m	38	59	85	102	120	140	149	168
Rated power	P_N	kW	8.0	12.4	17.8	21.4	25.1	29.3	31.2	35.2
Rated point efficiency	η	%	91.4	92.1	93.1	93.2	93.4	93.6	94.3	95.1
Power of 65k	P (65k)	kW	7.3	10.1	11.3	15.7	19.9	25.1	/	/
65k torque	T (65k)	N·m	35.0	48.0	54.0	75.0	95.0	120.0	/	/
65k current	I (65 k)	A	11.70	16.40	16.30	24.10	32.00	40.80	/	/
Max. current	$I_{max.}$	A	48.0	48.0	55.5	66	84.0	84.0	112.5	135
Max. speed	$_{N·max}$	rpm	3000							
Torque corresponding to max. speed	$T_{N·max}$	N·m	48	74.4	89.9	127.6	156.5	165.5	220.5	233.1
Peak current at rated speed	$I_{N·max}$	A	48	48	55.5	66	84	84	112.5	135
Peak torque at rated speed	$T_{N·max}$	N·m	74.9	115.2	136	185.6	226	240	307.3	352.9
D-axis incremental inductance	L_d	mH	7.554	5.258	4.236	2.832	2.454	2.03	1.696	1.64
Q-axis incremental inductance	L_q	mH	16.14	11.53	8.864	7.014	5.776	4.748	3.92	4.19
Line resistance at 20℃	R_w	Ω	1.556	0.8909	0.6313	0.4407	0.2901	0.2432	0.1897	0.200005
Torque constant at 20℃	K_t	N·m/A	3.14	3.09	3.18	3.32	3.10	3.02	2.94	3.27

Item		Unit	Model: MEG20-XXXXXX-A3A1F							
			80C20CD	13D20CD	18D20CD	22D20CD	25D20CD	30D20CD	32D20CD	35D20CD
Back EMF constant at 20℃	K_e	V/krpm	190	187	192	201	187	183	177	198
Back EMF temperature coefficient	dK_e/dT	%/℃	-0.1							
Stall current	I_o	A	15.8	25.3	34.6	39.5	50.6	59.0	64.4	72.4
Stall torque	T_o	N·m	44.6	70.7	103.2	125	147.9	169.6	181.8	215
Motor weight	M	kg	48.0	56.0	64.0	72.0	80.0	88.0	96.0	106.0
Rotor moment of inertia	J_m	$kg·cm^2$	70.0	90.0	111.0	132.0	152.0	173.0	194.0	215.0

Table 2–5 Motor performance (flange size 200 x 200 at 1700 rpm)

Item		Unit	Model: MEG20-XXXXXX-A3A1F							
			71C17CD	11D17CD	17D17CD	19D17CD	23D17CD	27D17CD	29D17CD	32D17CD
Rated voltage	U_N	V	380							
Rated current	I_N	A	13.0	19.5	27.4	30.0	36.8	43.0	45.5	48.8
Rated speed	n_N	rpm	1700	1700	1700	1700	1700	1700	1700	1700
Rated frequency	f_N	Hz	113	113	113	113	113	113	113	113
Rated torque	T_N	N·m	40	61	93	107	125	150	158	178
Rated power	P_N	kW	7.1	10.9	16.6	19.0	22.3	26.7	28.1	31.7
Rated point efficiency	η	%	91.4	92.1	93.1	93.2	93.4	93.6	94.2	95.1
Power of 65k	P (65k)	kW	6.6	8.7	10.9	14.1	17.6	23.0	/	/
65k torque	P (65k)	N·m	37.0	49.0	61.0	79.0	99.0	129.0	/	/
65k current	P (65k)	A	11.50	15.00	17.70	22.30	28.70	36.50	/	/
Max. current	$I_{max.}$	A	48.0	48.0	55.5	66	84.0	84.0	112.5	135
Max. speed	$N·max$	rpm	3000							
Torque corresponding to max. speed	$T_{N·max}$	N·m	43.7	63	92.6	110.3	142.4	158.3	202.3	191.8
Peak current at rated speed	$I_{N·max}$	A	48	48	55.5	66	84	84	112.5	135
Peak torque at rated speed	$T_{N·max}$	N·m	81.4	121.4	163.7	200	249.6	266.7	344.5	359.3
D-axis incremental inductance	L_d	mH	10.44	7.3	4.997	4.477	3.199	3.018	2.391	2.908
Q-axis incremental inductance	L_q	mH	21.37	16.08	11.15	9.883	7.538	6.939	5.416	6.69

Item		Unit	Model: MEG20-XXXXXX-A3A1F							
			71C17CD	11D17CD	17D17CD	19D17CD	23D17CD	27D17CD	29D17CD	32D17CD
Line resistance at 20℃	R_w	Ω	1.704	1.128	0.659	0.5837	0.3825	0.331	0.2813	0.2974
Torque constant at 20℃	K_t	N·m/A	3.44	3.54	3.54	3.74	3.54	3.61	3.52	3.92
Back EMF constant at 20℃	K_e	V/krpm	208	214	214	226	214	219	213	237
Back EMF temperature coefficient	dK_e/dT	%/℃	-0.1							
Stall current	I_o	A	15.4	22.5	30.6	36.7	42.6	50.6	54.3	58.7
Stall torque	T_o	N·m	47.6	70.7	103.9	131.2	145	176.8	188.9	214.3
Motor weight	M	kg	48	56	64	72	80	88	96	106
Rotor moment of inertia	J_m	$kg·cm^2$	70	90	111	132	152	173	194	215

Table 2–6 Motor performance (flange size 230 x 230 at 2200 rpm)

Item		Unit	Model: MEG23-XXXXXX-A3A1F			
			51D22CD	55D22CD	63D22CD	75D22CD
Rated voltage	U_N	V	380			
Rated current	I_N	A	88.0	92.5	112.5	125.2
Rated speed	n_N	rpm	2200	2200	2200	2200
Rated frequency	f_N	Hz	147	147	147	147
Rated torque	T_N	N·m	220	240	270	323
Rated power	P_N	kW	50.7	55.3	62.2	74.4
Rated point efficiency	η	%	95.2	95.4	95.5	95.6
Max. current	$I_{max.}$	A	135	168	202.5	202.5
Max. speed	$N·max$	rpm	3000			
Torque corresponding to max. speed	$T_{N·max}$	N·m	244.1	303.6	377.1	384.3
Peak current at rated speed	$I_{N·max}$	A	135	168	202.5	202.5
Peak torque at rated speed	$T_{N·max}$	N·m	319.5	405.5	492	501.5
D-axis incremental inductance	L_d	mH	1.54	1.458	1.066	1.056

Item		Unit	Model: MEG23-XXXXXX-A3A1F			
			51D22CD	55D22CD	63D22CD	75D22CD
Q-axis incremental inductance	L_q	mH	2.729	2.48	1.86	1.83
Line resistance at 20℃	R_w	Ω	0.1098	0.09942	0.07086	0.06644
Torque constant at 20℃	K_t	N·m/A	2.72	2.76	2.68	2.72
Back EMF constant at 20℃	K_e	V/krpm	164	167	162	164
Back EMF temperature coefficient	dK_e/dT	%/℃	-0.1			
Stall current	I_o	A	98.0	109.0	121.5	147.5
Stall torque	T_o	N·m	248	283	324	381.5
Motor weight	M	kg	101	111	121	131
Rotor moment of inertia	J_m	$kg·cm^2$	375	427	479	531

Table 2–7 Motor performance (flange size 230 x 230 at 2000 rpm)

Item		Unit	Model: MEG23-XXXXXX-A3A1F			
			48D20CD	52D20CD	59D20CD	67D20CD
Rated voltage	U_N	V	380			
Rated current	I_N	A	81.7	87.0	98.8	117.4
Rated speed	n_N	rpm	2000	2000	2000	2000
Rated frequency	f_N	Hz	133	133	133	133
Rated torque	T_N	N·m	227	245	280	322
Rated power	P_N	kW	47.5	51.3	58.6	67.4
Rated point efficiency	η	%	95.2	95.4	95.5	95.6
Max. current	$I_{max.}$	A	135	168	202.5	202.5
Max. speed	$N_{·max}$	rpm	3000			
Torque corresponding to max. speed	$T_{N·max}$	N·m	244.1	303.6	377.1	384.3
Peak current at rated speed	$I_{N·max}$	A	135	168	202.5	202.5
Peak torque at rated speed	$T_{N·max}$	N·m	358.8	422.1	504	557.7
D-axis incremental inductance	L_d	mH	1.917	1.853	1.37	1.105

Item		Unit	Model: MEG23-XXXXXX-A3A1F			
			48D20CD	52D20CD	59D20CD	67D20CD
Q-axis incremental inductance	L_q	mH	3.284	3.332	2.543	2.006
Line resistance at 20℃	R_W	Ω	0.1403	0.1246	0.09965	0.07907
Torque constant at 20℃	K_t	N·m/A	3.04	3.16	3.11	2.96
Back EMF constant at 20℃	K_e	V/krpm	183.5	190.79	188	179
Back EMF temperature coefficient	dK_e/dT	%/℃	-0.1			
Stall current	I_o	A	97.0	105.5	120.5	148.0
Stall torque	T_o	N·m	269.6	297.2	341.6	406
Motor weight	M	kg	101	111	121	131
Rotor moment of inertia	J_m	$kg·cm^2$	375	427	479	531

Table 2–8 Motor performance (flange size 230 x 230 at 1700 rpm)

Item		Unit	Model: MEG23-XXXXXX-A3A1F			
			41D17CD	48D17CD	55D17CD	59D17CD
Rated voltage	U_N	V	380			
Rated current	I_N	A	70.8	79.5	88.4	99.7
Rated speed	n_N	rpm	1700	1700	1700	1700
Rated frequency	f_N	Hz	113	113	113	113
Rated torque	T_N	N·m	233	268	305	325
Rated power	P_N	kW	41.4	47.7	54.3	57.8
Rated point efficiency	η	%	95.2	95.4	95.5	95.6
Max. current	$I_{max.}$	A	135	168	202.5	202.5
Max. speed	$_{N·max}$	rpm	3000			
Torque corresponding to max. speed	$T_{N·max}$	N·m	208.8	237.4	264.4	318.7
Peak current at rated speed	$I_{N·max}$	A	135	168	202.5	202.5
Peak torque at rated speed	$T_{N·max}$	N·m	390.7	460.1	509.2	587.1
D-axis incremental inductance	L_d	mH	2.585	2.31	2.234	1.723
Q-axis incremental inductance	L_q	mH	4.419	3.901	3.899	2.978

Item		Unit	Model: MEG23-XXXXXX-A3A1F			
			41D17CD	48D17CD	55D17CD	59D17CD
Line resistance at 20℃	R_w	Ω	0.1895	0.1619	0.138	0.1128
Torque constant at 20℃	K_t	N·m/A	3.51	3.51	3.80	3.46
Back EMF constant at 20℃	K_e	V/krpm	212.5	212	229.9	209.2
Back EMF temperature coefficient	dK_e/dT	%/℃	-0.1			
Stall current	I_o	A	85.1	95.5	106.5	117.6
Stall torque	T_o	N·m	279.9	322.2	367.6	383.5
Motor weight	M	kg	101	111	121	131
Rotor moment of inertia	J_m	$kg·cm^2$	375	427	479	531

2.2.3.2 Mechanical Characteristics

Table 2–9 Motor specifications

Item	Specification				
Degree of protection	IP54				
Voltage withstanding level	2160 VAC for 1s (380 V class)				
Insulation resistance 500 VDC	≥ 20 MΩ				
Max. vibration acceleration	Peak acceleration 50 m/s^2; duration: 30 ms				
Max. vibration in radial direction	Acceleration 25 m/s^2; vibration duration: 30 min				
Insulation class	155 (F)				
Cooling method	IC 416				
Type of construction	IM B35/IM V1				
Duty cycle	S1				
PT1000 alarm threshold	130℃				
Resistance of PT1000 at 10℃ to 30℃	1039 Ω to 1118 Ω				
Ambient temperature	-20℃ to +40℃ (non-frozen)				
Ambient humidity	20% to 90% RH (without condensation)				
Storage temperature	-20℃ to +60℃ (non-frozen)				
Storage humidity	20% RH to 90% RH (without condensation)				
Rated altitude	Below 1000 m (derating required for altitudes above 1000 m)				
Altitude-based derating	1000 m	2000 m	3000 m	4000 m	5000 m
	1	0.947	0.887	0.824	0.645
Ambient temperature-based derating	40℃	45℃	50℃	55℃	60℃
	1	0.952	0.901	0.855	0.781

Item	Specification
Operating location	• Install the drive in a place free from corrosive and inflammable gases and combustible materials, such as the hydrogen sulfide, chlorine, ammonia, sulphur gas, chloridize gas, acid, soda and salt. • Use the motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings. • Install the motor away from heating sources such as a heating stove. • Do not use the motor in an enclosed environment. Running in an enclosed environment can lead to motor overtemperature, which shortens its service life.

Table 2–10 Fan specifications

Item	G23-SC225A1-068-00M	G20-SC175A1-068-000
Rated voltage	230 VAC	
Rated voltage range	207 VAC to 253 VAC	
Capacitance (±5%)	4 μF/450 V	1.5 μF/450 V
Current (±10%)	0.62 A/0.87 A	0.23 A/0.24 A
Input power (±10%)	140 W/198 W	48 W/55 W
Noise (-7/+3)	71 dB/73 dB	61 dB/64 dB
Degree of protection	IP54	IP54 (for horizontal shaft installation)
Insulation class	F	

2.2.4 Product Dimensions

Dimensions of MEG20-*******-A3A1F servo motors

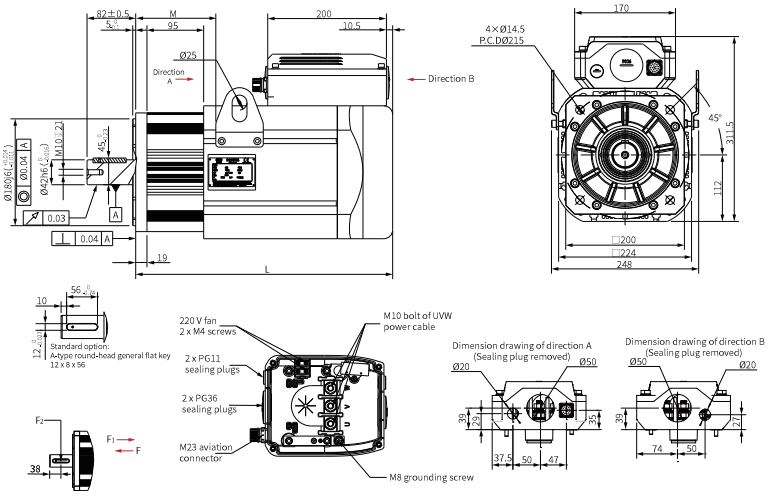


Figure 2-5 Dimensions of MEG20-*******-A3A1F servo motors (unit: mm)

Note

- Technical requirements: The tolerance of unmarked dimensions is compliant with GB/T 18042000 Class C.
- Foot mounting is available. Contact Inovance for details.

Table 2–11 Dimensions and weight of MEG20-*******-A3A1F servo motors

Model MEG20-*******-A3A1F	M (mm)	L (mm)	Net weight (kg)	Gross weight (kg)
71C17CD 80C20CD 85C22CD	134	320	30	35
11D17CD 13D20CD 13D22CD	134	351	35	40
17D17CD 18D20CD 20D22CD	134	377	40	50
19D17CD 22D20CD 23D22CD	134	405	45	50
23D17CD 25D20CD 27D22CD	135	434	50	55
27D17CD 30D20CD 31D22CD	148	462	55	60
29D17CD 32D20CD 33D22CD	162	491	60	70
32D17CD 35D20CD 39D22CD	180	519	70	75

MEG20-*******-A3A1F-K

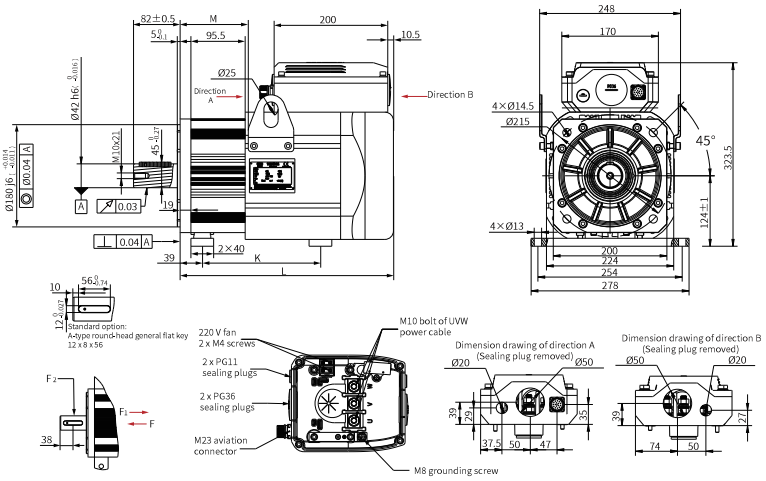


Figure 2-6 Dimensions of MEG20-*******-A3A1F-K servo motors (unit: mm)

Note

- Technical requirements: The tolerance of unmarked dimensions is compliant with GB/T 18042000 Class C.
- Foot mounting is available. Contact Inovance for details.

Table 2–12 Dimensions and weight of MEG20-*******-A3A1F-K servo motors

Model MEG20-*******-A3A1F	M (mm)	L (mm)	K (mm)	Net weight (kg)	Gross weight (kg)
71C17CD 80C20CD 85C22CD	134	320	151	35	40
11D17CD 13D20CD 13D22CD	134	351	180	40	45
17D17CD 18D20CD 20D22CD	134	377	208	45	50
19D17CD 22D20CD 23D22CD	134	405	237	50	55
23D17CD 25D20CD 27D22CD	135	434	265	55	60
27D17CD 30D20CD 31D22CD	148	462	294	60	70
29D17CD 32D20CD 33D22CD	162	491	322	65	75
32D17CD 35D20CD 39D22CD	180	519	351	75	80

MEG20-*******-A3A1F-W

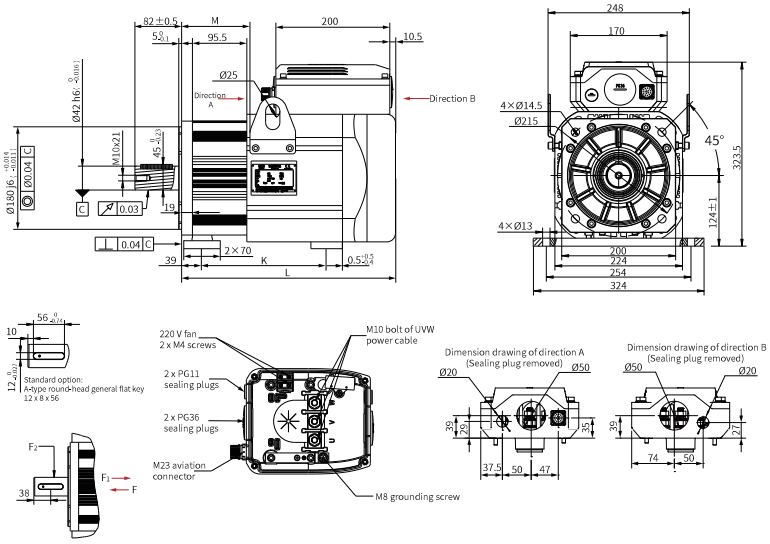


Figure 2-7 Dimensions of MEG20-*******-A3A1F-W servo motors (unit: mm)

Note

- Technical requirements: The tolerance of unmarked dimensions is compliant with GB/T 18042000 Class C.
- Foot mounting is available. Contact Inovance for details.

Table 2–13 Dimensions and weight of MEG20-*******-A3A1F-W servo motors

Model MEG20-*******-A3A1F	M (mm)	L (mm)	K (mm)	Net weight (kg)	Gross weight (kg)
71C17CD 80C20CD 85C22CD	134	320	151	35	40
11D17CD 13D20CD 13D22CD	134	351	180	40	45
17D17CD 18D20CD 20D22CD	134	377	208	45	50
19D17CD 22D20CD 23D22CD	134	405	237	50	55
23D17CD 25D20CD 27D22CD	135	434	265	55	60
27D17CD 30D20CD 31D22CD	148	462	294	60	70

Model MEG20-*******-A3A1F	M (mm)	L (mm)	K (mm)	Net weight (kg)	Gross weight (kg)
29D17CD 32D20CD 33D22CD	162	491	322	65	75
32D17CD 35D20CD 39D22CD	180	519	351	75	80

Dimensions of MEG23-*******-A3A1F servo motors

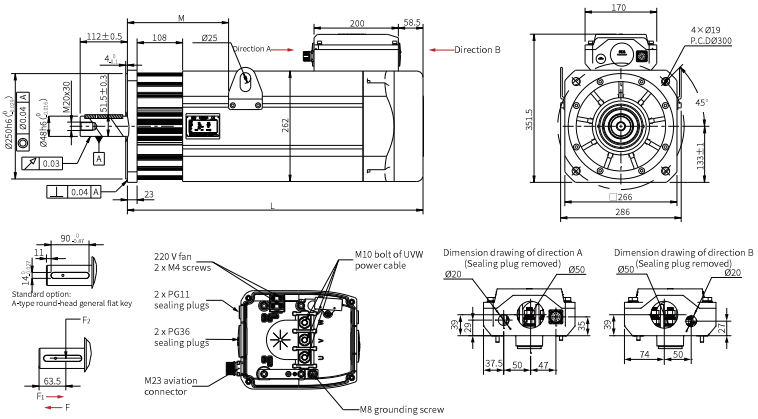


Figure 2-8 Dimensions of MEG23-*******-A3A1F servo motors (unit: mm)

Note

- Technical requirements: The tolerance of unmarked dimensions is compliant with GB/T 18042000 Class C.
- Foot mounting is available. Contact Inovance for details.

Table 2–14 Dimensions and weight of MEG23-*******-A3A1F servo motors

Model MEG23-*******-A3A1F	M (mm)	L (mm)	Net weight (kg)	Gross weight (kg)
41D17CD 48D20CD 51D22CD	188	568	90	100
48D17CD 52D20CD 55D22CD	205	611.5	105	110
55D17CD 59D20CD 63D22CD	223	657	115	125

Model MEG23-*******-A3A1F	M (mm)	L (mm)	Net weight (kg)	Gross weight (kg)
59D17CD 67D20CD 75D22CD	240	701.5	125	135
63D17CD 72D20CD 79D22CD	260	746	135	140

MEG23-*******-A3A1F-K

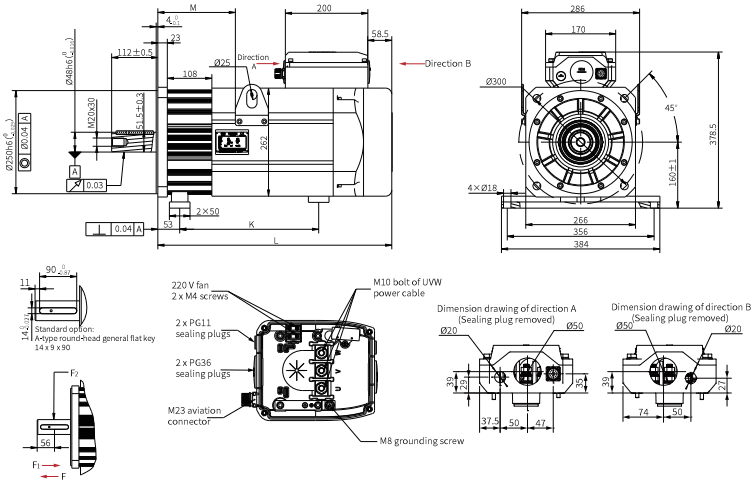


Figure 2-9 Dimensions of MEG23-*******-A3A1F-K servo motors (unit: mm)

Note

- Technical requirements: The tolerance of unmarked dimensions is compliant with GB/T 18042000 Class C.
- Foot mounting is available. Contact Inovance for details.

Table 2–15 Dimensions and weight of MEG23-*******-A3A1F-K servo motors

Model MEG23-*******-A3A1F	M (mm)	K (mm)	L (mm)	Net weight (kg)	Gross weight (kg)
41D17CD 48D20CD 51D22CD	188	568	337	90	100
48D17CD 52D20CD 55D22CD	205	611.5	380	110	120
55D17CD 59D20CD 63D22CD	223	657	426	125	130
59D17CD 67D20CD 75D22CD	240	701.5	470	135	140

MEG23-*******-A3A1F-W

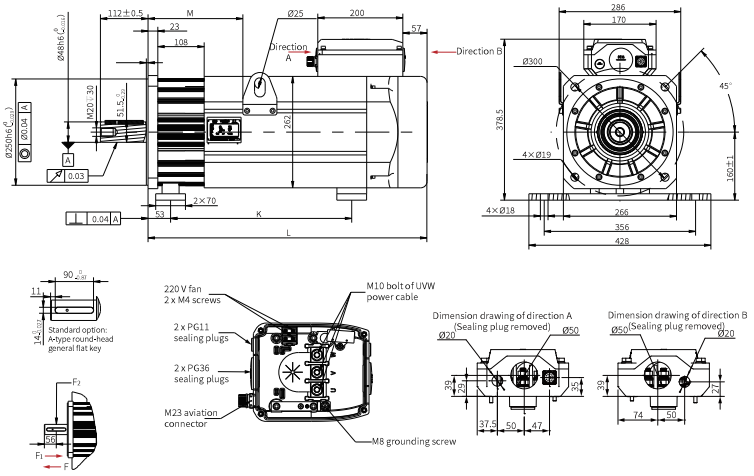


Figure 2-10 Dimensions of MEG23-*******-A3A1F-W servo motors (unit: mm)

Note

- Technical requirements: The tolerance of unmarked dimensions is compliant with GB/T 18042000 Class C.
- Foot mounting is available. Contact Inovance for details.

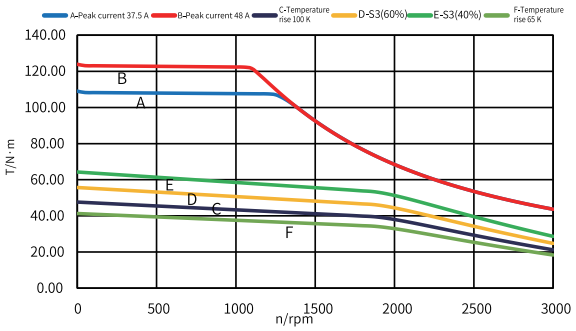
Table 2–16 Dimensions and weight of MEG23-*******-A3A1F-W servo motors

Model MEG23-*******-A3A1F	M (mm)	K (mm)	L (mm)	Net weight (kg)	Gross weight (kg)
41D17CD 48D20CD 51D22CD	188	568	337	90	100
48D17CD 52D20CD 55D22CD	205	611.5	380	105	110
55D17CD 59D20CD 63D22CD	223	657	426	125	130
59D17CD 67D20CD 75D22CD	240	701.5	470	135	140

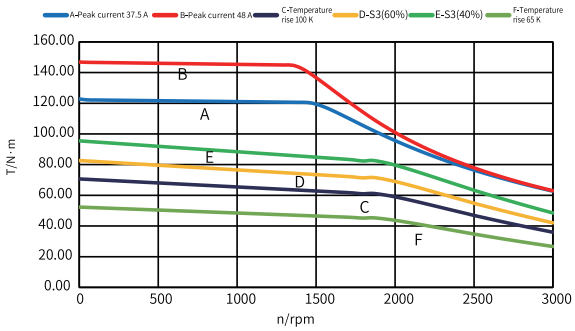
2.2.5 Torque-Speed Characteristics

Table 2–17 1700 rpm rated speed

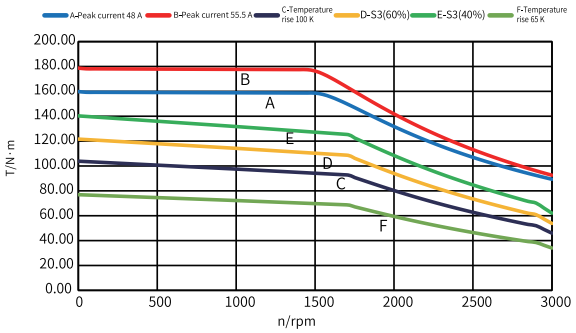
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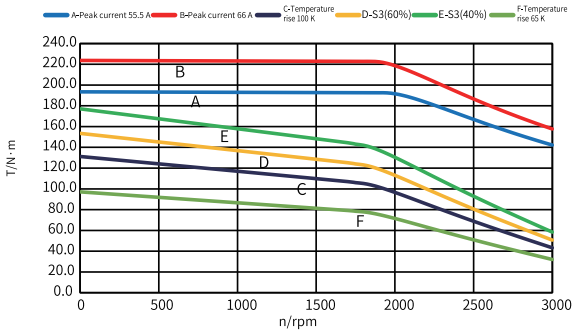
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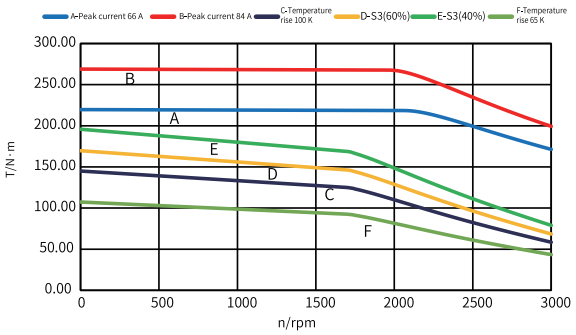
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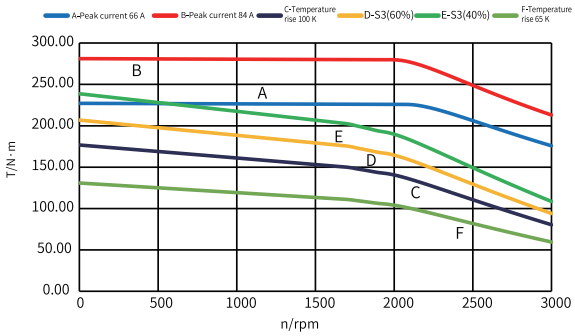
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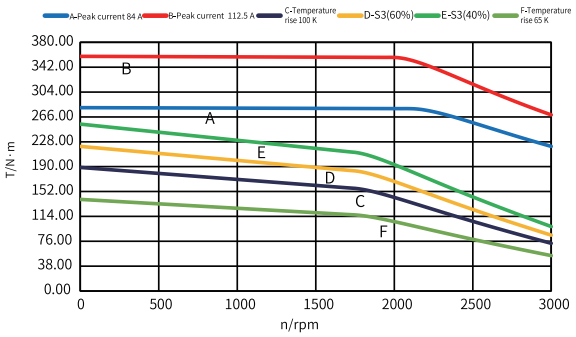
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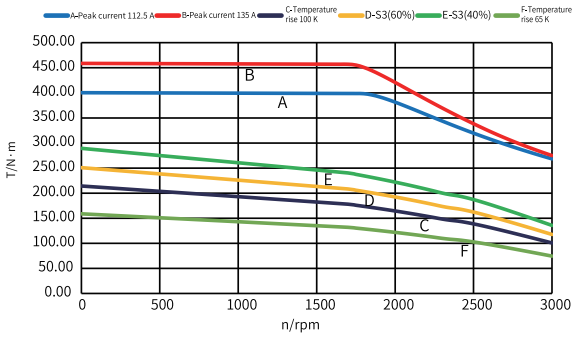
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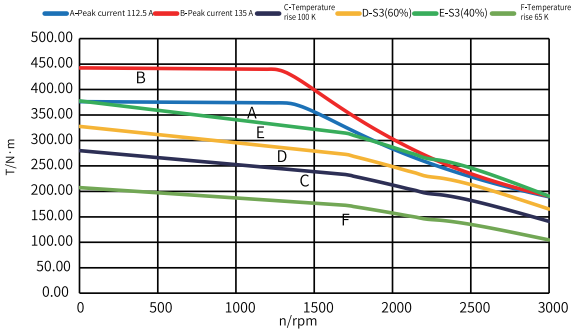
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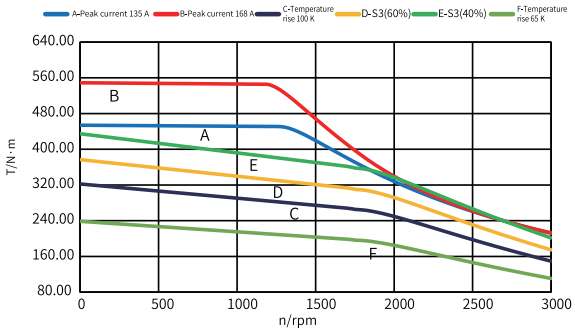
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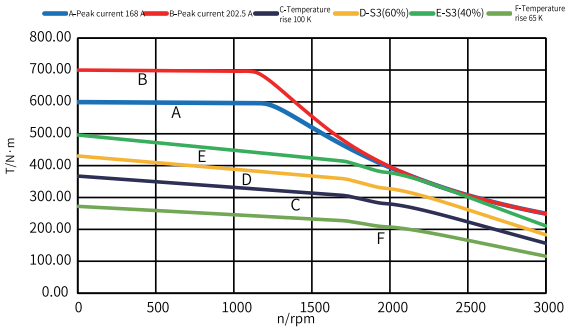
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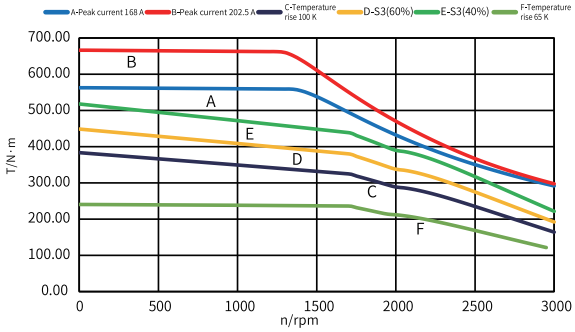
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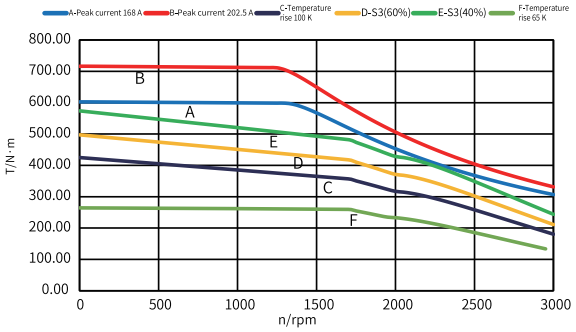
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MEG23-59D17CD-A3A1F



MEG23-63D17CD-A3A1F



MEG20-35D17CD-A3A1F

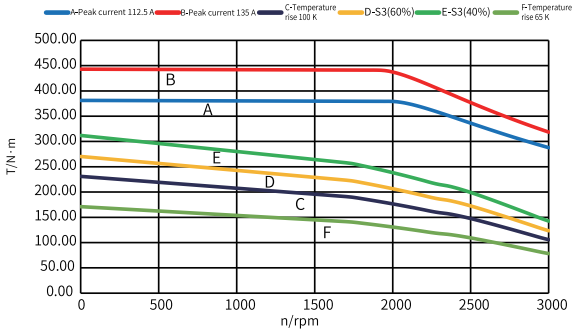
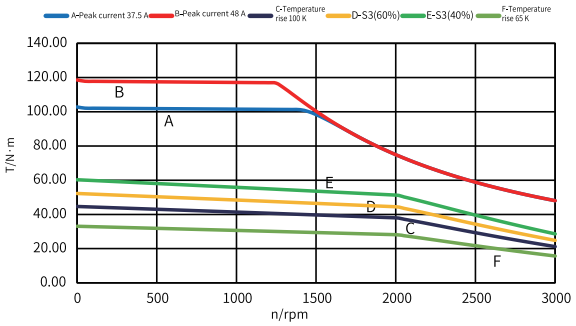
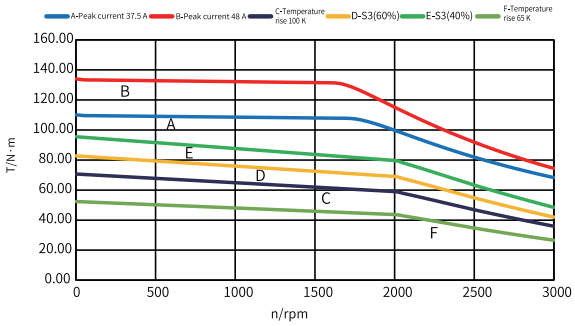


Table 2–18 2000 rpm rated speed

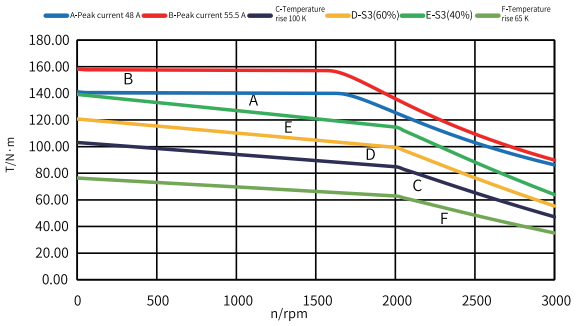
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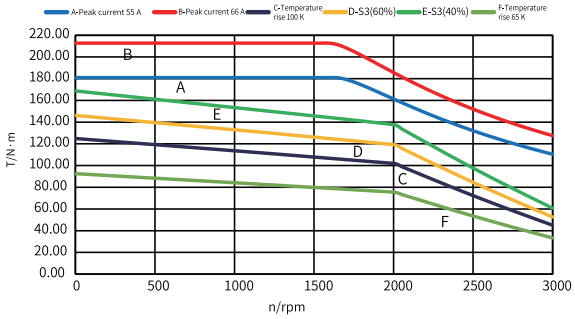
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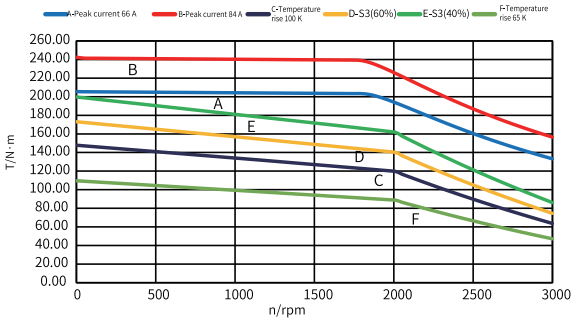
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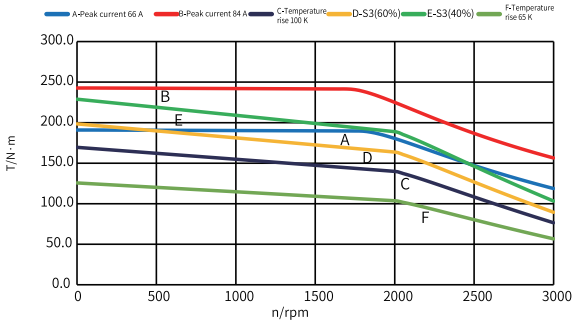
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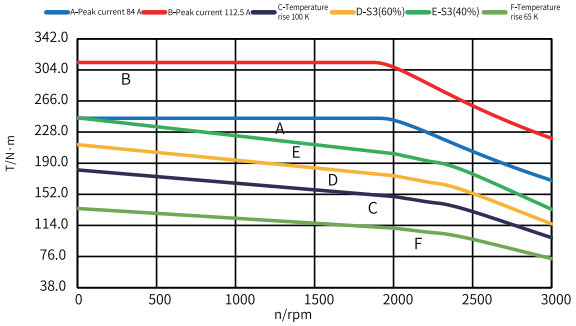
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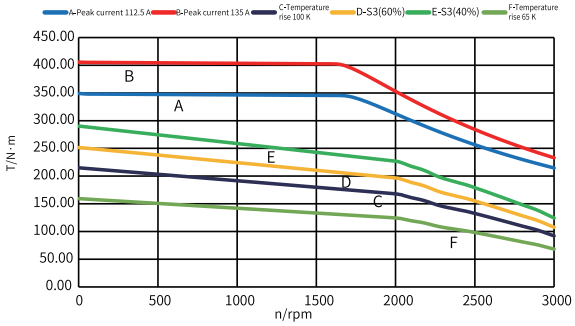
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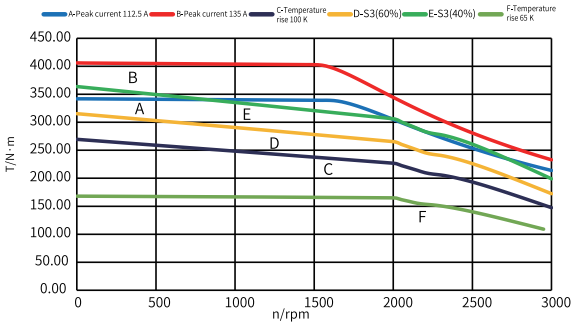
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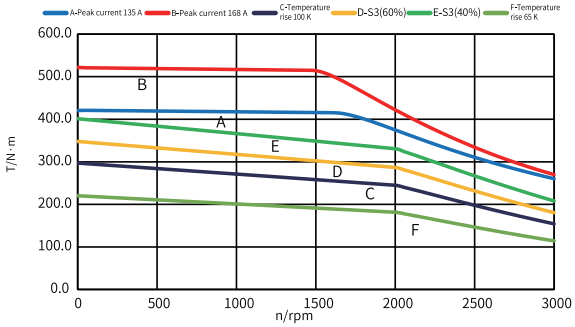
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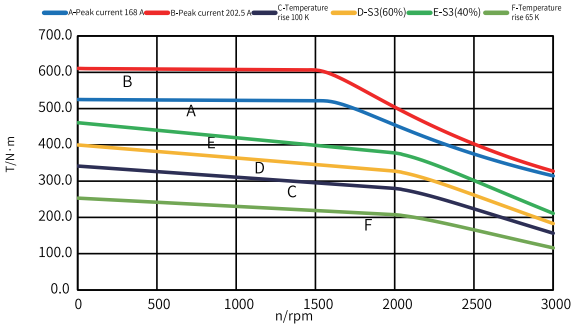
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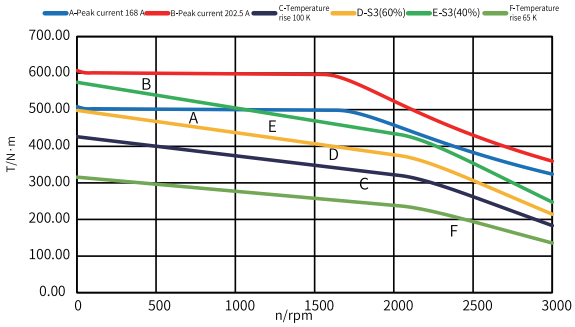
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MEG23-59D20CD-A3A1F



MEG23-67D20CD-A3A1F



MEG20-38D20CD-A3A1F

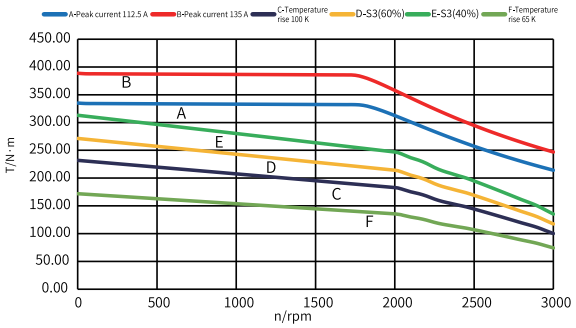
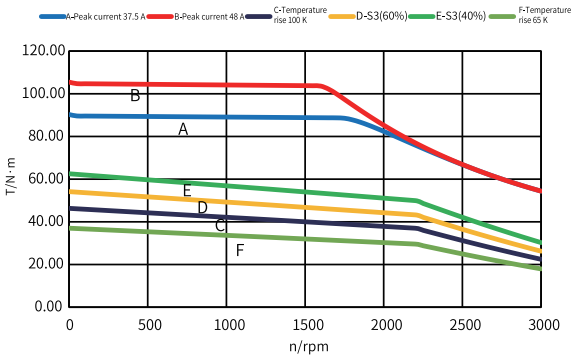
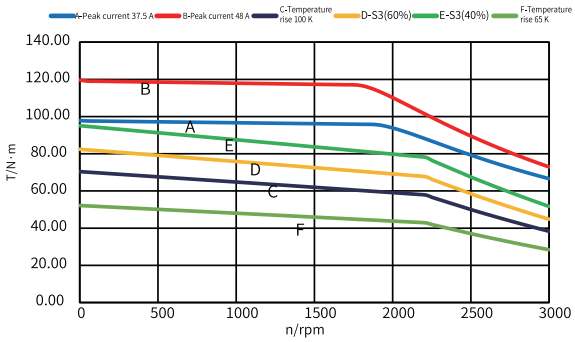


Table 2–19 2200 rpm rated speed

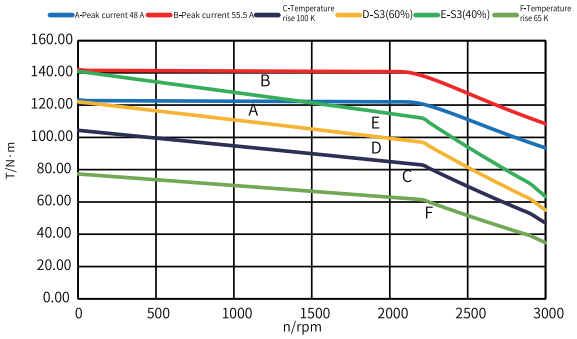
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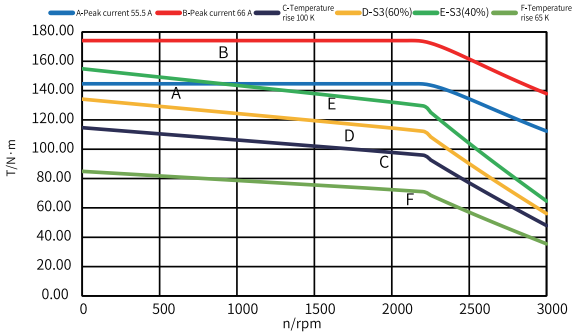
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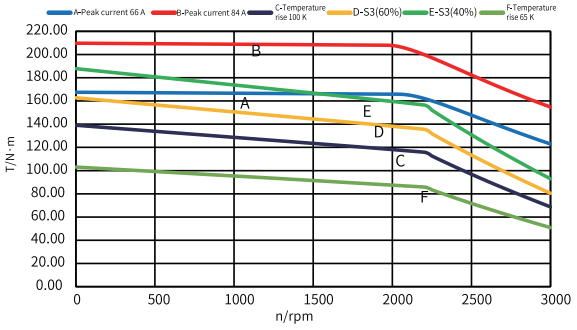
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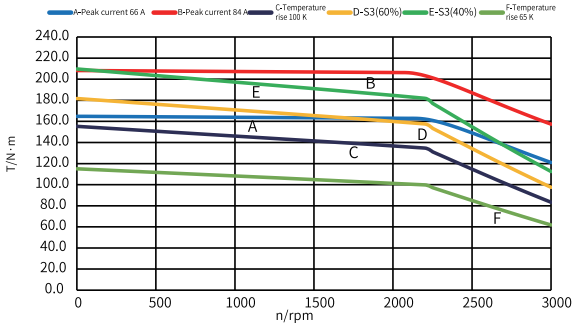
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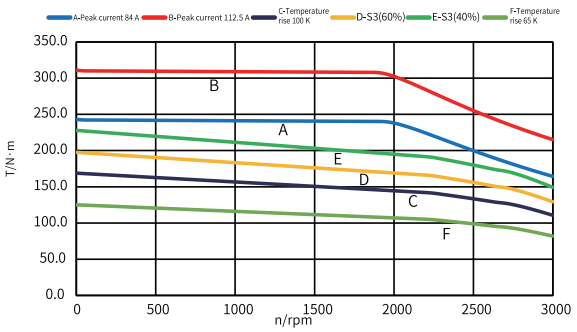
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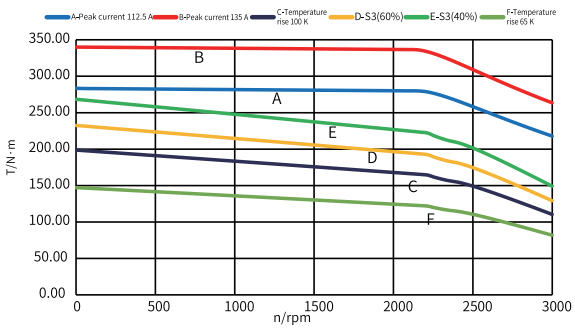
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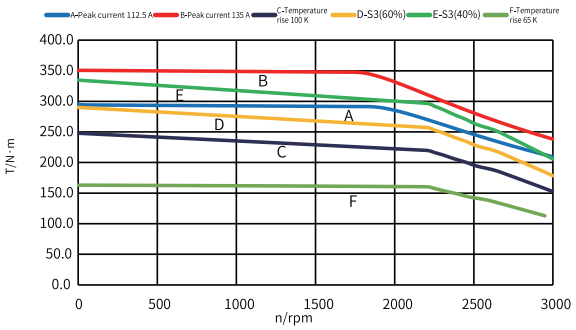
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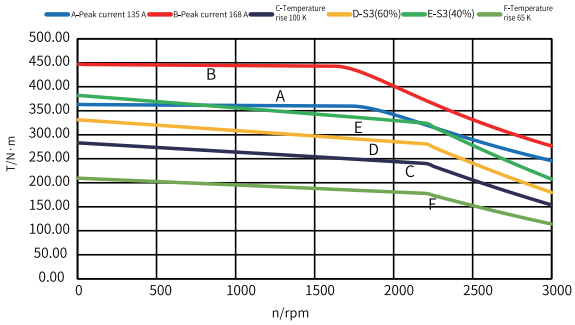
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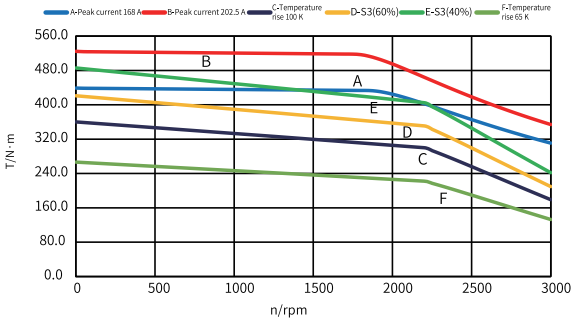
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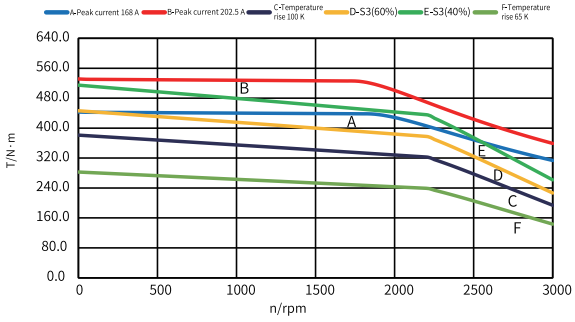
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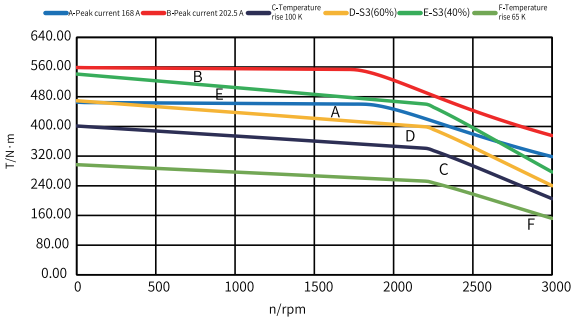
MEG23-63D22CD-A3A1F



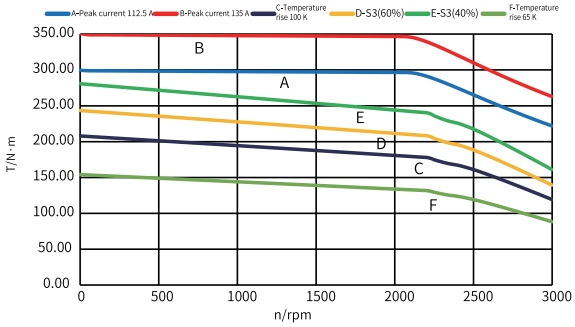
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MEG23-79D22CD-A3A1F



MEG20-42D22CD-A3A1F



2.3 Servo System Configurations

Drive model	Motor model
ES680-4T025-C1	MEG20-71C17CD-A3A1F MEG20-80C20CD-A3A1F MEG20-85C22CD-A3A1F MEG20-11D17CD-A3A1F MEG20-13D20CD-A3A1F MEG20-13D22CD-A3A1F
ES680-4T032-C1	MEG20-71C17CD-A3A1F MEG20-80C20CD-A3A1F MEG20-85C22CD-A3A1F MEG20-11D17CD-A3A1F MEG20-13D20CD-A3A1F MEG20-13D22CD-A3A1F MEG20-17D17CD-A3A1F MEG20-18D20CD-A3A1F MEG20-20D22CD-A3A1F
ES680-4T037-C1	MEG20-17D17CD-A3A1F MEG20-18D20CD-A3A1F MEG20-20D22CD-A3A1F MEG20-19D17CD-A3A1F MEG20-22D20CD-A3A1F MEG20-23D22CD-A3A1F
ES680-4T044-C1	MEG20-19D17CD-A3A1F MEG20-22D20CD-A3A1F MEG20-23D22CD-A3A1F MEG20-23D17CD-A3A1F MEG20-25D20CD-A3A1F MEG20-27D22CD-A3A1F MEG20-23D17CD-A3A1F MEG20-30D20CD-A3A1F MEG20-31D22CD-A3A1F
ES680-4T060-C1	MEG20-23D17CD-A3A1F MEG20-25D20CD-A3A1F MEG20-27D22CD-A3A1F MEG20-23D17CD-A3A1F MEG20-30D20CD-A3A1F MEG20-31D22CD-A3A1F MEG20-29D17CD-A3A1F MEG20-32D20CD-A3A1F MEG20-33D22CD-A3A1F

Drive model	Motor model
ES680-4T075-C1	MEG20-29D17CD-A3A1F MEG20-32D20CD-A3A1F MEG20-33D22CD-A3A1F MEG20-32D17CD-A3A1F MEG20-35D20CD-A3A1F MEG20-39D22CD-A3A1F MEG20-38D20CD-A3A1F MEG20-42D22CD-A3A1F MEG23-41D17CD-A3A1F MEG23-48D20CD-A3A1F MEG23-51D22CD-A3A1F
ES680-4T091-C1	MEG20-32D17CD-A3A1F MEG20-35D20CD-A3A1F MEG20-39D22CD-A3A1F MEG23-41D17CD-A3A1F MEG23-48D20CD-A3A1F MEG23-51D22CD-A3A1F MEG23-48D17CD-A3A1F MEG23-52D20CD-A3A1F MEG23-55D22CD-A3A1F
ES680-4T112-C1	MEG23-48D17CD-A3A1F MEG23-52D20CD-A3A1F MEG23-55D22CD-A3A1F MEG23-55D17CD-A3A1F MEG23-59D20CD-A3A1F MEG23-63D22CD-A3A1F MEG23-59D17CD-A3A1F MEG23-67D20CD-A3A1F MEG23-75D22CD-A3A1F
ES680-4T150-C1	MEG23-55D17CD-A3A1F MEG23-59D20CD-A3A1F MEG23-63D22CD-A3A1F MEG23-59D17CD-A3A1F MEG23-67D20CD-A3A1F MEG23-75D22CD-A3A1F MEG23-63D17CD-A3A1F MEG23-72D20CD-A3A1F MEG23-79D22CD-A3A1F
ES680-4T176-C1	Being developed
ES680-4T210-C1	MEG26-33B25CD-A3A1L
ES680-4T253-C1	Being developed

Drive model	Encoder cable model
ES680-4T025-C1	ES680-P10-3.0 ES680-P10-6.0 ES680-P10-8.0 ES680-P10-12.0 ES680-P10-15.0 ES680-P10-25.0 ES680-P10-30.0
ES680-4T032-C1	
ES680-4T037-C1	
ES680-4T044-C1	
ES680-4T060-C1	
ES680-4T075-C1	
ES680-4T091-C1	
ES680-4T112-C1	
ES680-4T150-C1	
ES680-4T176-C1	
ES680-4T210-C1	
ES680-4T253-C1	

2.4 System Composition

Install necessary peripheral components on the input/output side of the drive to ensure safety and stability of the hydraulic system used to control permanent magnet synchronous motors. The system components are as shown in the following figure.

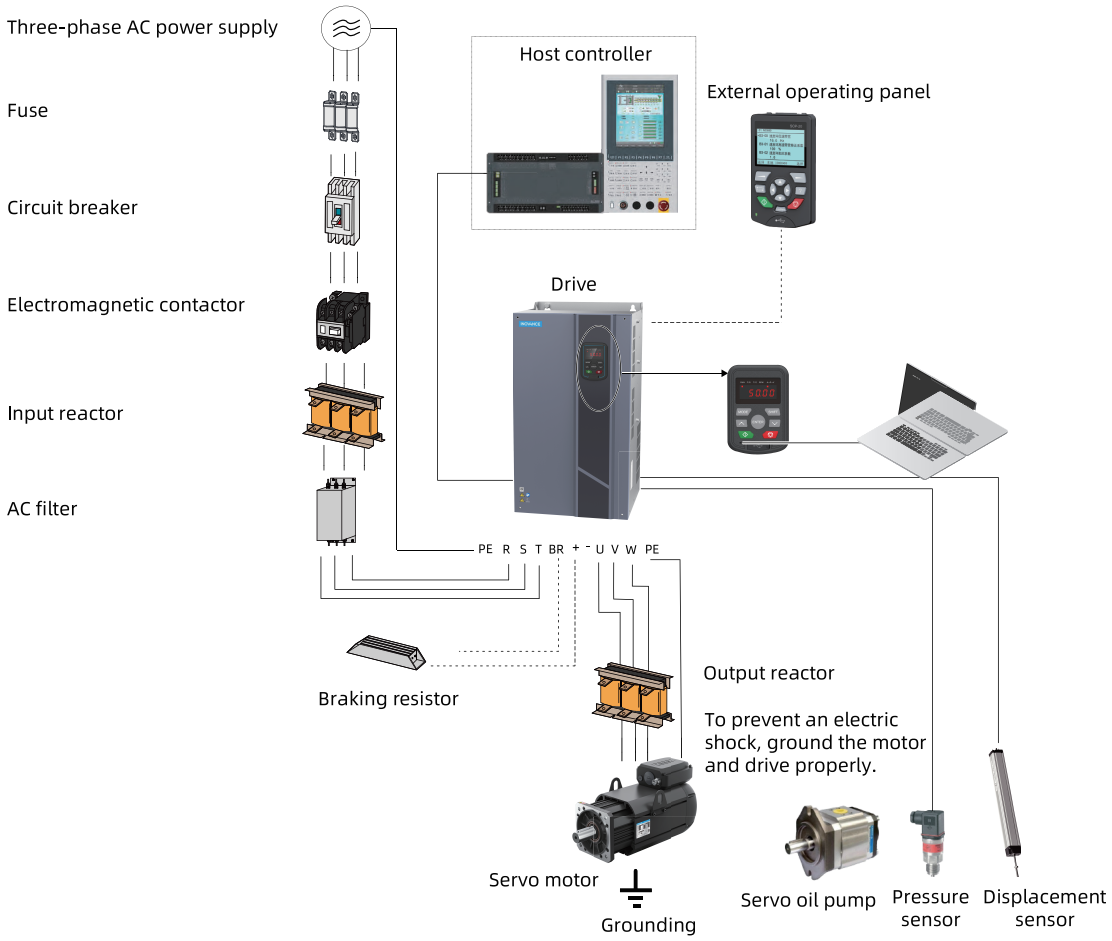


Figure 2-11 System components

Component	Installation position	Function description
Fuse	Between the power supply and the input side of the drive	Provides protection against short circuit and protects downstream rectifier module semiconductors.
Circuit breaker	Between the power supply and the input side of the drive	Short circuit breaker: Cuts off the power supply when overcurrent occurs on downstream devices to prevent accidents. Earth leakage circuit breaker (ELCB): Provides protection against potential leakage current during drive running to prevent electric shock and even a fire. Select proper ELCBs as needed.
Electromagnetic Contactor	Between the circuit breaker and the input side of the drive	Controls energization and de-energization of the drive. Do not use the contactor to power on or off the drive frequently (ensure a minimal interval of one hour) or use the contactor to directly start the drive.
Input reactor	Input side of the drive	Improve the input-side power factor. Eliminate harmonics on the input side and prevent other devices from being damaged due to voltage waveform distortion. Eliminate input current unbalance due to inter-phase unbalance. It is recommended to install the input reactor in case of power grid suffering from pollution and harmonics.
AC filter	Input side of the drive	Reduces the conduction and radiation interference generated by the drive to external devices. Reduces conductive interference flowed from the power supply to the servo drive, improving the anti-interference capacity of the servo drive.
Braking resistor	Input side of the drive	Consumes the regenerative energy generated during deceleration.
Output reactor	Between the output side of the drive and the motor (close to the drive)	Harmonics are present in the output side of the servo drive. When the motor is far away from the drive, there is high distributed capacitance in the circuit, Certain harmonics may cause resonance in the circuit, which will: • Degrade the motor insulation performance and damage the motor in the long run. • Generates large leakage current, thereby activating frequent protection trips of the drive. It is recommended to install an output AC reactor if the distance between the servo drive and the motor exceeds 100 m.
Output magnetic ring	Output side of the drive	Reduces bearing current.
Host controller	Some control signals are connected to the drive.	Used to control the overall operations, sen commands to the drive, and exchange data with the drive.
Servo motor	Output side of the drive	Use a proper motor.
Servo oil pump	Connected to the servo motor	Provides flow and pressure for the hydraulic system.
Pressure sensor	Oil outlet on the oil circuit (with feedback signals connected to the drive)	Provides pressure feedback of the hydraulic circuit in analog signals.

Component	Installation position	Function description
Displacement sensor	Template of the injection molding machine	Provides position feedback analog signals for closed-loop position control.
External operating panel	CN7 interface	Used for commissioning and parameter settings.

2.5 List of Options

Table 2–20 List of optional parts

Component		Model	Applicable model	Description
Expan-sion Card	RS485 communication expansion card	MD38IO3	All models	Provides three DIs, one RS485 communication signal isolation input, and one NO relay output.
	CAN communication expansion card	MD38CAN1	All models	Supports CANopen communication
	PROFIBUS DP fieldbus communication expansion card	MD38DP2	T4 and above	Supports PROFIBUS DP communication.
	PROFINET communication expansion card	MD500-PN1	All models	Supports PROFINET communication.
Input reactor		For applicable models, see *"8.1.2 AC Input Reactor" on page 122*		-
EMC filter		For applicable models, see *"8.1.3 EMC Filter" on page 125*		-
Output reactors		For applicable models, see *"8.1.6 Output Reactor" on page 131*		-
Magnetic ring and ferrite clamp		For product models, see *"8.1.7 Magnetic Ring and Ferrite Clamp" on page 135*	All models	-
External Operating Panel		SOP-20-880 and SOP-20-810	All models	Equipped with LCD and operating panel to support parameter copy/ modification.
Extension cable		MDCAB	All models	Standard 8-core cable with a length of 3 m as standard Used to connect external operating panel SOP-20-880 or SOP-20-810.
Through-hole mounting bracket		MD500-AZJ- A1T*	For applicable models, see *"8.3 Through-Hole Mounting Bracket" on page 141*	Fulfills the through-hole mounting demands of the customer.
Grounding Bracket for Cable Shield		For applicable models, see *"8.4 Grounding Bracket of Cable Shield" on page 148*		Supports repetitive power cable fixation and 360° grounding of the shield.

3 Unpacking and Handling

3.1 Pre-unpacking Handling

3.1.1 Packing Dimensions and Weight (with Package)

T model	Drive model	Package type	Exterior package dimensions (mm) L × W × H	Net weight (kg)	Gross weight (kg)
T3	ES680-4T025-C1	Carton box + Expanded polyethylene	360 x 208 x 235	3.3	3.6
T4	ES680-4T032-C1 ES680-4T037-C1 ES680-4T044-C1	Carton box + Expanded polyethylene	420 x 270 x 265	4.3	4.7
T5	ES680-4T060-C1	Carton box + Expanded polyethylene	465 x 352 x 322	7.6	8.6
T6	ES680-4T075-C1 ES680-4T091-C1	Carton box + Expanded polyethylene	530 x 386 x 367	17.7	19.1
T7	ES680-4T112-C1 ES680-4T150-C1	Carton box + Expanded polyethylene + Plywood pallet	715 x 435 x 427	34.5	42
T8	ES680-4T176-C1 ES680-4T210-C1 ES680-4T253-C1	Carton box + Expanded polyethylene + Plywood pallet	742 x 480 x 467	51	59

3.1.2 Handling Requirements

- T3 to T6 models are small and light and therefore can be handled manually. T7 to T8 models, however, must be transported with an appropriate lifting tool.
- When handling the drive with a forklift, fix the drive to a wooden pallet. When handling the drive with a crane, fix the drive to a pallet and lift them together, as shown in the following figure.

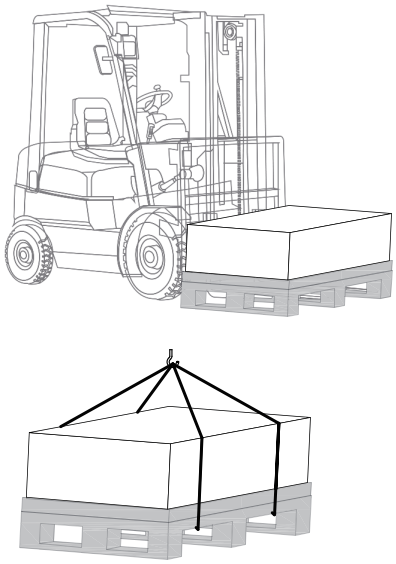


Figure 3-1 Lifting the drive

- Transport the drive in the upright position indicated on the packing box. Never turn it upside down or place it on its side, as shown in the following figure.

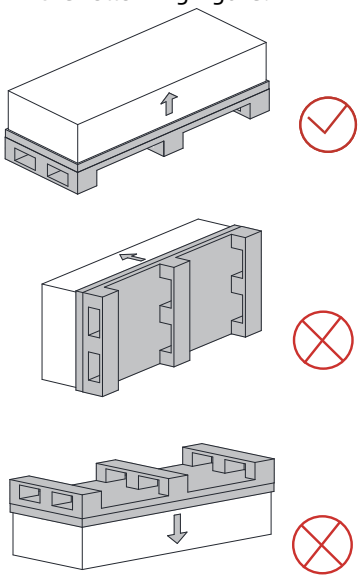


Figure 3-2 Placing the drive

3.2 Unpacking Inspection

When receiving goods from the shipping company, check that you have received all the items specified on the delivery note. Notify the shipping company immediately of any missing components or damage. If necessary, contact Inovance or the local agent for technical support.

Caution

The electrical safety performance of the drive may be affected if it is damaged during transportation. Perform professional high-voltage test on the drive before connection.

Packing methods and components vary with models due to difference in structural dimensions and weight.

- T3 to T6 models are packed using cartons.
- T7 to T8 models are packed using cartons and plywood pallets.

The following figure shows the packing list.

- **Packing list for T3 to T6 models**

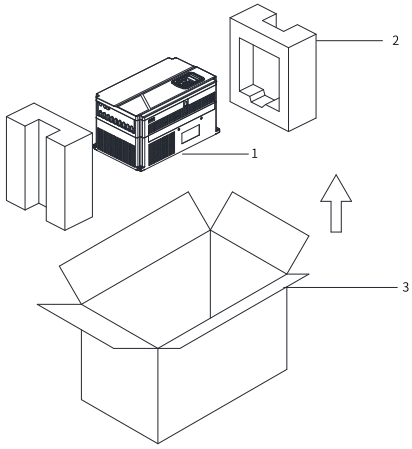


Figure 3-3 Packing list for T3 to T6 models

No.	Name
1	Drive
2	Cushion
3	Carton

- **Packing list of T7 to T8 models**

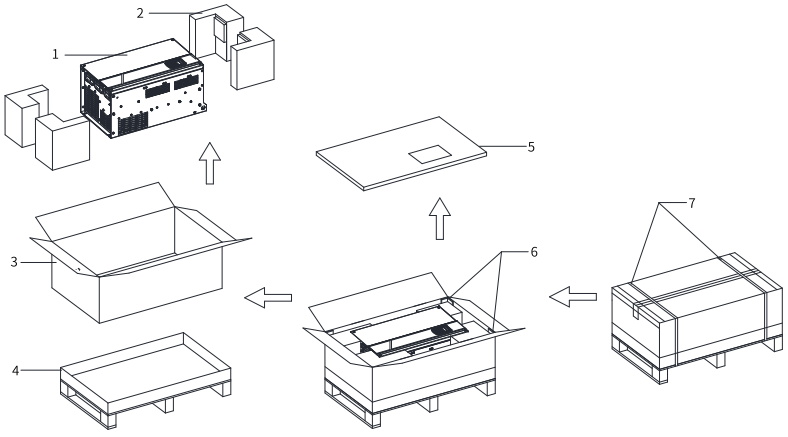


Figure 3-4 Packing list of T7 to T8 models

No.	Name
1	Drive
2	Cushion
3	Carton
4	Plywood pallet
5	Honeycomb cardboard
6	Paper corner protector
7	Packing strap

Note

Dispose of the packaging materials in accordance with applicable local regulations.

3.3 Handling and Hoisting After Unpacking

T3 to T6 models can be handled manually. T7 models must be hoisted with a proper hoisting device.

Precautions for handling and hoisting:

- Comply with local regulations when handling the drive.
- To prevent physical injury, do not grab the drive by the top cover or external cover only during handling. Ensure that all the screws are tightened before handling. Failure to comply may cause the main body of the drive to fall, leading to physical injury.
- Straighten the flat-lying equipment before further handling.
- Ensure that the load capacity of the crane for transportation is larger than the weight of the drive.
- Ensure that the upper cover, terminals, and other components of the drive are secured firmly with screws before vertical lifting. Failure to comply may result in physical injuries due to fall-off of the drive.
- Do not subject the drive to excessive vibration or shock when hoisting the drive with a sling. Failure to comply may result in physical injuries due to fall-off of the drive.
- When hoisiting the drive with a sling, do not turn the drive over or let the drive hang in the air for too long. Failure to comply may result in physical injuries due to fall-off of the drive.

Hoisting procedure:

1. Hook the lifting rope to the two auxiliary lifting lugs at the top of the drive.
   It is recommended that the lifting angle be greater than 45 degrees and the height fluctuation be no greater than 0.3 m.

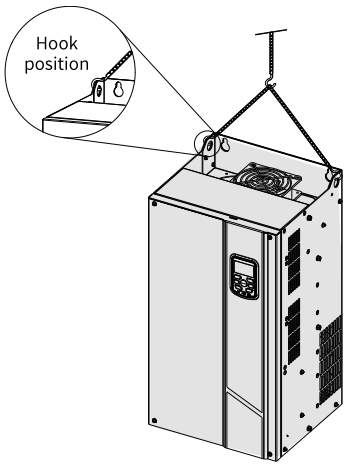


Figure 3-5 Lifting the drive

2. Roll up the lifting rope slowly with a crane. After the lifting rope is fully stressed, lift the drive up.
3. Lower the drive down slowly, with a pause at a certain height midway, then continue until the drive reaches the ground or mounting surface. Finally, install the drive to the control cabinet.

3.4 Storage

- The drive must be stored in a clean and dry room, where the temperature ranges from -20°C and +60°C and temperature change rate is smaller than 1°C/min.
- If the drive needs to be stored for a long period of time, cover it up or take similar measures to prevent the drive from being polluted or affected by the surrounding environment.
- Try to store the system with the original packing carton box.
- Do not expose the equipment to environments with moisture, high temperatures, or direct sunlight for a long time.
- The electrolytic capacitor can deteriorate after long-term storage. Therefore, switch on the drive once for at least 5 hours every 6 months. After switch-on, increase the input voltage slowly to the rated value by using a voltage regulator. Contact Inovance for technical support if necessary.

4 Installation Preparation

4.1 Installation Flowchart

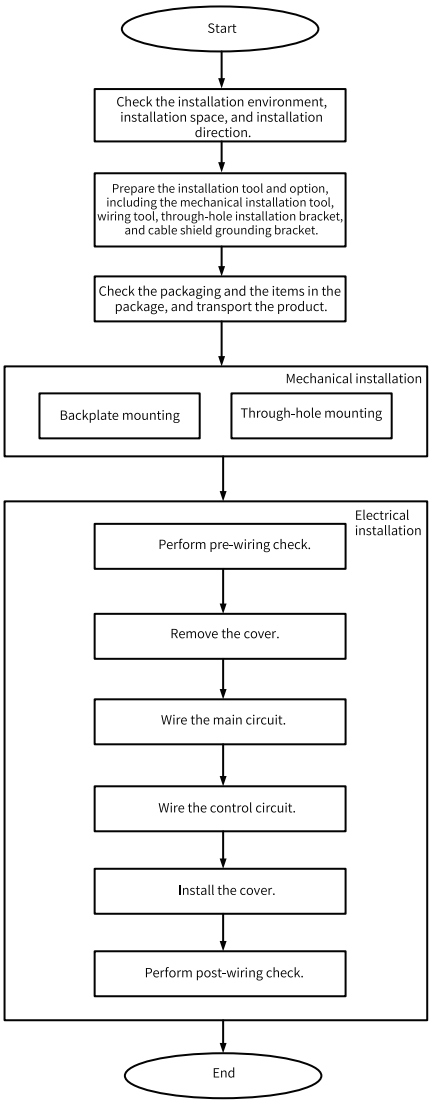


Figure 4-1 Installation flowchart

4.2 Installation Site Inspection

4.2.1 Installation Environment

Install the drive in environments that meet the following requirements.

Table 4–1 Environment requirements

Environment	Requirement
Installation location	Indoor
Grid overvoltage	OVCIII
Temperature	Operating/Ambient temperature: –10°C to +50°C (When the temperature ranges from –10°C to +40°C, no derating is required. For temperature above 40°C, derate 1.5% for every additional 1°C.) Storage temperature: -20°C to +60°C (air temperature change rate less than 1°C/min) • To improve the reliability of the drive, use the drive in environments without dramatic temperature change. • When installing the drive into an enclosed cabinet or chassis, use a cooling fan or air conditioner to keep the temperature of the inlet air below 50°C. Failure to comply can result in overtemperature or fire. • The drive generates a large amount of heat during operation. Install the drive on the surface of an incombustible object therefore, with sufficient surrounding space reserved for heat dissipation. • Take measures to prevent the drive from being frozen.
Storage/ Operating humidity	≤ 95% RH (without condensation)
Environment	• Pollution degree: PD2 or below • Free from direct sunlight, dust, corrosive gas, combustible or explosive gas, oil mist, water vapor, drip, or salt • Install the drive in a place away from vibration source. Keep the drive away from devices such as a punch press. • Do not install any device that may generate electromagnetic waves or interference, such as transformers, around the drive. If such a device is required, install a shielding plate between the device and the drive. Otherwise, the drive can malfunction. • The drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations, and to relevant IEC requirements.
Altitude	For altitudes below 1000 m, derating is not required. For altitudes above 1000 m, derate 1% for every additional 100 m. For altitudes above 3000 m, contact Inovance.
Vibration	Application scenario: Tested according to IEC 60068-2-6 Vibration amplitude at 5 Hz to 8.4 Hz: 3.5 mm; acceleration at 8.4 Hz to 200 Hz: 1 g; 10 cycles in each of X/Y/Z-axis direction Transportation scenario: Tested according to IEC 60068-2-64 Power spectrum density at 5 Hz to 100 Hz: 0.01 g^2/Hz; power spectrum density at 200 Hz: 0.001 g^2/Hz; Grms: 1.14 g

4.2.2 Installation Clearance

The installation clearance required varies with different power ratings of drives.

1. **Installing one drive**

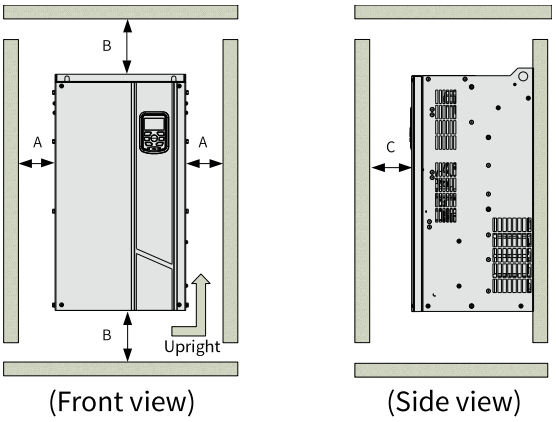


Figure 4-2 Clearance for installation of one drive

T model	Drive model	Power rating	Clearance (mm)		
T3	ES680-4T025-XX	11 kW	A ≥ 10	B ≥ 100	C ≥ 40
T4	ES680-4T032-XX ES680-4T037-XX ES680-4T044-XX	15 kW to 22 kW		B ≥ 200	
T5	ES680-4T060-XX	30 kW			
T6	ES680-4T075-XX ES680-4T091-XX	37 kW to 45 kW	A ≥ 50		
T7	ES680-4T112-XX ES680-4T150-XX	55 kW to 75 kW		B ≥ 300	
T8	ES680-4T176-C1 ES680-4T210-C1 ES680-4T253-C1	90 kW to 132 kW	A ≥ 50	B ≥ 300	C ≥ 40

2. **Installing multiple drives**

- **Side-by-side installation**
  The drive dissipates heat from bottom to top. When multiple drives are required to work together, install them side by side. Keep their tops level with each other, especially for those of different sizes.

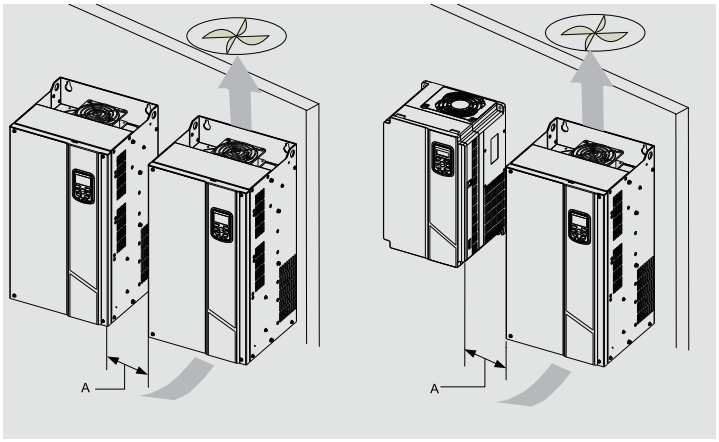


Figure 4-3 Installing multiple drives side by side

T model	Drive model	Power rating	Clearance (mm)
T3	ES680-4T025-XX	11 kW	A ≥ 10
T4	ES680-4T032-XX ES680-4T037-XX ES680-4T044-XX	15 kW to 22 kW	
T5	ES680-4T060-XX	30 kW	
T6	ES680-4T075-XX ES680-4T091-XX	37 kW to 45 kW	A ≥ 50
T7	ES680-4T112-XX ES680-4T150-XX	55 kW to 75 kW	
T8	ES680-4T176-C1 ES680-4T210-C1 ES680-4T253-C1	90 kW to 132 kW	

- **Dual-row installation**

  If one drive needs to be installed above another one, install an air guide plate, as shown in *"Figure 4-4" on page 62* . That can prevent overtemperature/overload fault that may occur due to heat dissipated from the lower row to the upper row.

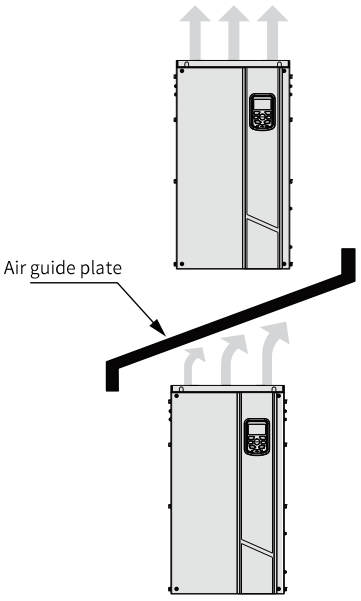


Figure 4-4 Requirements on dual-row installation

4.2.3 Installation Direction

Install the drive vertically upward only, as shown in *"Figure 4-5" on page 63* . Do not lie down the drive horizontally or by its side, or install it in the upside-down direction.

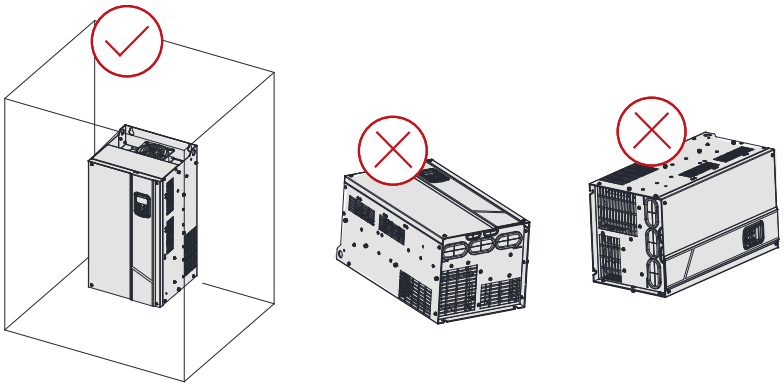


Figure 4-5 Installation direction

4.3 Installation Tools

4.3.1 Tools for Mechanical Installation

For details about the tools, see *"Table 4-2" on page 63*.

Table 4–2 Tools for mechanical installation

Tool name	Description
Electric drill and appropriate drilling bits	Used to drill mounting holes on the mounting surface.
Nut wrench or socket wrench	Used to tighten or loosen screws during mechanical installation. The following specifications are required: #13, #16, and #18.
Phillips screwdriver and straight screwdriver (2.5 mm to 6 mm)	Used to tighten or loosen screws during mechanical installation.
Torque wrench	Used to tighten or loosen screws during mechanical installation.
Crowbar	It is used to pry off the top cover or cover of the drive.
Hoisting machine	It is used to lift the equipment.
Tape measure	Used to measure the mounting dimensions of the equipment.
Gloves	Used to prevent static electricity during mechanical installation.
Screw	Used to fix the drive to the mounting surface.

For screw specifications and quantity, see *"Table 4-3" on page 63*.

Table 4–3 Specifications and quantity of screws

Installation method	T model	Screw specification	Tightening torque (Unit: N·m)	Quantity (Unit: PCS)	Description
Backplate mounting	T3 to T5	M5	5.39	4	Used to fix the drive to the wall.
	T6	M6	8.82		
	T7 to T8	M8	19.6		
Through-hole Mounting	T3 and T4	M4	2.84	4	Used to fix the drive to the backplate of the control cabinet.
	T5	M5	5.39		
	T6	M6	8.82		
	T7 to T8	M8	19.6		

4.3.2 Tools for Wiring

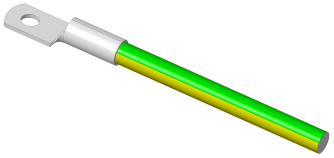
When wiring the main circuit terminal, select an appropriate installation tool based on the terminal size. Requirements on the main circuit wiring tools are shown in *"Table 4-4" on page 64*.

Table 4–4 Requirements on the main circuit wiring tools

T model	Recommended fastener	Tool
T3 to T4	M5 SEMS screw	Phillips screwdriver (#3 slot)
T5 to T6	M6 SEMS screw	Phillips screwdriver (#3 slot)
T7	M8 nut, spring washer	Socket wrench (#13 socket wrench)
T8	M12 nut, spring/flat washer	Socket wrench (#13 socket wrench)

4.3.3 Cable Preparations

Table 4–5 Cable

Type	Name	Appearance	Type	Name	Appearance
Main circuit cable	Power cable		Control circuit cable	Signal cable	
	Grounding cable			Network cable	

5 Mechanical Installation

5.1 Precautions for Drive Installation

- Ensure that the installation location is sturdy enough to bear the mechanical strength of the drive.
- Cover the top of the drive with a piece of cloth or paper during installation to prevent unwanted objects such as metal chippings, oil, and water from falling into the drive. Failure to comply may cause malfunction of the drive. After installation is done, remove the cloth or paper. Failure to comply may degrade ventilation and result in unexpected heat.
- Reserve sufficient clearance for heat dissipation, including heat dissipation of other components in the cabinet. For details, see "Installing one drive" in *“4.2.2 Installation Clearance” on page 60*.
- Install the drive vertically upward to facilitate heat dissipation. To install multiple drives in one cabinet, arrange them side by side. When multiple drives need to be installed one above another, install an air guide plate between drives. For details, see “Dual-row installation” in *“4.2.2 Installation Clearance” on page 60*.
- The mounting bracket (if needed) must be made of incombustible materials.
- In environments with metal dust, use an enclosed cabinet that can completely isolate the drive from the metal dust. In this case, ensure the maximum possible space in the cabinet and install cooling devices outside the cabinet.
- Tighten all screws properly with specified tightening torque. Failure to comply may result in electric shock or fire.
- Keep combustible and explosive materials away from the drive.

5.2 Drive Installation Method

5.2.1 Backplate Mounting

During backplate mounting, do not fasten the drive with two fixing nuts on the top only. Failure to comply will lead to an uneven distribution of stress, causing the drive to fall after long-term operation.

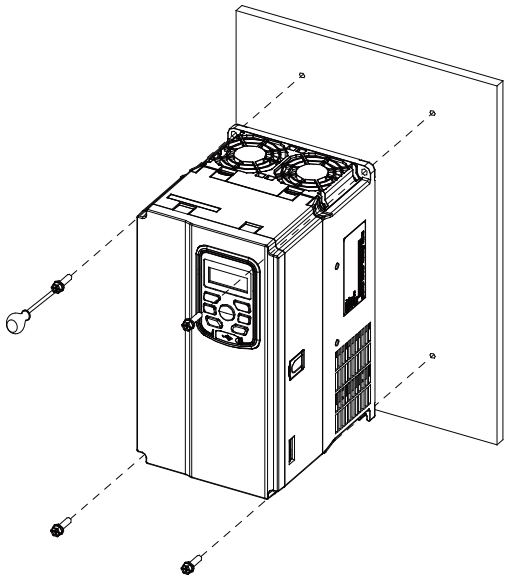


Figure 5-1 Backplate mounting of T3 to T6 models

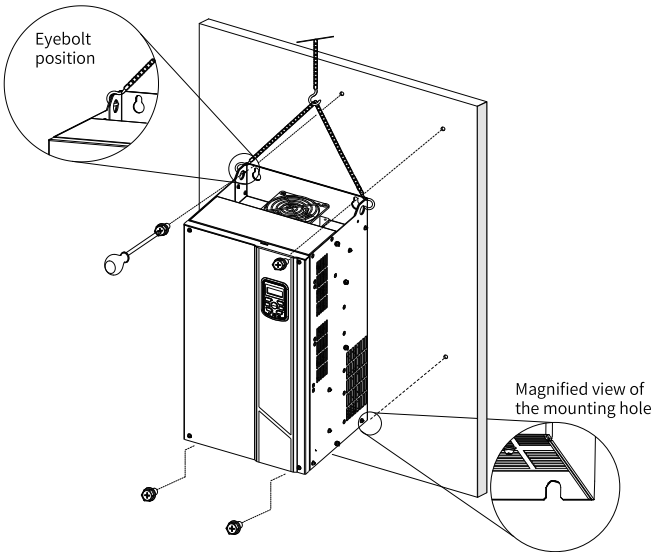


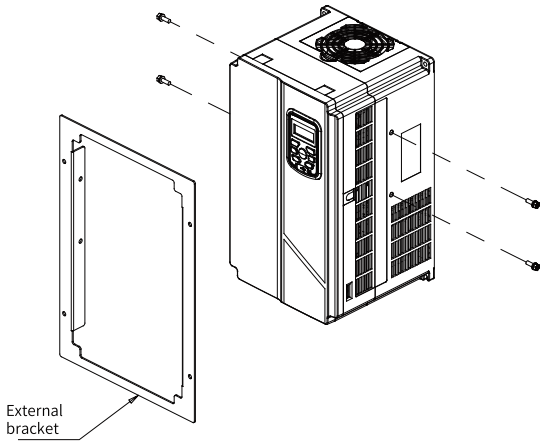
Figure 5-2 Backplate mounting of T7 to T8 models

5.2.2 Through-Hole Mounting

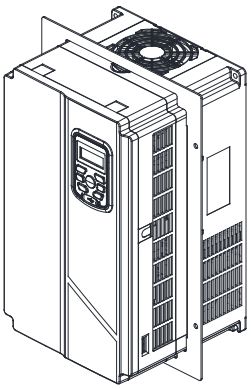
The through-hole mounting bracket is required for through-hole mounting. The bracket is optional and needs to be purchased separately.

1. T3 to T6 models

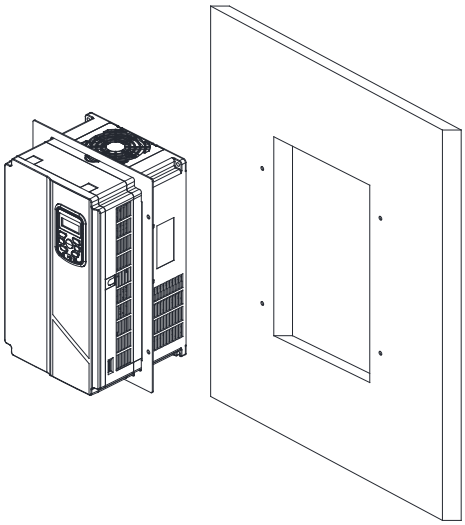
   a. Insert the through-hole mounting bracket into the enclosure and tighten the mounting screws on the left and right sides of the enclosure.



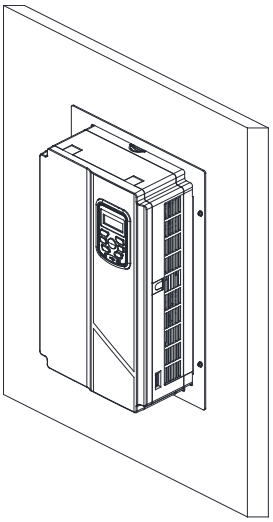
The following figure shows the drive with through-hole mounting bracket installed.



b. Fix the drive with through-hole mounting bracket to the back of the control cabinet.

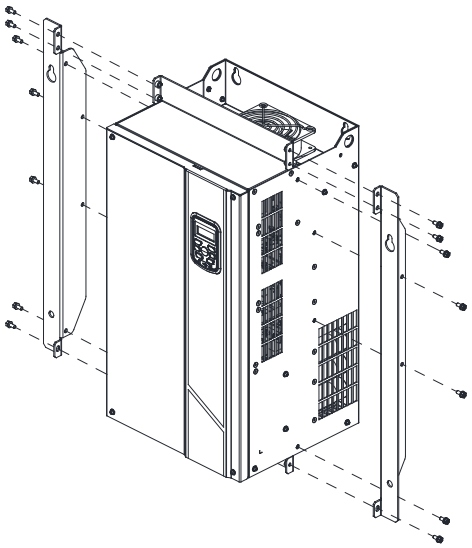


The following figure shows the drive that is installed properly.

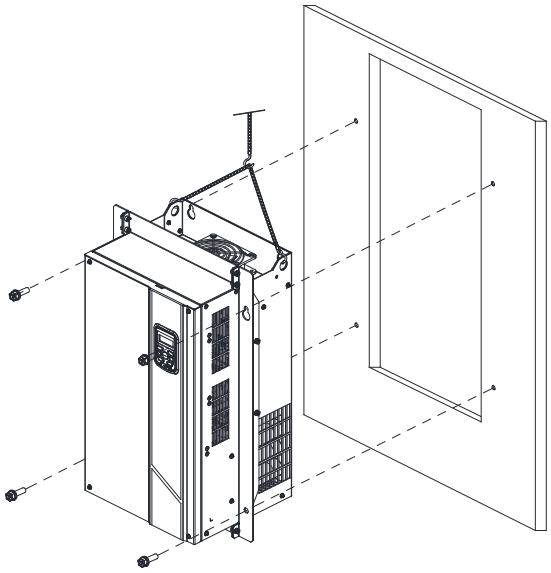


2. T7 to T8 models

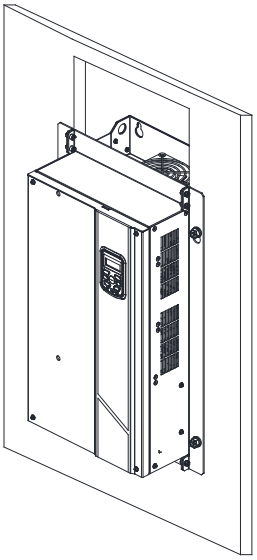
a. Fix the through-hole mounting bracket from both sides of the enclosure.



b. Fix the drive with brackets to the backplate of the control cabinet.



The following figure shows the drive that is installed properly.



5.3 Drive Cover Removal and Installation

5.3.1 Removing the Cover

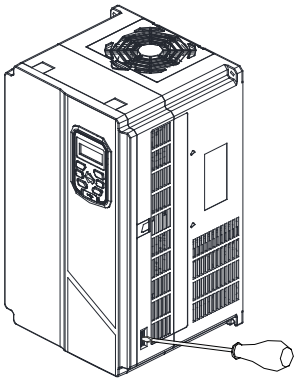
During control circuit wiring, if the jumper or function extension card is involved, remove the cover first. When removing the cover, hold the cover with your hands and carefully lift the lower part of the cover to prevent it from falling off. Failure to comply will result in equipment damage or personal injury.

Prerequisites

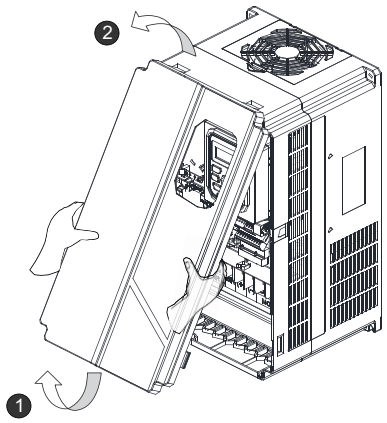
Before removing the cover, ensure that the machine has been powered off for over 10 minutes.

1. To remove the cover of T3 to T6 models, perform the following steps:

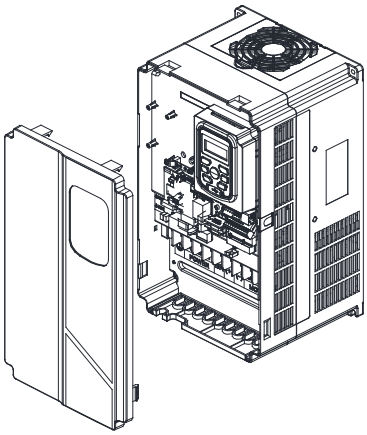
a. Use a tool to push the snap-fit joints inwards at both sides of the drive to release the cover.



b. Hold the cover with your hands, lift the lower part of the cover (as shown in ①), push the cover upward, and lift the upper part of the cover (as shown in ②).

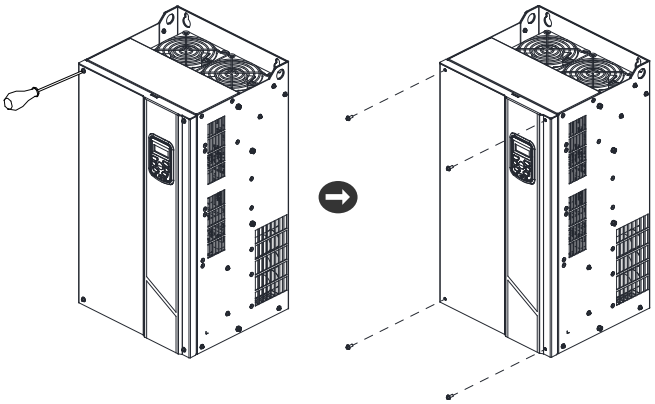


The drive without cover is shown in the following figure.

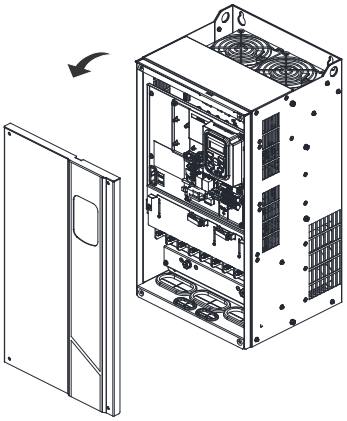


2. Remove the cover for T7 to T8 models.

a. Release the four fixing screws on the cover with a screwdriver.



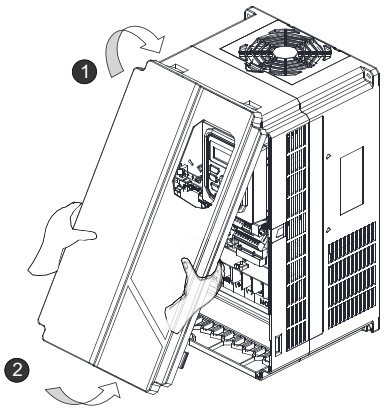
b. Hold the cover with both hands and lift it up in the direction indicated by the arrow.



5.3.2 Installing the Cover

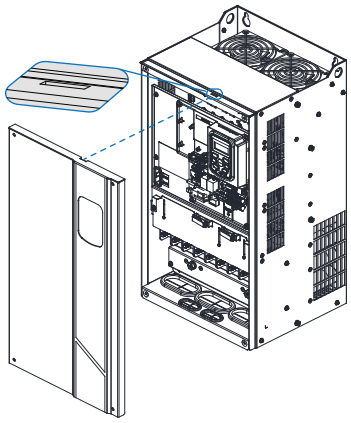
Remove the cover before wiring the main circuit and control circuit. After wiring is done, re-install the cover.

1. Install the cover for T3 to T6 models.
   a. Hold the cover with both hands and insert the upper edge snap-fit joint of the cover into the hole on the drive.
   b. Then, press down the cover in the direction indicated by the arrow, as shown in ②.

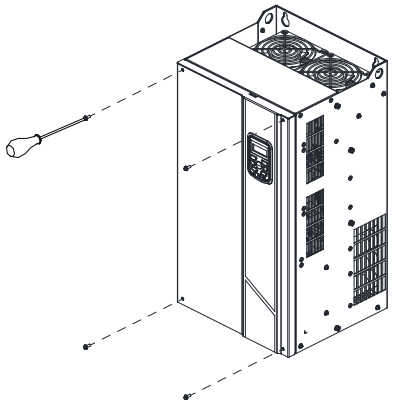


2. Install the cover for T7 to T8 models.

a. Hold the cover with both hands, align the cover with the upper edge snap-fit joint on the chassis and push it in place, as shown in the following figure.

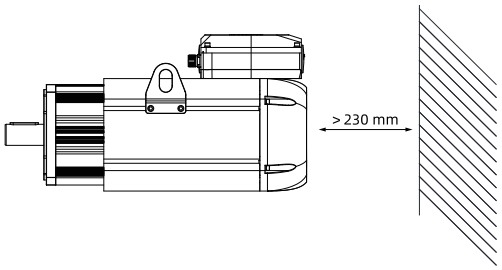


b. Install the four fixing screws with a screwdriver.



5.4 Installing the Motor

- Use shrinkage fitting for transition fit or interference fit when installing parts (such as the coupler or timing pulley) to the motor shaft extension. Do not strike the shaft extension during assembly or disassembly. Failure to comply may damage the bearing or incur shaft movement, affecting normal operation of the motor.
- Keep the motor flange clean during installation. To prevent verticality or concentricity error, ensure there are no unwanted objects or scratches in the flange.
- If the load is connected with a bracket or similar, take the motor shaft as the basis to measure the verticality and coaxiality of the spigot and the end face on the load side after motor installation is completed.
  Recommended specifications: Coaxiality: < 0.1 mm; Verticality: < 0.1 mm.
- During installation, keep the motor rear exposed with a clearance of at least 230 mm for heat dissipation.



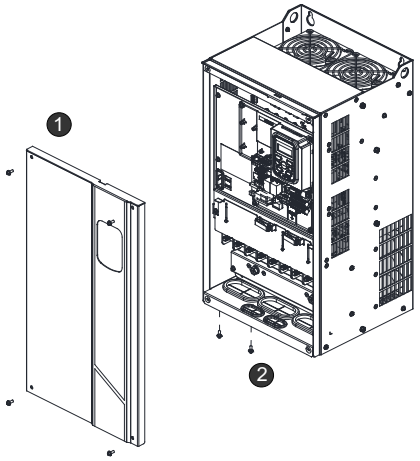
- Ensure the ambient temperature of the motor is below 40℃ during installation. If the ambient temperature exceeds 40℃, check the motor model based on the derating standards.
- To prevent short circuit, ensure that no unwanted objects fall into the junction box during U/V/W cable connection.

5.5 Installation Options

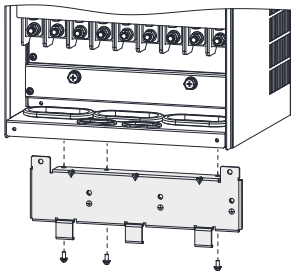
5.5.1 Grounding Bracket for Cable Shield

The cable shield grounding bracket is optional and needs to be purchased separately. Procedure of installing the grounding bracket of cable shield:

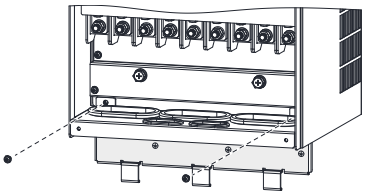
1. Remove the cover, as shown in ❶. Remove the two M4x12 SEMS screws on the air inlet plate, as shown in ❷.



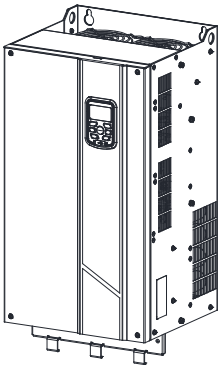
2. Place the grounding bracket of the cable shield on the chassis, and fasten the bracket with three M4×12 SEMS screws at the positions shown in the following figure.



3. Tighten the two M4×12 SEMS screws at the positions shown in the following figure.



4. Install the cover.



5.5.2 EMC Filter

- Install the filter near the input terminals of the drive. The cable between the filter and the drive must be shorter than 30 cm.
- Connect the grounding terminals of the filter and the grounding terminal of the drive together, and install the filter and drive on the same conductive surface that is connected to the main grounding terminal of the cabinet.
- Connect the LINE terminal of the EMC filter to the power grid, and the LOAD terminal to the drive.

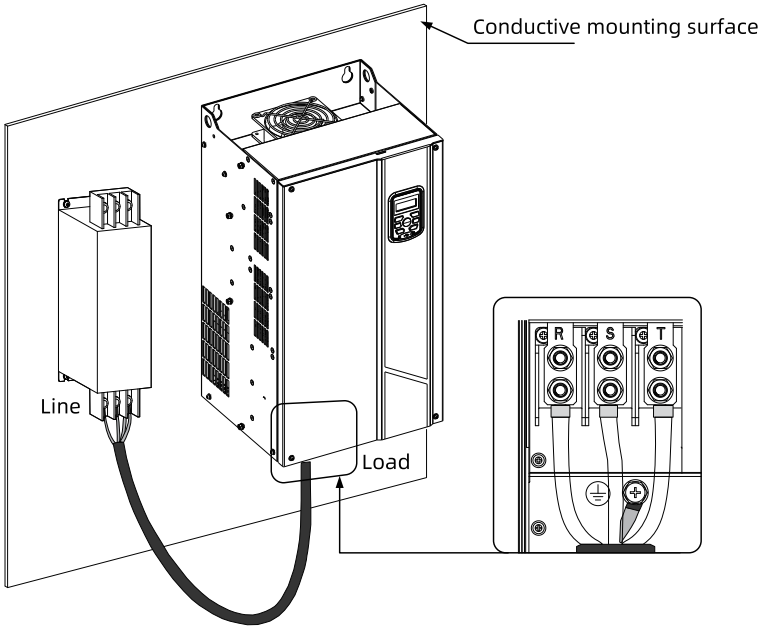


Figure 5-3 EMC filter installation

5.5.3 Simple Filter

The simple filter must be grounded securely, and the cable between the filter and the drive must be shorter than 300 mm.

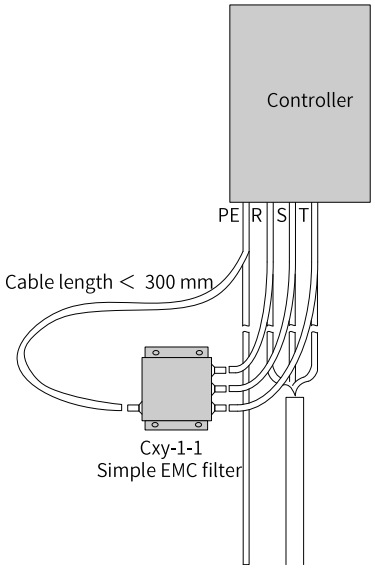


Figure 5-4 Simple filter installation

5.5.4 Magnetic Ring

The magnetic ring can be installed on the input or output side of the drive. Install the magnetic ring as close to the drive as possible.

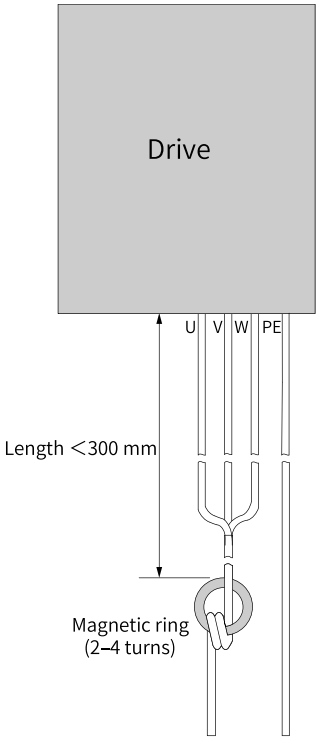


Figure 5-5 Installing the magnetic ring

Note

The R/S/T or U/V/W cables must pass through the same magnetic ring to suppress the common mode noise.

6 Mechanical Design

6.1 Dimensions and Weight of the Drive

Dimensions of the drive and mounting (backplate mounting) dimensions are shown as follows. The through hole mounting requires an optional through-hole mounting bracket. For details on mounting dimensions, see *"8.3 Through-Hole Mounting Bracket" on page 141*.

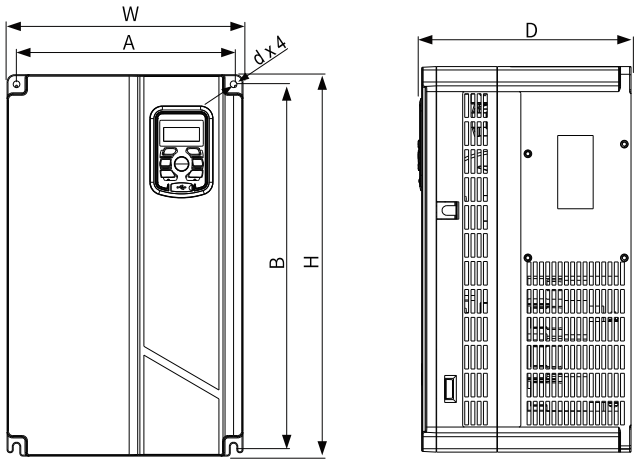


Figure 6-1 Outline and installation dimensions (unit: mm) of T3 to T6 models

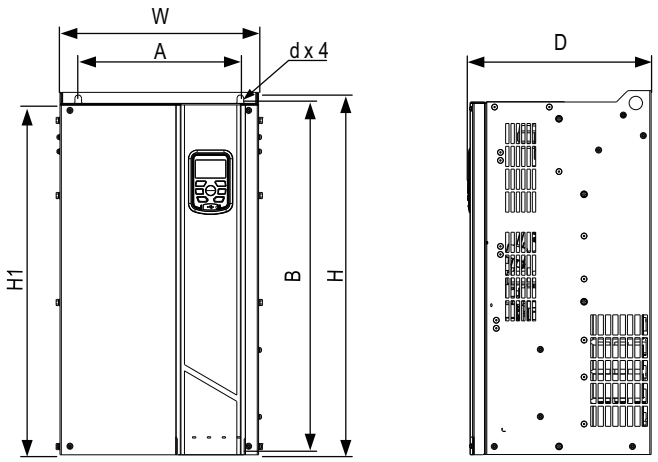


Figure 6-2 Outline and installation dimensions (unit: mm) of T7 to T8 models

Table 6–1 Dimensions, mounting holes, and weight of the drive

Model	Product model	Mounting hole dimension (mm)		Outline dimension (mm)				Mounting hole diameter (mm)	Net weight (kg)	Gross weight (kg)
		A	B	H	H1	W	D			
T3	ES680-4T025-C1	128	238	250	/	140	170	Φ6	3.3	3.6
T4	ES680-4T032-C1 ES680-4T037-C1 ES680-4T044-C1	166	266	280	/	180	170	Φ6	4.3	4.7
T5	ES680-4T060-C1	195	335	350	/	210	195	Φ6	7.6	8.6

Model	Product model	Mounting hole dimension (mm)		Outline dimension (mm)				Mounting hole diameter (mm)	Net weight (kg)	Gross weight (kg)
		A	B	H	H1	W	D			
T6	ES680-4T075-C1 ES680-4T091-C1	230	380	400	/	250	222.5	Φ7	17.7	19.1
T7	ES680-4T112-C1 ES680-4T150-C1	245	523	542	525	300	278	Φ10	34.5	42
T8	ES680-4T176-C1 ES680-4T210-C1 ES680-4T253-C1	270	560	554	/	338	315	Φ10	51	59

6.2 Cabinet Design

6.2.1 In-Cabinet Clearance

It is recommended to install the drives side by side.

Table 6–2 Minimum installation clearance

Item	11 kW	15 kW to 45 kW	55 kW to 75 kW	90 kW to 132 kW
S1	≥ 100 mm	≥ 200 mm	≥ 300 mm	≥ 300 mm
S2	≥ 100 mm	≥ 200 mm	≥ 300 mm	≥ 300 mm

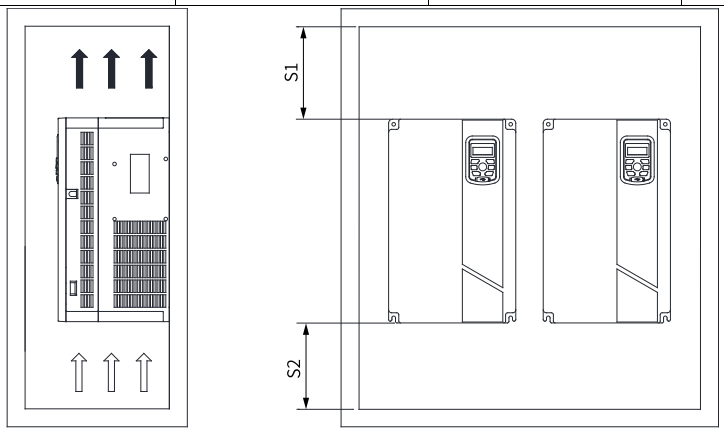


Figure 6-3 Minimum installation clearance

Note

Install the fan in the correct air exhaust direction to ensure that air flows from inside to outside of the cabinet. Otherwise, if hot air cannot be exhausted, the drive will be overheated or damaged.

6.2.2 Mounting Backplate Requirements

Requirements on backplate thickness, dimensions, and stiffness

To prevent damage to the drive during transportation and ensure proper operation of the drive, use a mounting plate with sufficient stiffness, strength, and thickness (≥ 2 mm). Take enhancement measures on the backplate if necessary. It is recommended to weld a horizontal reinforced beam to the back of the backplate, as shown in the following figure.

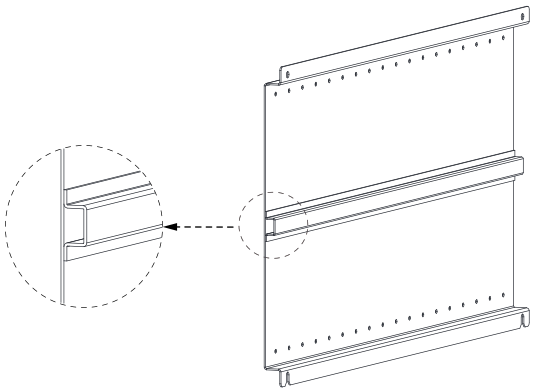


Figure 6-4 Welding a lateral reinforcing beam on the back of the backplate

Requirements on the mounting holes

- You can drill mounting holes on the backplate in advance. For details on mounting hole dimensions, see *"6.1 Dimensions and Weight of the Drive" on page 77*.
- To prevent damage to the drive during delivery, fix not only the mounting screws to the mounting backplate but also self-clinching nuts or independent nuts to enhance robustness and strength.

6.2.3 Cabinet Heat Dissipation

Heat dissipation design of the cabinet door

As the drive dissipates heat through the fan, the air inlet on the cabinet door must be wide enough to allow the cooling air to enter the cabinet.

Ensure the air inlet of the cabinet is lower than that of the drive by more than 50 mm to allow the cooling air to flow upwards after being heated, as shown in the following figure.

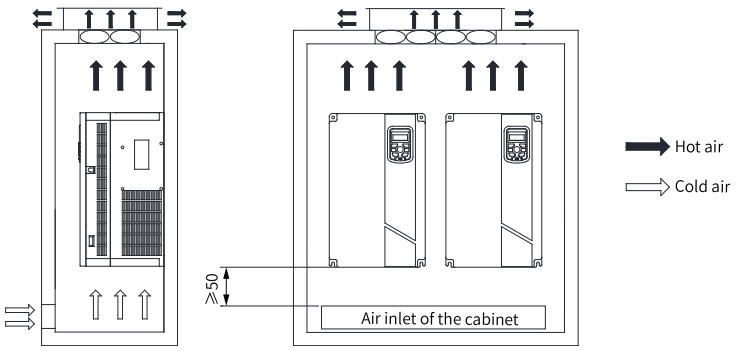


Figure 6-5 Position of the cabinet air inlet

Note

In cases whether multiple drives are installed inside the cabinet, if the fan blows air from external to internal, the air flow inside the cabinet will be disturbed, affecting the overall cooling effect. Therefore, do not install a fan at the air inlet of the cabinet to blow air into the cabinet.

When the drive is placed into the cabinet, the minimum effective area of the air inlet is shown in *"Table 6-3" on page 80*.

Table 6–3 Minimum effective ventilation area of the cabinet air inlet

Drive	Minimum effective area of the cabinet air inlet (cm^2)
T3	50
T4	
T5	60
T6 to T7	102
T8	204

"Table 6-3" on page 80 only applies to an individual AC drive. When multiple drives are placed inside the cabinet, add up the preceding air inlet area to obtain the total air inlet area. For example, if two T5 drives and one T7 drive are placed inside the cabinet, the minimum effective area of the cabinet air inlet is 2 x 60 + 1 x 102 = 222 cm^2.

For air inlets installed with a filtering net, the air inlet resistance increases substantially. In this case, the minimum ventilation area of the air inlet must be increased to 1.2 to 1.5 times the value listed in the preceding table.

The ventilation area in *"Table 6-3" on page 80* refers to the actual through-hole area of an opening. The ventilation area is calculated by the following: opening area x opening rate.

Top air outlet

To ensure sufficient heat dissipation of the drive, hot air in the cabinet must be exhausted to the outside. The passive or active air ventilation mode can be adopted.

1. Passive air ventilation (self-ventilated)

   As the hot air flows upwards, the forcible air flow guides the air inside the drive to flow to the outside from the top air outlet of the cabinet.

   This might cause accumulated hot air at the top of the cabinet, rising the air pressure. The air pressure in the air inlet of the cabinet is low due to the suction action of the fan of the drive. Therefore, there is an air pressure difference between the air outlet and air inlet of the cabinet to form an air flow in the cabinet. This air flow forces the hot air at the air outlet to flow towards the air inlet so that it is absorbed into the drive again, causing a significant temperature rise and an adverse effect on the performance of the drive.

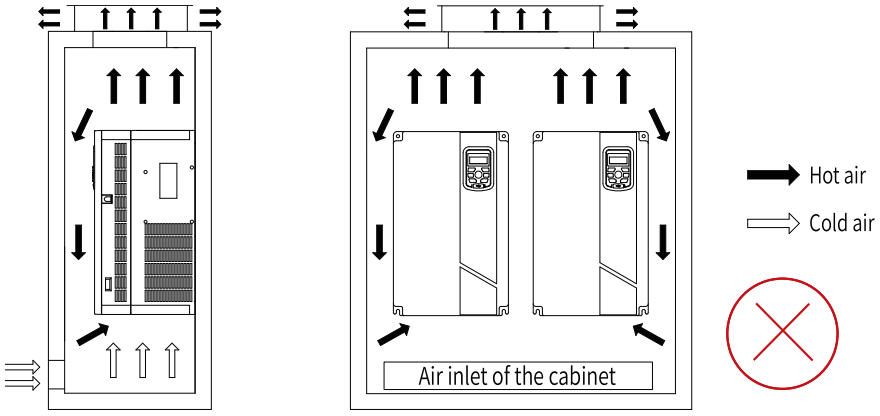


Figure 6-6 Hot air backflow in passive air ventilation mode (without isolation devices)

For cabinets that adopt the passive air ventilation mode, use an isolation device to prevent hot air backflow, as shown in the following figure. The isolation device can be a plate or exhaust duct.

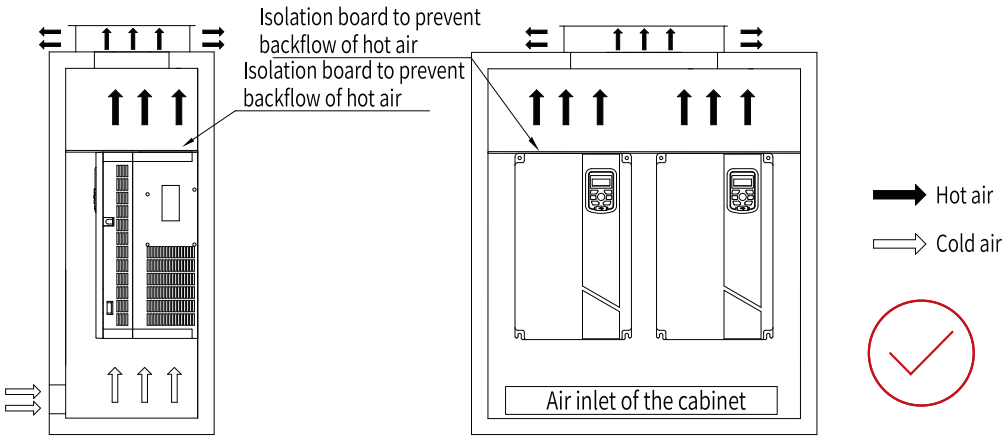


Figure 6-7 Hot air backflow in passive air ventilation mode (with isolation devices)

The temperature of the air outlet of the drive is high, which features a lower density compared with that of the air inlet. To allow the hot air inside the cabinet to flow to the outside, ensure the minimum effective area of the cabinet air outlet listed in *"Table 6-4" on page 81* is reserved in the passive air ventilation mode.

Table 6-4 Minimum effective area of the cabinet air outlet in passive air ventilation mode

Drive	Minimum effective ventilation area (cm^2)
T3	80
T4	
T5	96
T6 to T7	163
T8	326

Values listed in *"Table 6-4" on page 81* only apply to an individual drive. When multiple drives are inside the cabinet, add up the preceding air outlet area to obtain the total air outlet area.

For air outlets installed with a filtering net, the air outlet resistance increases substantially. In this case, the minimum ventilation area of the air outlet must be increased to 1.2 to 1.5 times the value listed in the preceding table.

The ventilation area in *"Table 6-4" on page 81* refers to the actual through-hole area of the opening. The ventilation area is calculated by the following: opening area x opening rate.

2. Active air ventilation

In active air ventilation mode, a fan is installed at the top of the cabinet to draw hot air out of the cabinet. This is a commonly used ventilation mode.

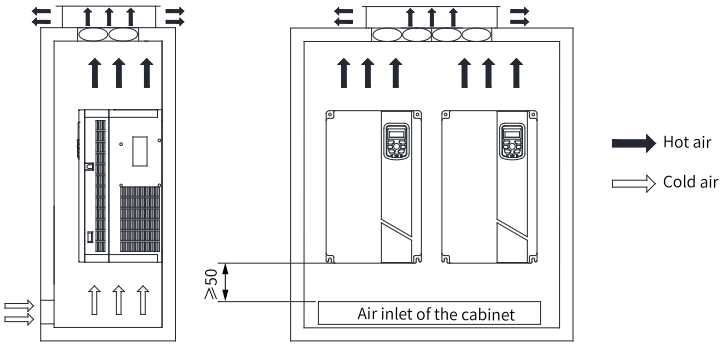


Figure 6-8 Cabinet ventilation system

To ensure that the hot air can be exhausted to the outside, the total air volume of the fan cannot be smaller than that of all drives in the cabinet. The cooling air needed by the drive is shown in *"Table 6-5" on page 82*.

Table 6-5 Cooling air of the drive

Power of the drive (kW)	Cooling air of the drive (CFM)
11	56
15	42
18.5	64
22	54
30	70
37	106
45	102
55	122
75	122
90	287
110	354.2
132	354.2
Note: 1 CFM = 0.02832 m^3/min	

Cabinet fan design

To select the fan for the cabinet, do as follows:

1. Calculate the total cooling air needed by the drive based on *"Table 6-5" on page 82*.
2. Determine the maximum air volume value (Qmax).
3. Determine the specification and quantity of the fan based on the maximum air volume (Qmax).

Specifically, the maximum air volume of the cabinet is 1.3 to 1.5 times the sum of the cooling air volume. If mesh filters, shutters, or other components are installed at the cabinet air outlet, the maximum air volume of the cabinet is 1.6 to 2.2 times the sum of the cooling air volume.

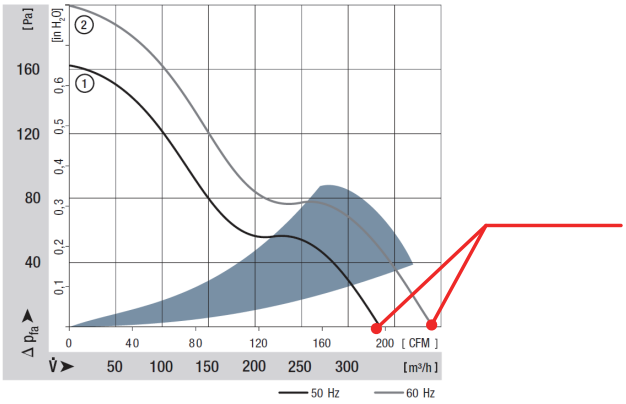
Note

The air volume of the selected fan cannot be lower than the maximum air volume Qmax. When an individual fan cannot deliver the required air volume, connect multiple fans in parallel.

The following figure shows the common specifications of the fan air volume.

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

Maximum air flow of the fan (Qmax)



Maximum air flow of the fan (Qmax)

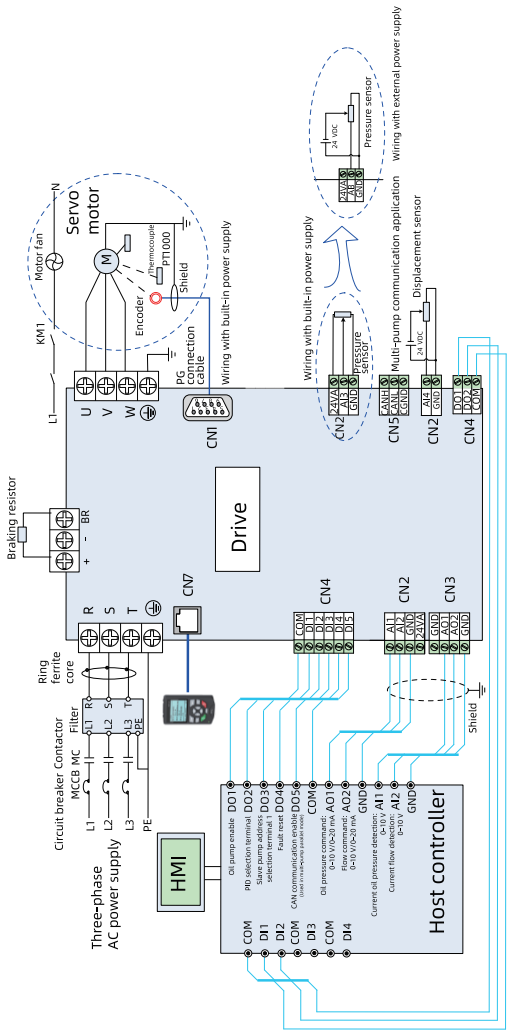
Figure 6-9 Q_{max} of a system fan

Note

Install the fan in the correct air exhaust direction to ensure that air flows from inside to outside of the cabinet. Otherwise, if hot air cannot be exhausted, the drive will be overheated or damaged.

7 Electrical Installation and Design

7.1 Electrical Wiring



7.2 Inspection Before Wiring

- Do not wire the drive with power on. Keep all circuit breakers in the OFF state. Failure to comply will result in an electric shock.
- Before operation, cut off the input and output power, and wait at least 10 minutes until the power indicator is off.
- Ensure that the motors, cabinets, and other components are installed and connected in accordance with the recognized technical rules of the country and the region. Pay special attention to regulations concerning cable dimensions, fuses, grounding, open circuit, isolation, and overcurrent protection.
- If the fuse in a branch circuit trips, the fault current may have been disconnected. To reduce the risk of fire and electric shocks, check the conductive parts and other components of the cabinet and replace the damaged ones. If any fuse trips, find out the cause and rectify the fault.

7.3 Main Circuit Wiring

7.3.1 Descriptions of Main Circuit Terminals

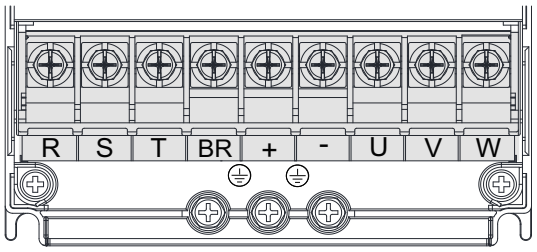


Figure 7-1 Layout of main circuit terminals for T3 to T4 models

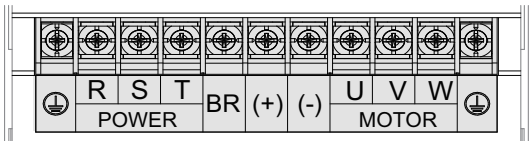


Figure 7-2 Layout of main circuit terminals for T5 to T6 models

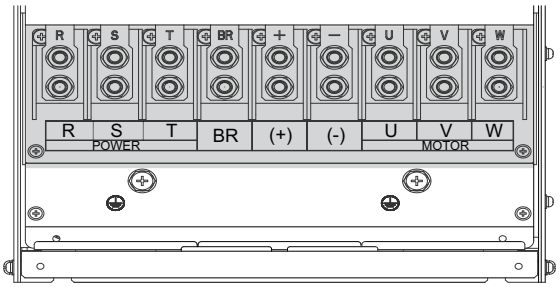


Figure 7-3 Layout of main circuit terminals for T7 models

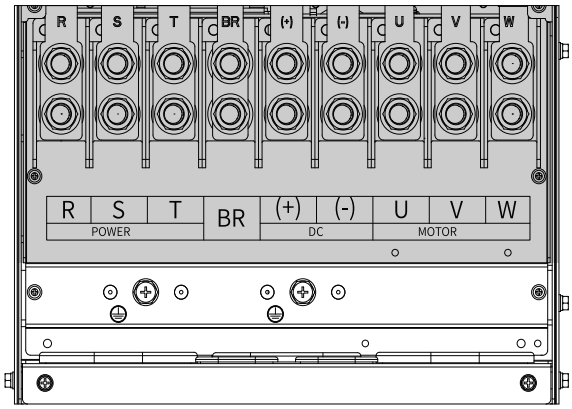


Figure 7-4 Layout of main circuit terminals for T8 models

Table 7–1 Descriptions of main circuit terminals

Terminal identification	Terminal name	Function description
R, S, T	Input terminals of three-phase power supply	Used to connect the three-phase AC input power supply.
(+), (-)	Positive and negative terminals of the DC bus	Used to connect the common DC bus.

Terminal identification	Terminal name	Function description
(+), BR	Braking resistor connection terminals	Used to connect the braking resistor.
U, V, W	Output terminal	Used to connect the three-phase motor.
⏚	Grounding terminal (PE)	Used for protective grounding.

7.3.2 Main Circuit Terminal Dimensions and Cable Selection

Terminal dimensions

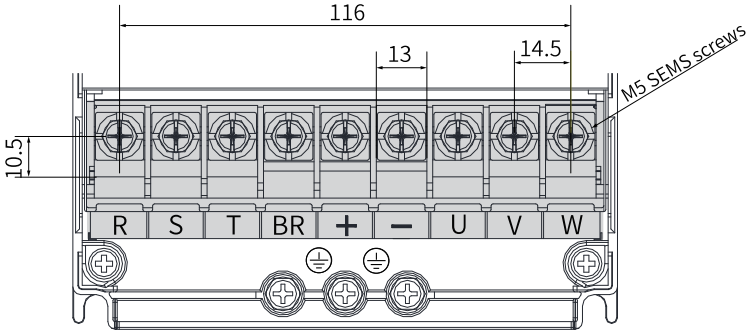


Figure 7-5 Main circuit terminal dimensions (mm) of T3 models

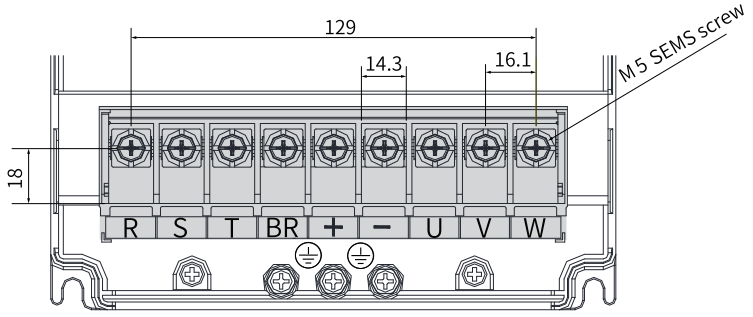


Figure 7-6 Main circuit terminal dimensions (mm) of T4 models

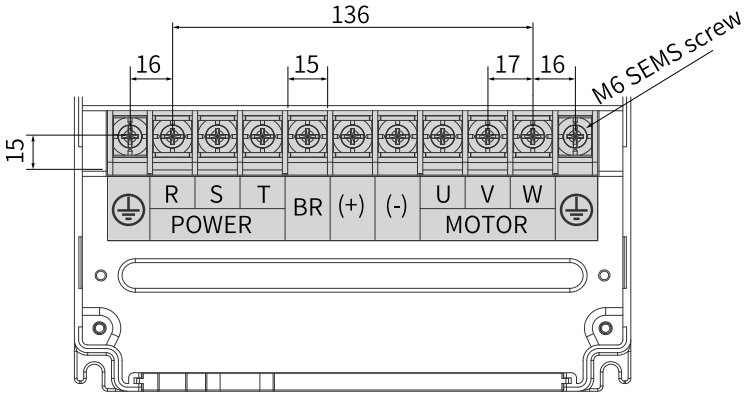


Figure 7-7 Main circuit terminal dimensions (mm) of T5 models

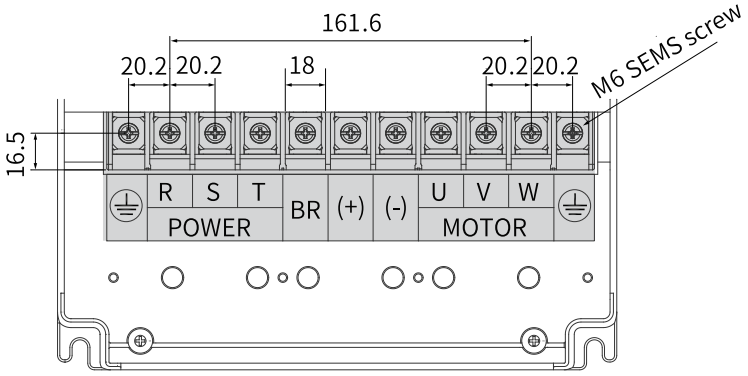


Figure 7-8 Main circuit terminal dimensions (mm) of T6 models

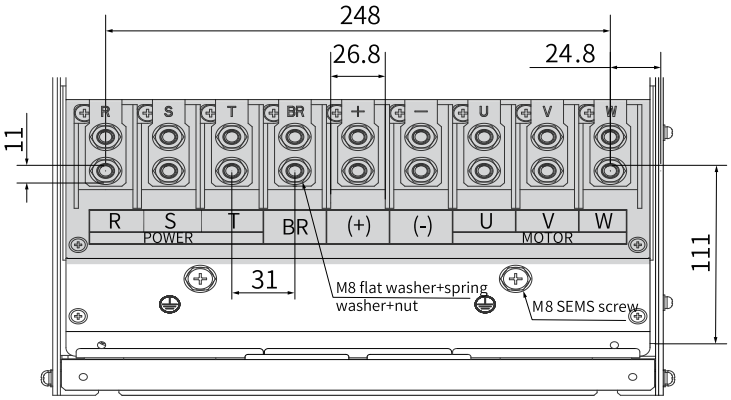


Figure 7-9 Main circuit terminal dimensions (mm) of T7 models

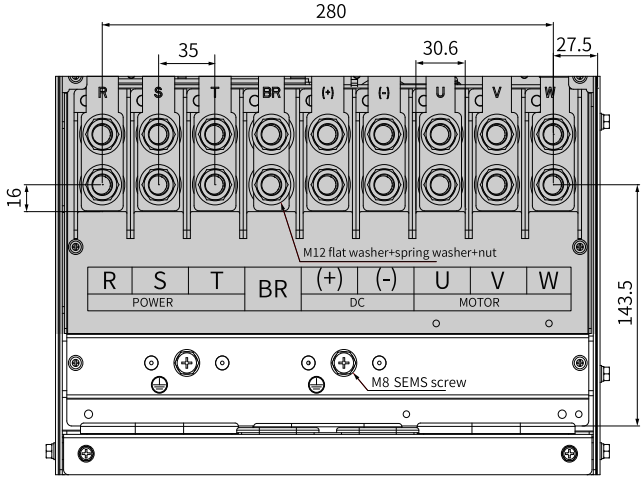


Figure 7-10 Main circuit terminal dimensions (mm) of T8 models

Power cable selection requirements

For selection of power cables, follow national or regional regulations. Select IEC cables according to the following requirements:

- Compliant with EN 60204-1 and IEC 60364-5-52 standards
- PVC insulated cables with copper conductors
- Ambient temperature of 40°C and cable surface temperature of 70°C (Note: When the ambient temperature exceeds 40°C, contact Inovance.)

- Symmetrical cable with copper-braided shield

Note

If the recommended cables for peripheral equipment or options are not suitable for the product, contact Inovance.

Use shielded cables to comply with the EMC requirements. The shielded cables are divided into three-conductor cables and four-conductor cables, as shown in the following figure. If the conductivity of the three-conductor cable shield is insufficient, add an extra PE cable or use a four-conductor shielded cable, with one conductor of which being PE cable. The shield of the shielded cable is comprised of coaxial cooper braids to suppress radio frequency interference. To enhance the shielding performance and conductivity, the braided density of the shield must be greater than 90%.

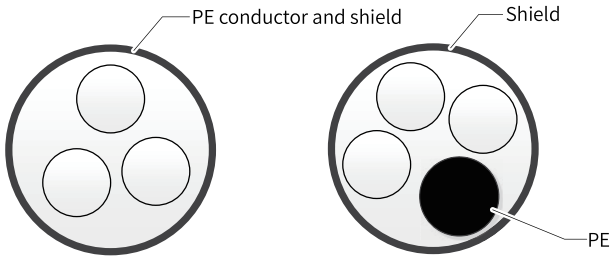


Figure 7-11 Recommended power cable

Specifications of recommended main circuit cables

Table 7–2 Specifications of recommended main circuit cables

T model	Drive model	RST/UVW		Grounding cable		RST/UVW cable lug width (mm)	Drive terminal width (mm)	RST/UVW screw specifications	Tightening torque (N·m)
		Recommended cables (mm^2)<1>	Recommended cable lug	Recommended cables (mm^2)<1>	Recommended cable lug				
T3	ES680-4T025-XX	3 x 6	GTNR6-5	6	GTNR6-5	10	14.3	M5	2.8
T4	ES680-4T032-XX	3 x 10	GTNR10-5	10	GTNR10-5	12.4	15	M5	2.8
	ES680-4T037-XX	3 x 10	GTNR10-5	10	GTNR10-5	12.4	15	M5	2.8
	ES680-4T044-XX	3 x 10	GTNR10-5	10	GTNR10-5	12.4	15	M5	2.8
T5	ES680-4T060-XX	3 x 16	GTNR16-6	16	GTNR16-6	12.4	15	M6	4.8
T6	ES680-4T075-XX	3 x 25	GTNR25-6	16	GTNR16-6	14	18	M6	4.8
	ES680-4T091-XX	3 x 35	GTNR35-6	25	GTNR25-6	16.5	18	M6	4.8

T model	Drive model	RST/UVW		Grounding cable		RST/UVW cable lug width (mm)	Drive terminal width (mm)	RST/UVW screw specifications	Tightening torque (N·m)
		Recommended cables (mm^2)<1>	Recommended cable lug	Recommended cables (mm^2)<1>	Recommended cable lug				
T7	ES680-4T112-XX	3 x 50	GTNR50-8	35	GTNR35-8	18	26.8	M8	13.0
	ES680-4T150-XX	3 x 70	GTNR70-8	50	GTNR50-8	21.8	26.8	M8	13.0
T8	ES680-4T176-XX	3x95	GTNR95-12	70	GTNR70-8	25	30.6	M12	35.0
	ES680-4T210-XX	3x120	GTNR120-12	95	GTNR95-8	28.4	30.6	M12	35.0
	ES680-4T253-XX	3x150	BC150-12	95	GTNR95-8	30	30.6	M12	35.0

Note

- <1>: Applicable to the standards in China. 3 x 10 indicates there is one three-core cable with a cross sectional area of 10 mm2; 2 x (3x95) indicates there are two three-core cables with a cross sectional area of 95 mm^2.
- The preceding cable temperature resistance needs to be no lower than 70℃. For carrier frequency, see GB5226 and GB50217.
- The preceding recommended lugs are the TNR, GTNR, and BC series lugs of Suzhou Yuanli.
- Observe national or regional regulations during selection. The preceding table is based on the following:
  - PVC insulation and copper conductor
  - Ambient temperature of 40℃ and cable surface temperature of 70℃ (Note: When the ambient temperature exceeds 40℃, contact Inovance.)
  - Cable layout type E is adopted (see IEC60204-1).
- If the conditions are different, you need to select the model according to actual conditions.

Table 7–3 Specifications of recommended main circuit cables (UL-compliant)

T model	Drive model	RST/UVW		Grounding cable		RST/UVW cable lug width (mm)	Drive terminal width (mm)	Screw specification	Tightening torque (N·m)
		Recommended cable (AWG/Kcmil)<2>	Recommended cable lug	Recommended cable (AWG/Kcmil)<2>	Recommended cable lug				
T3	ES680-4T025-XX	8	TLK10-5	8	TLK10-5	12	14.3	M5	2.8
T4	ES680-4T032-XX	8	TLK10-5	8	TLK10-5	12	15	M5	2.8
	ES680-4T037-XX	6	TLK16-5	6	TLK16-5	12	15	M5	2.8
	ES680-4T044-XX	6	TLK16-5	6	TLK16-5	12	15	M5	2.8
T5	ES680-4T060-XX	4	TLK25-6	4	TLK25-6	14	15	M6	4.8

T model	Drive model	RST/UVW		Grounding cable		RST/UVW cable lug width (mm)	Drive terminal width (mm)	Screw specification	Tightening torque (N·m)
		Recommended cable (AWG/ Kcmil)<2>	Recommended cable lug	Recommended cable (AWG/ Kcmil)<2>	Recommended cable lug				
T6	ES680-4T075-XX	2	TLK35-6	4	TLK25-6	17	18	M6	4.8
	ES680-4T091-XX	2	TLK35-6	4	TLK25-6	17	18	M6	4.8
T7	ES680-4T112-XX	1/0	TLK50-8	2	TLK35-8	20	26.8	M8	13.0
	ES680-4T150-XX	3/0	TLK95-8	1/0	TLK50-8	26	26.8	M8	13.0
T8	ES680-4T176-XX	4/0	TLK120-12	2/0	TLK70-8	28	30.6	M12	35.0
	ES680-4T210-XX	300kcmil	SQNBS150-12	3/0	TLK95-8	22	30.6	M12	35.0
	ES680-4T253-XX	350kcmil	SQNBS180-12	4/0	TLK120-8	30	30.6	M12	35.0

Note

- <1>: Applicable to AWG standards, in which 5 represents 5AWG, 1/0 represents 0AWG, 2/0 represents 00AWG, 3/0 represents 000AWG, and 4/0 represents 0000AWG; 2 x 250 kcmil represents two 250 kcmil cables.
- The preceding recommended cable lugs are TLK and SQNBS series lugs from KST.
- Observe national or regional regulations during selection. The cables recommended in the preceding table meet the following conditions:
  - PVC insulation and copper conductor.
  - Heat resistance: ambient temperature of 40℃ and cable surface temperature of 70℃ (Remark: When the ambient temperature exceeds 40℃, contact Inovance.)
  - Cable layout type E is adopted (see IEC 60204-1).
  - The cables meeting requirements for 125% overload are recommended. When local regulations allow, the cross-sectional area of the copper conductor can be reduced if the cable's temperature resistance exceeds 75℃.
  - Cables recommended for ES680-4T600SC1-V and ES6804T650SC1-V (with the symbol ※) are based on temperature resistance of 105℃.
- If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

7.3.3 Terminal selection

Specifications of the recommended terminals are shown below.

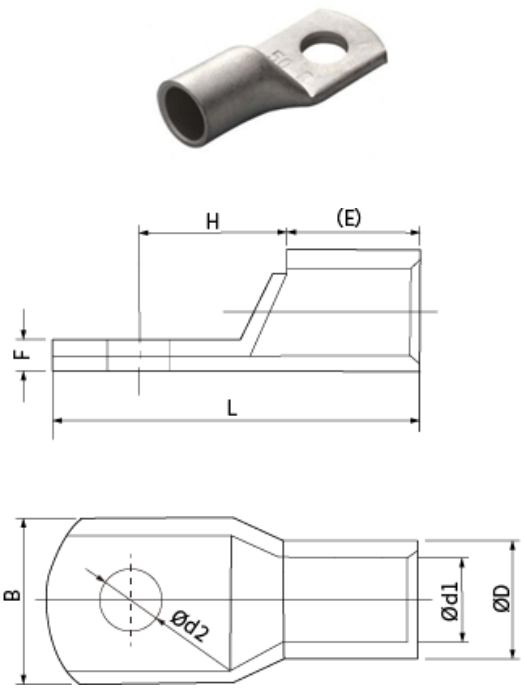


Figure 7-12 Appearances, models, and dimensions of the GTNR series terminals (unit: mm)

Table 7–4 Appearances, models, and dimensions of the GTNR series terminals (unit: mm)

Model	D	d1	E	H	B	d2	F	L	Crimping Tool
GTNR6-5	6	4.2	9	9	10	5.3	1.4	23.8	RTO-8
GTNR10-5	7	5	9	11.5	12.4	5.3	1.45	27.5	YYT-8 RYO-14
GTNR16-6	7.8	5.8	12	12	12.4	6.4	1.7	31	CT-38 CT-100
GTNR25-6	9.5	7.5	12	12.5	14	6.4	1.9	32	
GTNR35-6	11.4	8.6	15	14	16.5	6.4	2.7	38	
GTNR35-8						8.4			
GTNR50-8	12.6	9.6	16	17	18	8.4	2.8	43.5	CT-100
GTNR70-8	15	12	18	20	21.8	8.4	2.8	50	
GTNR95-8	17.4	13.5	20	22	25	8.4	3.9	55	
GTNR95-12						13			
GTNR120-12	19.8	15	22	24	28.4	13	4.7	60	RYC-150

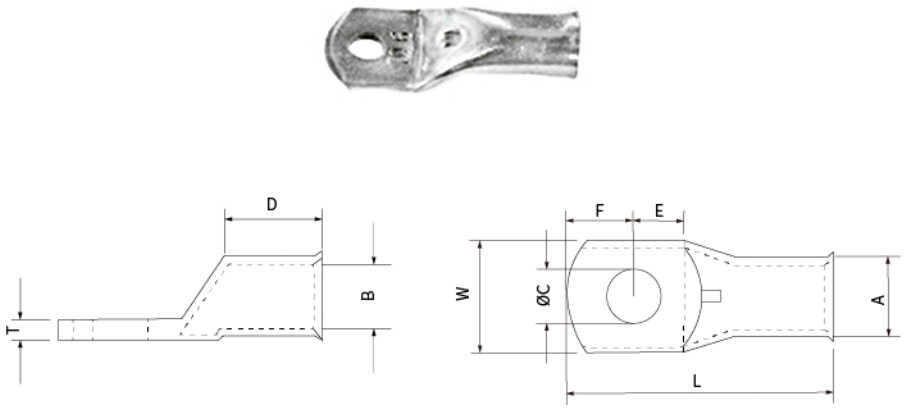


Figure 7-13 Appearances, models, and dimensions of the BC series terminals (unit: mm)

Table 7–5 Appearances, models, and dimensions of the BC series terminals (unit: mm)

Model	A	B	W	E	D	L	T	C	F
BC150-12	21	16.5	30	16.5	27	78	4.5	12.8	16.5
BC185-12	23	18.5	33.5	16.5	30	82	4.5	12.8	16.5
BC185-16								16.7	
BC240-12	26	21	37.7	18	32	88	5	12.8	17
BC240-16								16.7	
BC300-12	28	23	41	18	37	97	5	12.8	17
BC300-16								16.7	

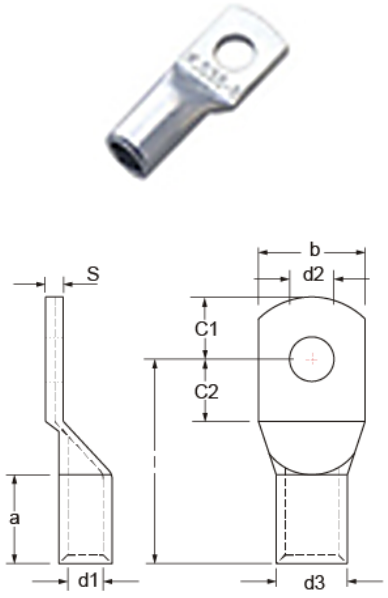


Figure 7-14 Appearances, models, and dimensions of the TLK series terminals (unit: mm)

Table 7–6 Appearances, models, and dimensions of the TLK series terminals (unit: mm)

Model	S	a	b	C1	C2	d1	d2	d3	I
TLK6-5	2.4	9	10	6.5	7.5	3.5	5.5	6.5	21
TLK10-5	1.8	10	12	6.5	7.5	4.6	5.5	7	22

Model	S	a	b	C1	C2	d1	d2	d3	I
TLK16-5	2.8	13	12	5.5	6.5	5.5	5.5	8.5	26
TLK16-6	2.8	13	12	6.25	7.5	5.5	6.5	8.5	27
TLK25-6	2.8	15	14	7.5	7.5	7	6.4	10	30
TLK35-6	32	17	17	7.5	7.5	8.5	6.4	12	32
TLK35-8				10	10		8.4		34
TLK50-8	3.7	19	20	10	10	10	8.4	14	37
TLK70-8	4.3	21	23	10	10	12	8.4	16.5	43
TLK95-8	4.2	25	26	12	12	13.5	8.4	18	48
TLK120-12	4.3	26	28	14	14	15	13	19.5	51

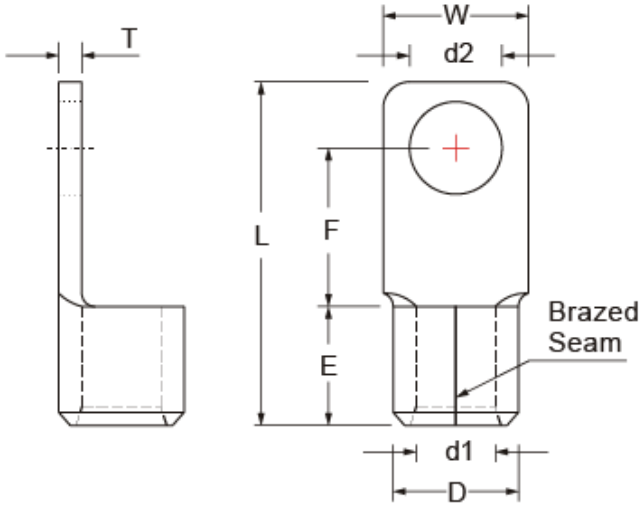


Figure 7-15 Appearances, models, and dimensions of the SQNBS series terminals (unit: mm)

Table 7–7 Appearances, models, and dimensions of the SQNBS series terminals (unit: mm)

Model	d2	W	F	L	E	D	d1	T
SQNBS150-12	13.0	22	22.3	61	26.5	26.5	19.5	3.2
SQNBS180-12	13.0	30	22.3	68	28.5	28.6	20.6	3.5
SQNBS250-12	13.0	36	22.3	72.5	31	32.7	24	4
SQNBS325-12	13.0	37.2	32	87.7	35.5	37.6	28	4.3

7.3.4 Wiring Requirements of Main Circuit

Wiring Requirements of Main Circuit

- The specifications and installation method of external main circuit cables must comply with local regulations and related IEC standards. For main circuit cables, select copper conductors of appropriate size according to the recommended specifications.
- No specific sequence is required for wiring of RST on the input side of the drive.
- To protect the main circuit, isolate and cover it from surfaces that may come into contact.
- The control circuit is the internal safety extra-low voltage (SELV) circuit, which must be insulated and isolated from other circuits. Make sure that the control circuit is connected to the external SELV circuit.

- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder twisted conductors (if used).
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws at an angle within 5 degrees. Failure to comply may result in screw damage.
- Terminals BR, (-), and (+) are used to connect optional parts. Do not connect these terminals to an AC power supply.
- Wiring requirements for DC bus (+) and (-) terminals
  - Power off and wait for at least 10 min until the power indicator is off before wiring because residual voltage still exists in the DC bus terminals (+ and -) immediately after power-off. Failure to comply can result in the risk of electric shock.
  - The cable length of the braking unit must not be longer than 10 m. Use the twisted pair cables or closely-paired cables for parallel connection.
  - Do not connect the braking resistor directly to the DC bus. Failure to comply may result in damage to the drive and even fire.
- Wiring requirements for (+) and BR terminals
  - The BR terminal is active only in 132 kW and below models that carry a built-in braking unit.
  - Connect a braking resistor of the recommended model, and ensure that the cable length of the braking resistor is shorter than 5 m. Otherwise, it may damage the drive. Failure to comply may damage the drive.
  - Keep the braking resistor away from combustibles. Avoid igniting the surrounding components due to overheating of the braking resistor.
  - After connecting the braking resistor of 132 kW models and below that carry embedded braking units, set F6-15 and F9-08 properly.

Main circuit cabling requirements

Power supply cables and motor cables may generate strong electromagnetic interference. To prevent electromagnetic interference generated by long-distance parallel routing and coupling between disturbing cables and control cables, keep a clearance of at least 30 cm between main circuit cables and signal cables. Common main circuit cables include input R/S/T cables, output U/V/W cables, DC bus, and brake cables. Signal cables include I/O signal cables, communication cables, and encoder cables.

Cable ducts must be connected and grounded properly. Aluminum cable ducts can be used to ensure equipotentiality of the device. The filter, drive, and motor must be properly connected to systems (machines or devices), with spraying protection applied at the installation part and the conductive metal kept in full contact.

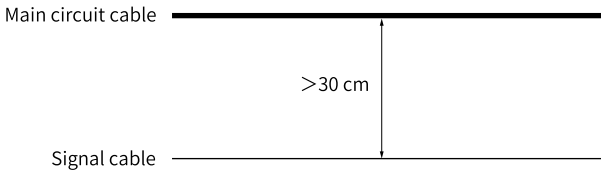


Figure 7-16 Cabling diagram

Wiring in an IT or angular grid system

Before wiring in an IT or angular grid system, disconnect the EMC grounding screw. Failure to comply will result in damage to the drive or even personal injury.

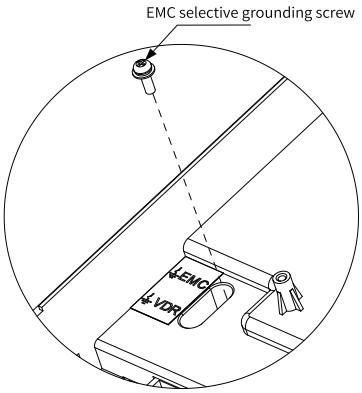


Figure 7-17 Disconnect the EMC selective grounding screw.

Note

When the drive is connected to a non-IT system or delta-type power system, disconnect the EMC and VDR selective grounding screws before voltage withstand test. Otherwise, the voltage withstand test may fail.

7.3.5 Protection Requirements

Requirements for protection of main circuit cables

Apply heat-shrink tubing to the copper lug and conductors of the cable, and ensure all conducting parts of the cable are properly wrapped, as shown in *"Figure 7-18" on page 95* .

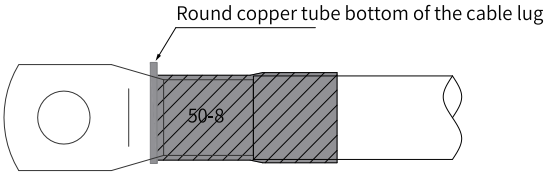


Figure 7-18 Cable conductor with the heat-shrink tube

Requirements on upstream protection device

- Install a proper protection device on the power input side to provide protections on overcurrent, short-circuit and electrical isolation.

- When selecting the protective devices, take the main circuit cable current capacity, system overload capacity, and short circuit capacity of upstream power distribution into account. The recommended values in the selection guide of peripheral components apply to most applications.

Application in IT system

- The drive is applicable to a power grid system with neural points grounded. If the drive is used in an IT power grid system (where the neural point is not grounded), remove the grounding jumpers from the voltage dependent resistor (VDR) and safety capacitor (EMC). That is, remove the No. 1 and No. 2 screws shown in the following figure. Do not install a filter. Failure to comply may result in damage to the drive or even personal injury.
- If a residual current device used trips during power-on, it cannot be ensured that the EMI level meets the C3 category requirements in IEC 61800-3. In this case, you can remove the grounding jumper from the EMC. That is, remove the No. 2 screw shown in *"Figure 7-19" on page 96* .

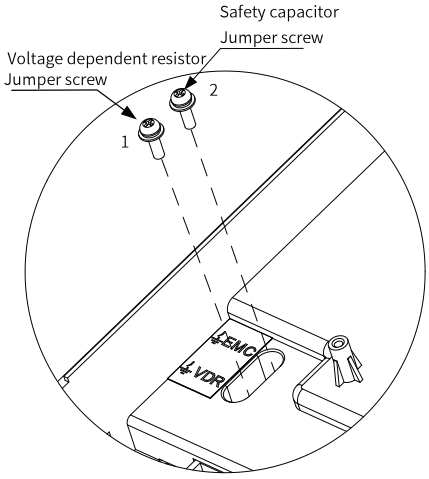


Figure 7-19 Positions of VDR and EMC grounding jumpers

7.4 Connecting the Motor

Shield of motor cables

It is recommended to use the shielded cable as motor cable. Perform a 360° connection on the shield structurally by using the shield grounding bracket, and crimp the drain wire of the shield to the PE terminal. The following figure shows wiring of the shield.

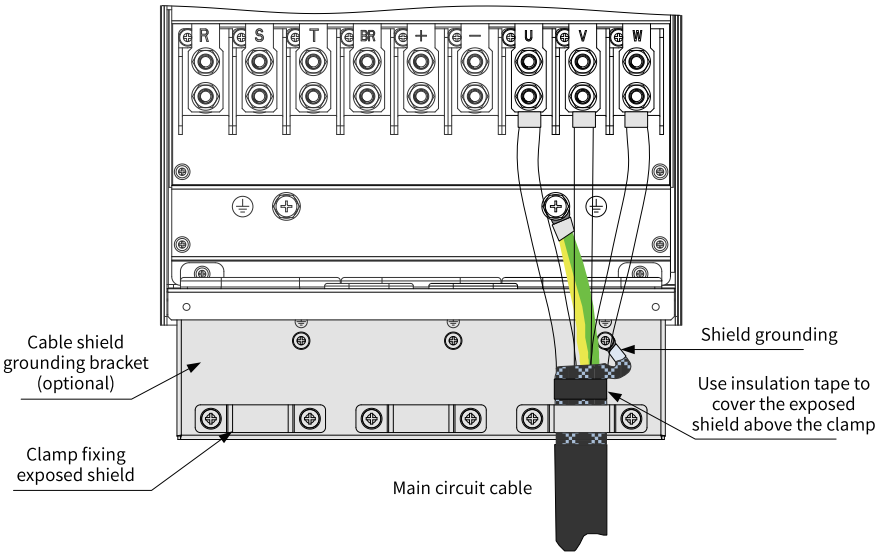


Figure 7-20 Wiring of the shield

Keep the drain wire of the motor cable shield as short as possible, with its width (b in the following figure) no shorter than 1/5 of its length (a in the following figure).

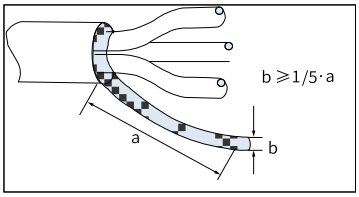


Figure 7-21 Drain wire of the motor cable shield

Length of motor cables

When the drive is working, the quick on-off of its power switch triode can lead to excessively large dU/dt at the output side. If the motor cable is too long, the motor winding will experience excessive voltage stress that may cause insulation breakdown. Use motors that comply with technical specifications in IEC 60034-25 IVIC B or motors with high voltage resistance. In addition, when the cable length increases, the distributed capacitance of the cable increases linearly, resulting in high harmonic current.

The cable connecting the drive and the motor cannot be excessively long. An excessively long cable can result in large distributed capacitance and high harmonic current. When the length of the output cable is equal to or higher than the value listed in the following table, install an output reactor near the drive.

Table 7–8 Minimum length of the cable for output reactor

T model	Drive model	Rated voltage (V)	Min. cable length for optional output reactor (m)
T3	ES680-4T025-XX	200 to 500	110
T4	ES680-4T032-XX	200 to 500	125
	ES680-4T037-XX	200 to 500	135
	ES680-4T044-XX	200 to 500	150

T model	Drive model	Rated voltage (V)	Min. cable length for optional output reactor (m)
T5 to T8	ES680-4T060-XX ES680-4T075-XX ES680-4T091-XX ES680-4T112-XX ES680-4T150-XX ES680-4T176-XX ES680-4T210-XX ES680-4T253-XX	280 to 690	150

Wiring of the Motor

Connect the motor to the drive with U, V, and W phases connected in the correct sequence.

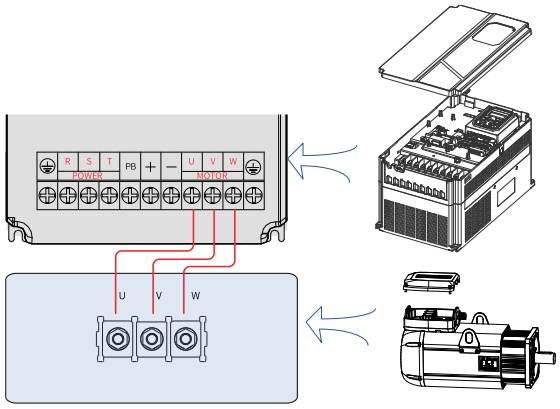


Figure 7-22 Wiring diagram

7.5 Connecting the Encoder

Caution

- During on-site installation and commissioning, route the signal cables (such as encoder cables) and power cables through different routes. Never bundle the signal cables and power cables together to prevent interference to the encoder.
- The motor enclosure must be connected to the PE terminal of the servo drive. Meanwhile, the grounding cable on the motor enclosure side must be connected properly. Failure to comply will result in poor grounding effect.
- Is recommended to use the shielded twisted pair cable as the encoder cable. The shielded twisted pair cable is above 26AWG. The shield of the shielded twisted pair cable is grounded at both ends, with one end connected to the grounding terminal (PE) of the drive and the other connected to the motor enclosure.
- For some large equipment, if the drive is far away from the motor, the motor cable may be excessively long resulting (≥ 10 m). The grounding performance can be affected by the inductance of the cable. In this case, the encoder shield can be ungrounded (by disconnecting the grounding cable of the control board from the grounding copper busbar).

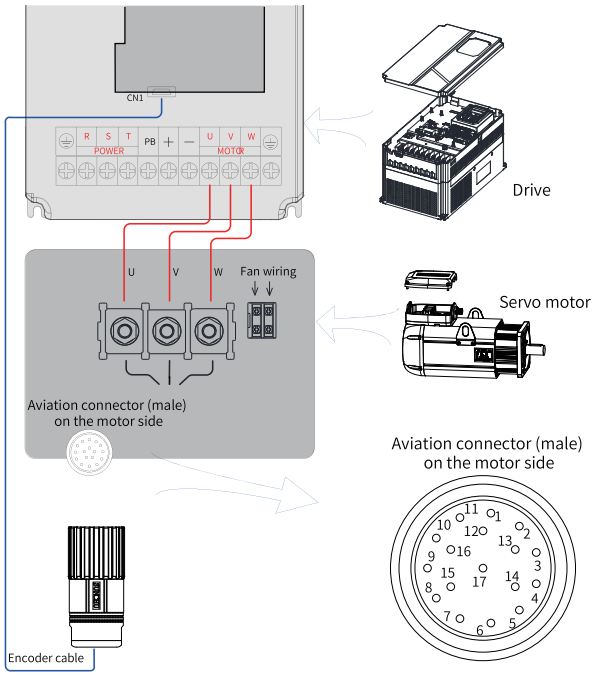


Figure 7-23 Wiring between the encoder and motor

Table 7–9 Encoder cable signals and colors

Drive end (DB9 male)	1	2	3	4	5	9	7	8		6	Enclosure
Motor end (17-pin aviation connector)	10	7	5	6	4	14	16	17	9	8	15
Signal assignment	PS+	PS-	-	-	PT1000-	PT1000+	+5 V	GND	-	-	Shield
Conductor color	Yellow	Yellow/ Black	Gray	Orange	White	Green	Red	Black	Blue	Purple	Shield
Remarks	Twisted pair		Twisted pair		Twisted pair		Twisted pair		Twisted pair		-

7.6 Control Circuit Wiring

7.6.1 Descriptions of Control Circuit Terminals

Layout of control circuit terminals is shown in *"Figure 7–24" on page 100* .

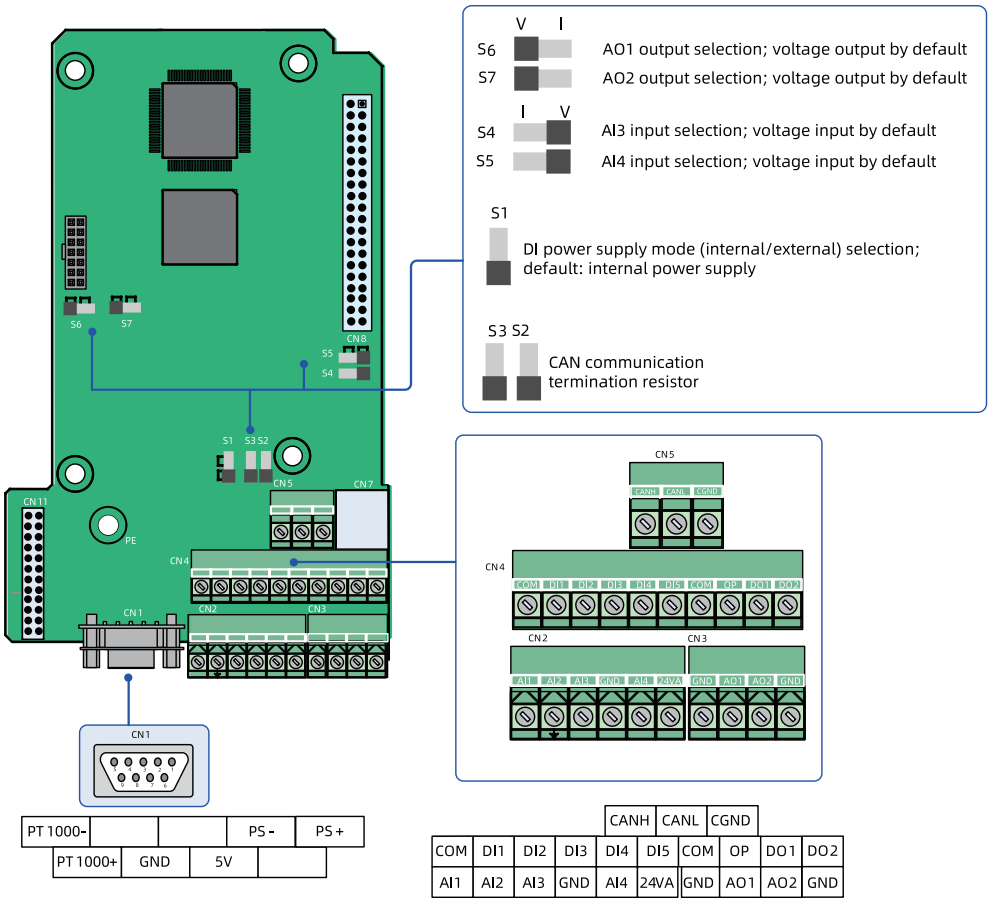


Figure 7-24 Layout of control terminals

Note

- This series of drives supports the S5 DIP switch and AI4 at the hardware level, but not at the software level.
- This series does not support a 24 V external power supply for commissioning.

Table 7–10 Descriptions of Control Circuit Terminals

Type	Symbol	Name	Function Description
Power supply (CN2)	24 VA	24VA analog signal source	24 V ± 10%; maximum output current: 30 mA Generally used to power the pressure sensor
Analog input (CN2)	AI1	AI1	• Input voltage range: -10 VDC to +10 VDC • Input impedance: 52 kΩ • 12-bit resolution, calibrated precision: 0.5%
	AI2	AI2	
	AI3	Analog input terminal 3	• Input range: 0 VDC to 10 VDC or 0 mA to 20 mA, which is determined by DIP switch S4 on the control board • Input impedance: 52 kΩ for voltage input or 500 Ω for current input • 12-bit resolution, calibrated precision: 0.5% • 16-bit high-precision control board available as option, calibrated precision: 0.1%
	AI4	AI4 ***Note*** This series of drives supports the S5 DIP switch and AI4 at the hardware level, but not at the software level.	• Input range: 0 VDC to 10 VDC or 0 mA to 20 mA, which is determined by DIP switch S5 on the control board • Input impedance: 156 kΩ • Connected to position sensor to form a closed position loop, 16-bit high precision detection (calibrated precision: 0.1%)
	GND	Analog reference ground	Internally isolated from COM.
Analog output (CN3)	AO1	AO1	• Voltage output or current output, as selected by the DIP switch on the control board (max. load resistance < 500 Ω) • Output voltage range: 0–10 V • Output current range: 0–20 mA • 12-bit resolution, calibrated precision 1%
	AO2	Analog output terminal 2	
	GND	Analog reference ground	Internally isolated from COM.
	GND	Analog reference ground	Internally isolated from COM.
Digital input/output (CN4)	DI1	Digital input 1	• Optocoupler isolation, input frequency lower than 100 Hz, driven by external or internal power supply as defined by S1 on the control board • Input impedance: 4.95 kΩ (upon 24 V input) • Voltage range upon active level input: 15 V to 30 V
	DI2	DI2	
	DI3	DI3	
	DI4	DI4	
	DI5	DI5	
	OP	External 24 V power supply for digital input	The DI circuit can be powered up by an external 24 V power supply, as selected by the DIP switch.
	COM	Digital input reference ground	Internally isolated from GND
	DO1	DO1	Optocoupler isolation; dual-polarity open collector output Output voltage range: 0 V to 24 V Output current range: 0 mA to 50 mA Note: DO can be driven by external power supplies only. Check whether the power supply ground can be connected to COM when using the external power supply.
	DO2	DO2	
	COM	Digital output reference ground	Internally isolated from GND

Type	Symbol	Name	Function Description
CAN communication (CN5)	CANH	CAN input (+)	One isolation CAN communication as standard, used for communication between the host controller or PLC and the drive • Max. communication speed: 1 Mbps • Max. number of nodes: 64
	CANL	CAN input (-)	
	CGND	Power ground	
Auxiliary interface	CN1	14-bit magnetic encoder interface	PT1000 as standard
	CN7	External operating panel interface	Supports SOP-20-880 and SOP-20-810 external operating panel.
	CN11	Extension card interface	Reserved
DIP switch	S1	DI power supply mode	Used to switch between the internal and external power supplies for DI signals. By default, the internal 24 V power supply is used.
	S2, S3	CAN termination resistor setting jumper	You can choose whether to match the termination resistor. The termination resistor is matched by default.
	S4	AI3 selection	Either voltage or current input (voltage input by default)
	S5	AI4 input mode selection ***Note*** This series of drives supports the S5 DIP switch and AI4 at the hardware level, but not at the software level.	Either voltage or current input (voltage input by default)
	S6	AO1 output	Either voltage or current output (voltage output by default)
	S7	AO2 output	Either voltage or current output (voltage output by default)

7.6.2 Requirements for Control Circuit Wiring

Cable selection requirements for the control circuit

To reduce interference suffered by the control circuit, shielded cables are recommended for the control circuit. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pairs for digital signals.

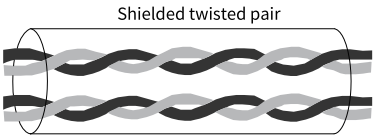


Figure 7-25 Shielded twisted pair cables

Grounding requirement on the control circuit cable shield

- It is recommended to use the grounding bracket (optional part) together with the shield. In this way, the cable shield can be grounded at 360°.
- Keep the drain wire of the shield as short as possible, as shown in the following figure. Fix the shield to the grounding sheet metal of the drive with screws.

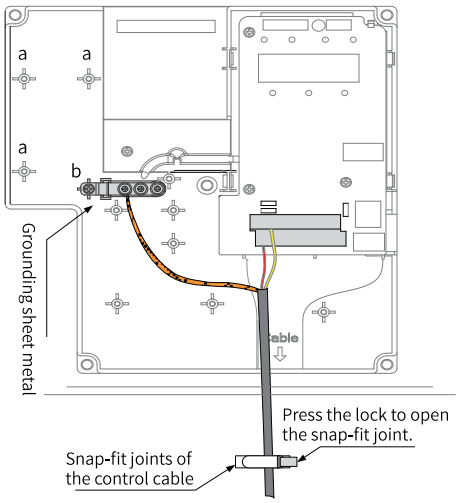


Figure 7-26 Grounding of the control circuit cable shield

Control circuit routing requirements

- To prevent interference, route the control circuit cables and main circuit cables through different routes and keep the control circuit cables away from the main circuit cables.
- When the control circuit and the drive cable must be cross-connected, the cross-connection angle must be 90 degrees.

The following figure shows the recommended cabling.

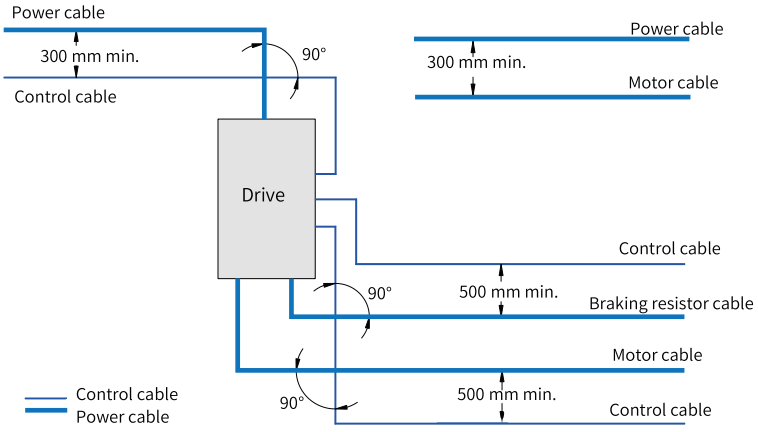


Figure 7-27 Recommended cabling

Requirements on tubular terminals of the control circuit

Use tubular terminals with insulation sheath. Keep the exposed conductor of a solid or stranded cable no longer than 6 mm, as shown in the following figure.

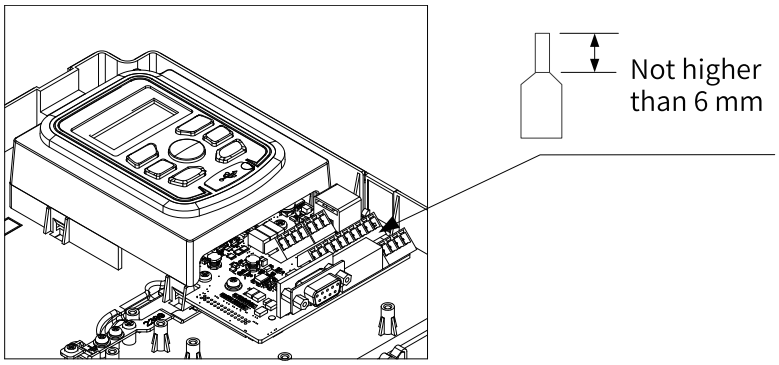


Figure 7-28 Requirements on tubular terminals of the control circuit

Solid cable	Stranded cable	Tightening torque
0.2 mm² to 0.75 mm² （24AWG to 18AWG）		0.565 N·m

7.6.3 Wiring of Control Circuit Terminals

Wiring of AI1/AI2

Weak analog voltage signals are prone to suffer external interference. Therefore, a shielded cable is required, and the wiring distance must be as short as possible (no longer than 20 m), as shown in *"Figure 7-29" on page 104* . In scenarios where analog signals experience severe external interference, install a filter capacitor or a ferrite core on the analog signal source, as shown in *"Figure 7-30" on page 105* . Connect the drain wire of the analog terminal shield to the PE terminal.

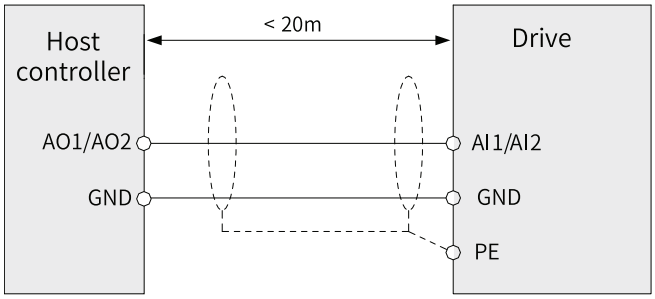


Figure 7-29 Wiring of AI terminals

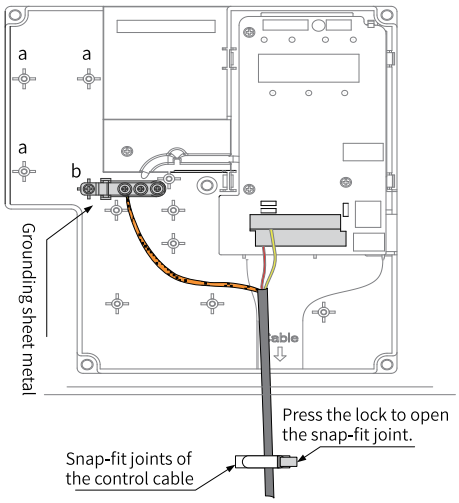


Figure 7-30 Grounding the shield of the AI terminal

Wiring of AI3/AI4

- AI3/AI4 is wired in the same way as AI1 when AI3/AI4 adopts voltage signal input.
- When AI3/AI4 adopts current signal input, AI3/AI4 is where the current flows into and 24VA is where the current flows out. In this case, the DIP switches for AI3 and AI4 are S4 and S5 respectively.

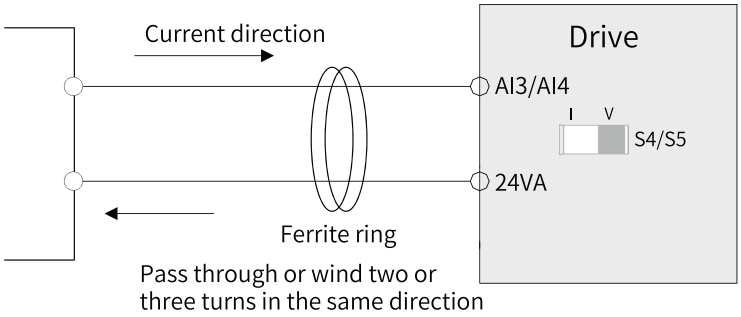


Figure 7-31 Wiring AI3/AI4

Wiring of DI1 to DI5

- Sink wiring mode

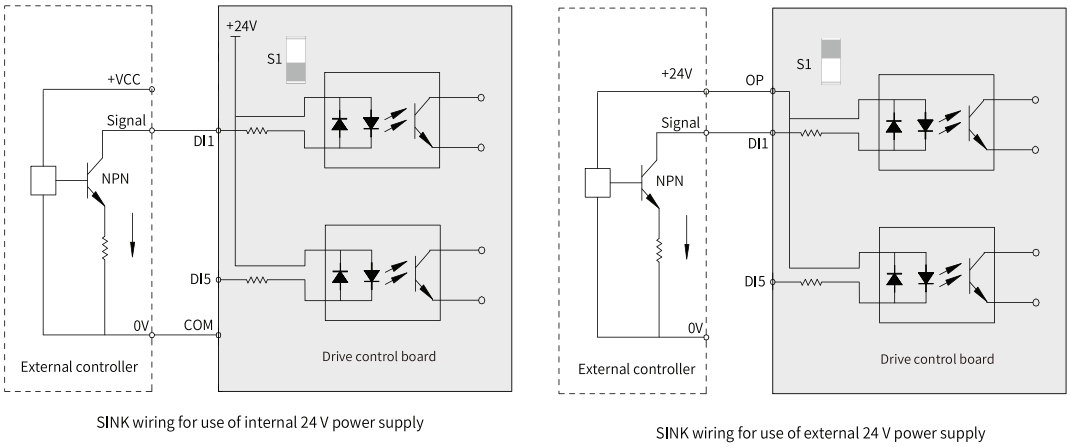


Figure 7-32 Sink wiring mode

- When using the internal 24 V power supply of the drive, which is also the most popular wiring mode, set S1 (downwards) based on the sequence shown in the internal 24 V wiring diagram, and connect COM terminal on the drive to 0V of the external controller.
- When using the external 24 V power supply, set S1 (upwards) based on the sequence shown in the preceding figure on the right. Then, connect +24V of the external power supply to the OP terminal and connect 0V of the external power supply to the corresponding DI terminal after passing the contact of the controller.

Note

In this wiring mode, the DI terminals of different drives cannot be connected in parallel. Otherwise, DI malfunction may result. If parallel connection (among different drives) is required, connect a diode in series (anode connected to DI) at the DI and the diode needs to satisfy the requirement: IF > 40 mA, VR > 40 V, as shown by *"Figure 7-33" on page 106* .

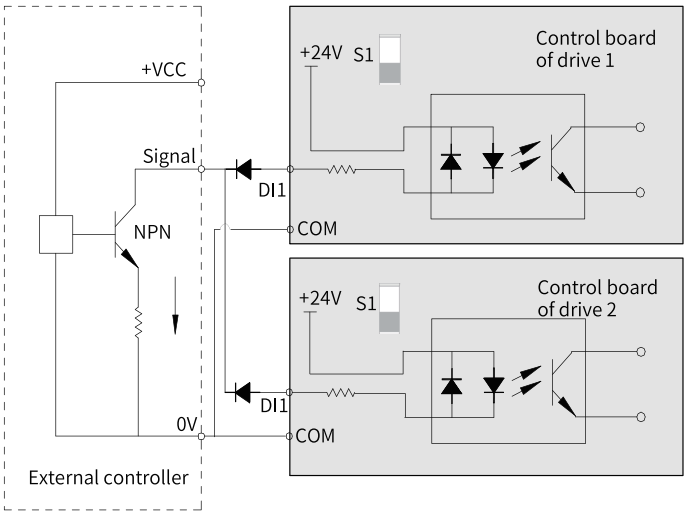
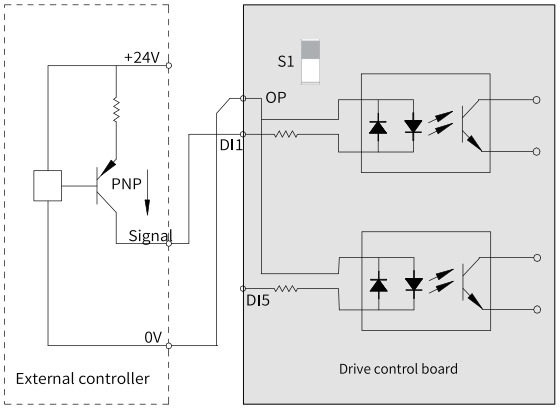


Figure 7-33 Parallel connection of DI terminals of multiple drives in the sink mode

- Source wiring mode



Source wiring for use of external 24 V power supply

Figure 7-34 Source wiring mode

To use the source wiring mode, use the external 24 V power supply and set S1 (upwards) as shown in *"Figure 7-34" on page 107* . Then, connect external 0V to OP.

DO wiring

When the DO needs to drive a relay, connect a snubber diode on both sides of the relay coil. Otherwise, the 24 V DC power supply may be damaged. Ensure that the driving capacity does not exceed 50 mA.

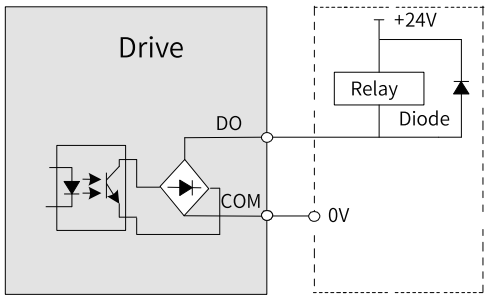


Figure 7-35 Wiring of DO terminals

Caution

- Be sure to properly install the polarity of the snubber diode; otherwise, the 24 VDC power supply will be damaged immediately upon the DO output.
- The DO terminals can be driven by external 24 V power supplies only. When DO1 is driven by an external power supply, ensure that the GND of the external 24 V power supply can be connected to the GND of the drive control board.

7.6.4 Grounding Requirements for Control Circuits

The control board is not grounded by default. When the control board needs to be grounded, secure the grounding terminal of the control board with an M3 x 8 Phillips pan-head SEMS screw. The following figure shows grounded/ungrounded control boards.

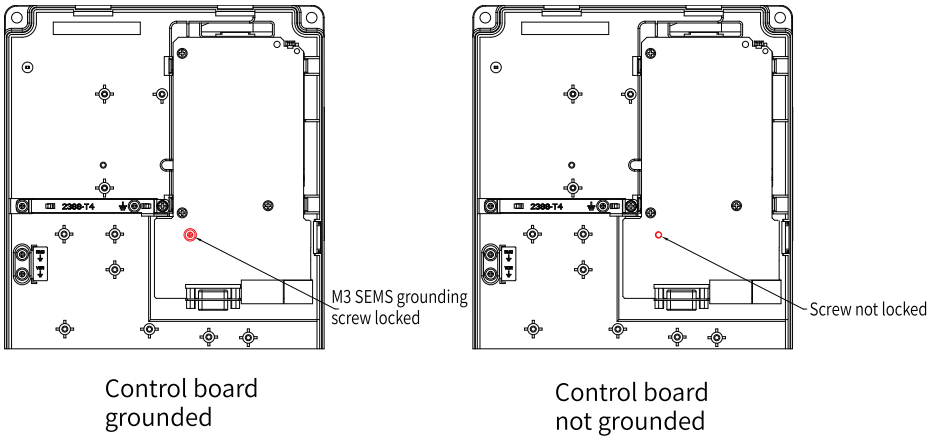


Figure 7-36 T3 and T6 control boards (grounded and ungrounded)

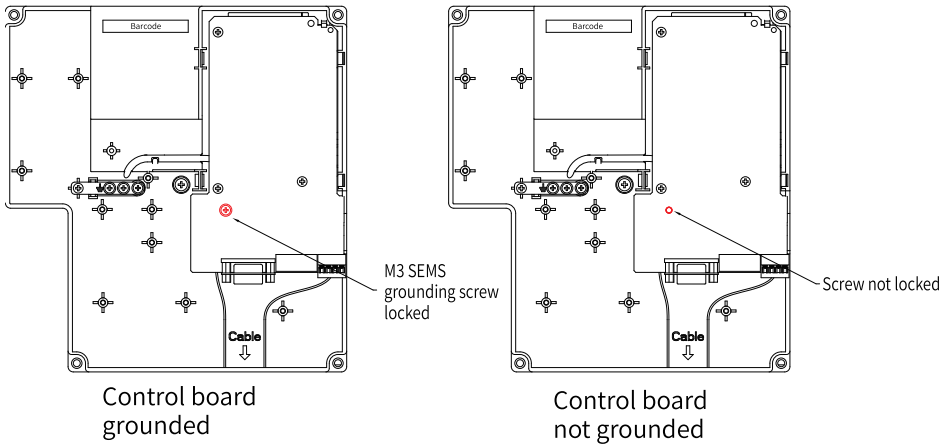


Figure 7-37 Control board grounded and not grounded for T7 to T8 models

7.7 Communication Connection

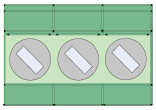
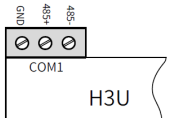
7.7.1 RS485 Communication Connection

To use RS485 communication, install an RS485 expansion card (MD38IO3) to the drive. For details on the RS485 expansion card, see *MD38IO3 I/O Expansion Card User Guide.*

RS485 Communication Connection

Use a three-conductor shielded cable as the RS485 bus to connect to 485+, 485-, and CGND terminals of the AC drive. Use the twisted pair cable to connect to the 485+ and 485- terminals and use the other cable to connect to the RS485 reference ground terminal CGND. Connect the shield to the equipment ground. (Connect the 120 Ω termination resistor to the grounding terminal of the drive or on each end of the grounding sheet metal to prevent RS485 signal reflection.) Pin connection between the PLC and communication cable of the drive is shown in the following cable.

Table 7–11 Pin connection between the PLC and communication cable of the drive

MD38IO3 Expansion Card (A) on the Drive Side			PLC side (B)		
Communication type	Signal name	Terminal Layout	Communication type	Signal name	Terminal Layout
RS485	RS485+ RS485- CGND	CN3 485+ 485- CGND 	RS485	RS485+ RS485- GND	
-	PE (shield)	Enclosure	-	PE (shield)	Enclosure

Terminal wiring

- Terminal wiring for nodes with CGND
  MD38IO3 has three conductors connected to 485+, 485-, and CGND respectively. Check that the RS485 bus on site contains three cables and that the wiring terminals are connected correctly. For use of shielded cables, connect the shield to the CGND terminal. Do not connect the shield to any other part (including enclosure on site and the grounding terminal of the device) except the CGND terminal.

  Given the effect of attenuation, it is recommended to use AWG26 or higher cables for connection longer than 3 m. Twisted pair cables are always recommended for connecting 485+ and 485-.

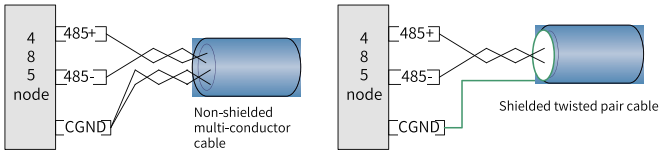


Figure 7-38 Wiring diagram 1 for multi-conductor non-shielded cables/shielded twisted pair cables

1. Recommended cable 1: Multi-conductor twisted pair cables. Connect the twisted pair cable to 485+ and 485-, and twist the remaining pairs together to connect CGND.
2. Recommended cable 2: Use shielded twisted pair cables, with the twisted pair connected 485+ and 485-, and the shield connected to CGND.

Caution

In cases where the shielded cable is used as the connecting cable, connect the shield to CGND only.

- Terminal wiring for nodes without CGND

For nodes without CGND, do not connect CGND cable or the shield to the PE terminal of nodes directly. Handle this issue by following the three methods.

1. Check whether another port on this node shares a common reference ground with the RS485 circuit. If yes, connect the CGND cable (the shield) of the bus directly to the pin.
2. Find the reference ground of RS485 circuit on the node board and connect the lead wire to CGND or shield.
3. If the reference ground of RS485 circuit cannot be found, leave the CGND cable or shield unconnected and use a separate grounding cable to connect this node to the PE of other node.

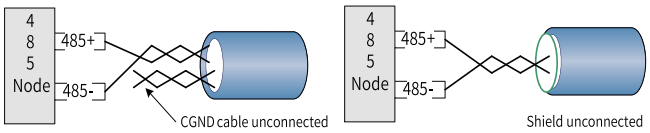


Figure 7-39 Wiring diagram 2 for multi-conductor non-shielded cables/shielded twisted pair cables

Communication networking

If multiple nodes are deployed, use the daisy chain topology for the RS485 bus, as shown in the following figure.

- Shielded twisted pair cables are recommended for connecting the RS485 bus. Twisted pair cables are recommended for connecting 485+ and 485-.
- Connect a 120 Ω termination resistor on each end of the bus to prevent signal reflection.
- Connect the RS485 signal reference ground of all nodes (up to 128 nodes) together, with the length of each node branch less than 3 m.

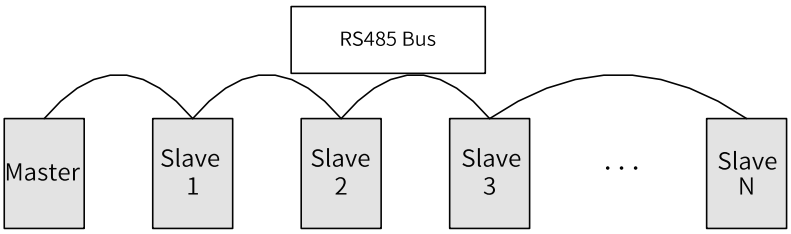


Figure 7-40 Daisy chain topology

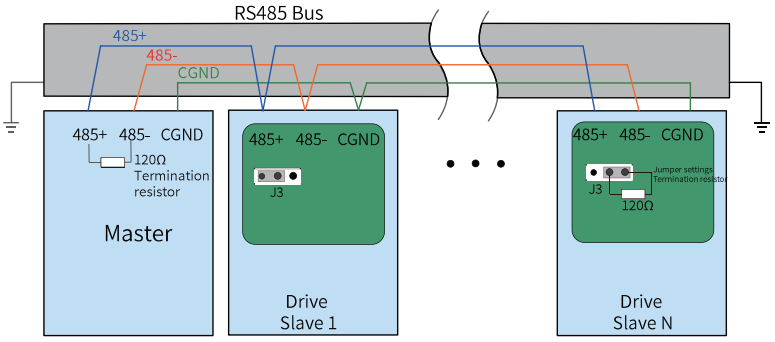


Figure 7-41 RS485 bus topology

Transmission distance

The maximum number of nodes and transmission distance of a standard RS485 circuit vary with the transmission rate, as listed in the following table.

Table 7–12 Transmission distance and number of nodes

Transmission rate (kbps)	Transmission distance (m)	Number of nodes	Cross-Sectional Area
115.2	100	128	26 AWG
19.2	1000	128	26 AWG

Termination resistor settings

Table 7–13 Termination resistor settings

Terminal symbol (Expansion card)	Name	Description	Position of the Jumper/DIP Switch
S1	DIP switch for RS485 termination resistor connection	Termination resistor is connected.	
		Termination resistor is not connected.	

Note

The DIP switch is set from the top view with main terminal block at the bottom. The DIP switch is subject to the silkscreen on the board.

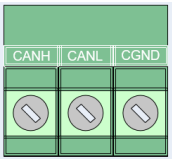
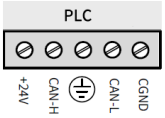
7.7.2 CAN Communication Connection

CAN communication connection

Use a three-conductor shielded cable for the CAN bus to connect to the CANH, CANL, and CGND terminals of the drive. Connect the twisted pair to the CANH and CANL terminals. Connect the third wire to the CAN reference ground terminal CGND. Connect the shield to the device ground. Connect a 120 Ω termination resistor at each end of the bus to prevent CAN signal reflection.

The following table describes the pin connection between CN5 and PLC when CN5 on the control board is used to achieve CAN communication networking. (An optional CAN communication expansion card (MD38CAN1) is required for CAN communication position sensor to achieve CAN communication networking. For detailed configuration of CAN communication expansion card, see the corresponding user guide.)

Table 7–14 Pin connection between the drive and PLC communication cable

CN5 (A) of the Control Board on the Drive Side			PLC side (B)		
Communication type	Signal name	Terminal Layout	Communication type	Signal name	Terminal Layout
CAN	CANH		CAN	CAN-H	
	CANL			CAN-L	
	CGND			CGND	
	-			+24 V	
-	PE (shield)	Enclosure	-	PE (shield)	Enclosure

The following figure shows how to connect the shield.

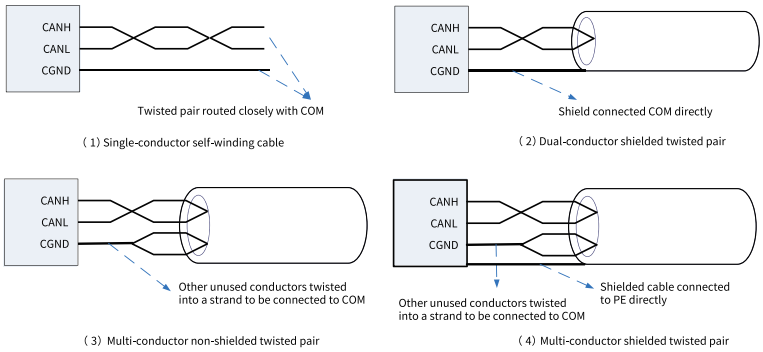


Figure 7-42 Recommended connection mode for the shield

Connect the shield of the CAN communication cable between cabinets to CGND. Given the potential interference generated by the grounding cable (PE), do not connect the shield of the CAN communication cable to the grounding cable (PE).

Communication networking

Use the daisy chain mode for the CAN bus, as shown in the following figure.

- Use shielded twisted pair cables for the CAN bus, and use twisted pair cables for CANH and CANL signal cables.
- Connect a 120 Ω termination resistor on each end of the bus to prevent signal reflection.
- Connect the reference grounds for CAN signals of all the nodes (up to 64 nodes) together. Ensure the distance of each node branch is lower than 0.3 m.

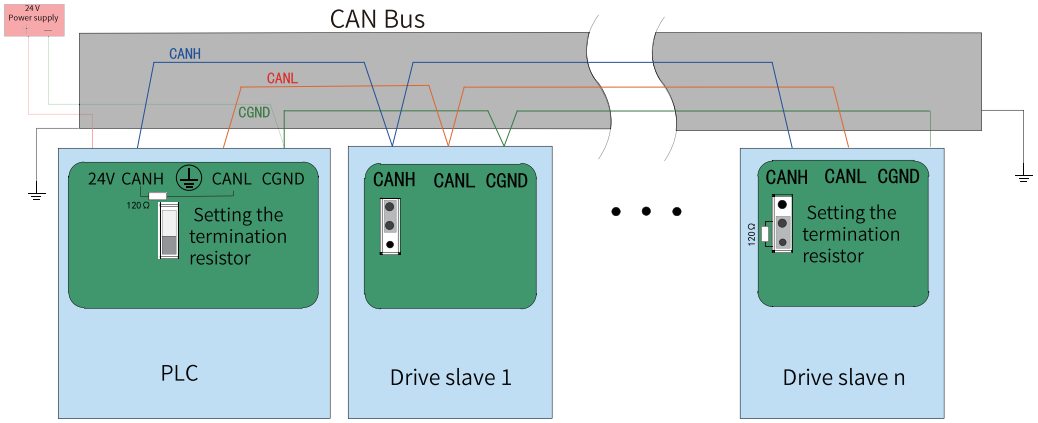


Figure 7-43 CAN bus topology

Transmission distance

The transmission distance of the CAN bus is directly related to the baud rate and the communication cable. The following table describes the relationship between the maximum bus length and the baud rate.

Table 7–15 Transmission distance and baud rate

Baud rate (kbps)	Cross-sectional area (mm^2)	Transmission distance (m)	Number of nodes
1024	0.205	25	64
500	0.34	95	64

Baud rate (kbps)	Cross-sectional area (mm^2)	Transmission distance (m)	Number of nodes
100	0.5	560	64
50	0.75	1100	64

Termination resistor settings

Table 7–16 Termination resistor settings

Terminal symbol (control board of the drive)	Name	Description	Position of the Jumper/DIP Switch	Remarks
S2, S3	DIP switch for CAN termination resistor setting	Termination resistor is connected.		The states of S2 and S3 must be consistent.
		Termination resistor is not connected.		

7.7.3 Wiring of PROFINET Communication

Communication networking

After the drive communicates properly with MD500-PN1 card, set related communication configurations to enable communication between MD500-PN1 card and PROFINET master, achieving the networking function of the drive.

PROFINET supports multiple types of topologies including the bus type, star type, and tree type. Multiple types of networking can be achieved through the switch.

Connect the cable to only one of the two ports.

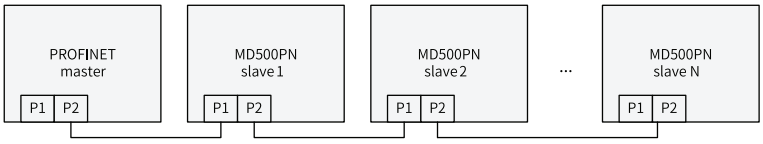


Figure 7-44 Bus-type topology

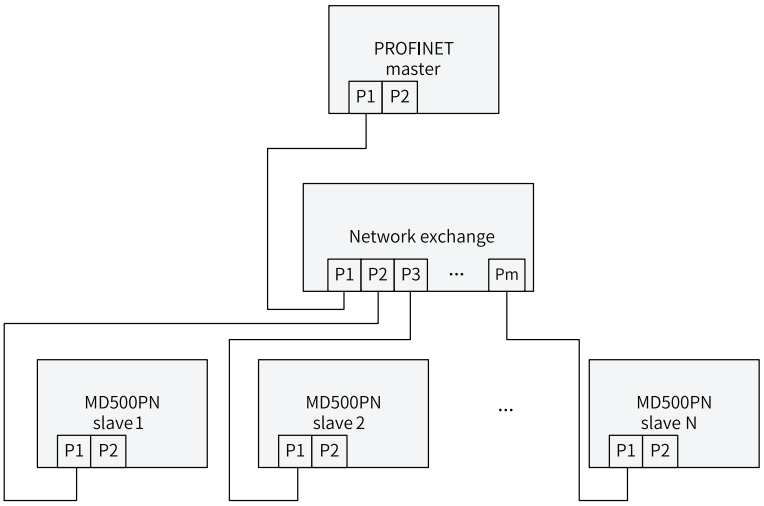


Figure 7-45 Star-type topology

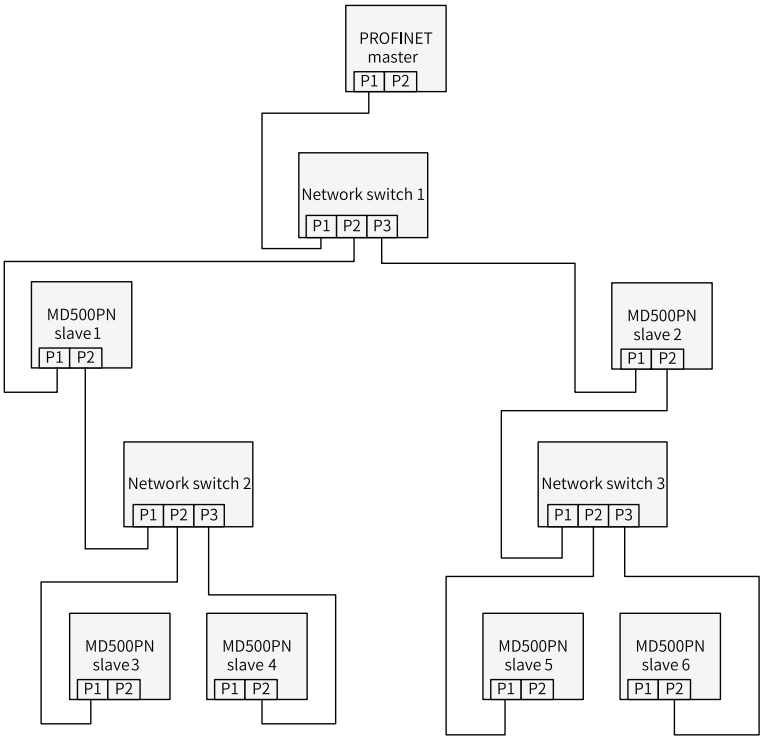


Figure 7-46 Tree-type topology

Transmission distance

The PROFINET communication circuit length is 100 m.

7.7.4 PROFIBUS DP Communication Connection

Communication networking

The following figure shows the connection between the DP card and PROFIBUS master.

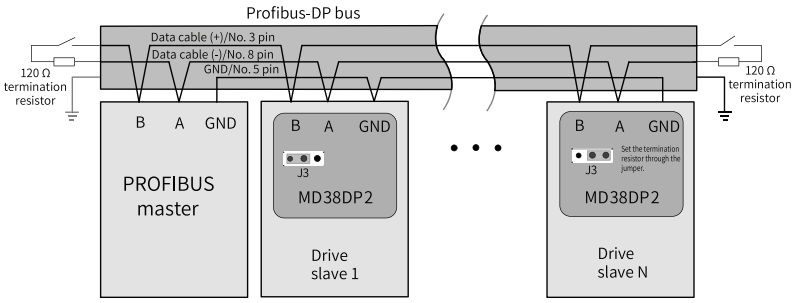


Figure 7-47 Connection between the PROFIBUS DP expansion card and PROFIBUS master

Connect the termination resistor to the PROFIBUS-DP bus terminal and set the DIP switch as indicated by the terminal block. Ground the PE terminal of the system properly.

Transmission distance

The length of a communication cable between the DP card and the PROFIBUS master is limited by the baud rate of the master. Restrict the length of communication data cables in strict accordance with Siemens DB9 wiring standard. The relationship between the baud rate and the cable length is as follows.

Table 7–17 Transmission distance

Baud rate (kbps)	Maximum length of conductor A (m)	Maximum length of conductor B (m)
9.6	1200	1200
19.2	1200	1200
187.5	600	600
500	200	200
1500	100	70
3000	100	Not supported
6000	100	Not supported
12000	100	Not supported

Termination resistor settings

Table 7–18 Termination resistor settings

Terminal symbol (expansion card)	Terminal name	Function description	Jumper/DIP switch position
J6	CANlink communication termination resistor setting jumper	The termination resistor is connected.	
		The termination resistor is not connected.	

7.8 Grounding

7.8.1 Main Circuit Grounding Requirements

Caution

- Ground the grounding terminal to avoid electric shocks. Follow the relevant electrical regulations of specific countries or regions on the grounding method.
- To prevent electric shocks, ensure the protective grounding conductor complies with technical specifications and local safety standards. Keep the grounding cable as short as possible.
- Grounding cables (except for motors) shall meet requirements of GB/T 12668.501 and EN 61800-5-1. In any case, the cross-sectional area of each protective grounding conductor that does not form part of the power cable or cable jacket cannot be less than 2.5 mm^2.
- The leakage current of a single drive does not exceed 3.5 mA AC or 10 mA DC. You only need to configure one protective grounding conductor with the same specifications as the phase cable.
- If the leakage current exceeds 3.5 mA, use the protective grounding conductor with the cross-sectional area of at least 10 mm^2 according to EN 61800-5-1, or connect with two protective grounding conductors of the same specifications.
- Observe the grounding requirements of all the devices as improper grounding can lead to malfunction.

Main circuit wiring requirements:

- The protective grounding conductor must be a yellow-green cable comprised of copper conductors. Do not connect the protective grounding conductor to a switching device (such as a circuit breaker) in series.
- Ground the grounding terminal properly. Improper grounding can result in device malfunction or damage.
- The grounding terminal cannot be shared with the neutral terminal (N) of the power supply.
- It is recommended to install the drive to a conductive metal mounting surface. Ensure the whole conductive bottom of the drive is connected properly to the mounting surface.
- Tighten the grounding screw with specified tightening torque to prevent the protective grounding conductor from being secured improperly.
- Install the filter and drive on the same mounting surface to ensure a proper filtering effect of the filter.

The drive can be installed individually or side by side with other drives. The grounding diagrams for different installation methods are shown below.

Installation of an individual drive

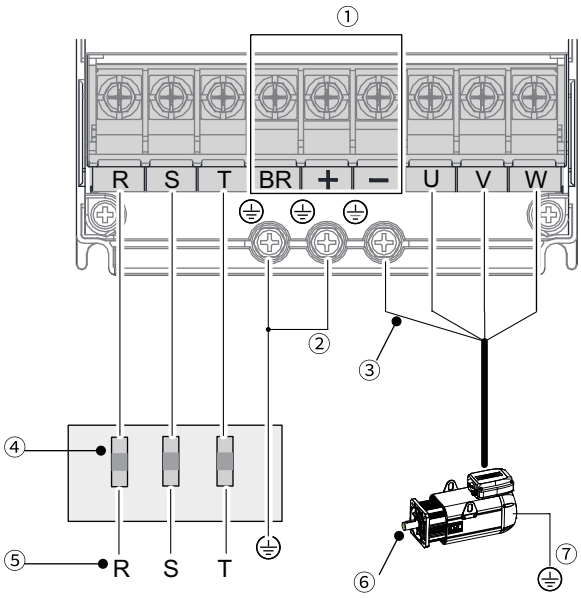


Figure 7-48 Grounding of the main circuit

Table 7–19 Grounding of the main circuit

No.	Wiring description
①	Do not ground the DC bus terminal or the braking resistor terminal.
②	Connect the PE on the input power supply end to the input PE terminal of the drive.
③	Connect the output PE of the drive to the motor cable shield.
④	Input protection (fuse or circuit breaker). Connect the lower end of the fuse to the filter.
⑤	Input power supply
⑥	Three-phase motor
⑦	Ground the motor enclosure.

Note

The layout of main circuit terminals varies with different models.

Side-by-side installation of multiple drives

The following figure shows the grounding of multiple paralleled drives installed in the cabinet.

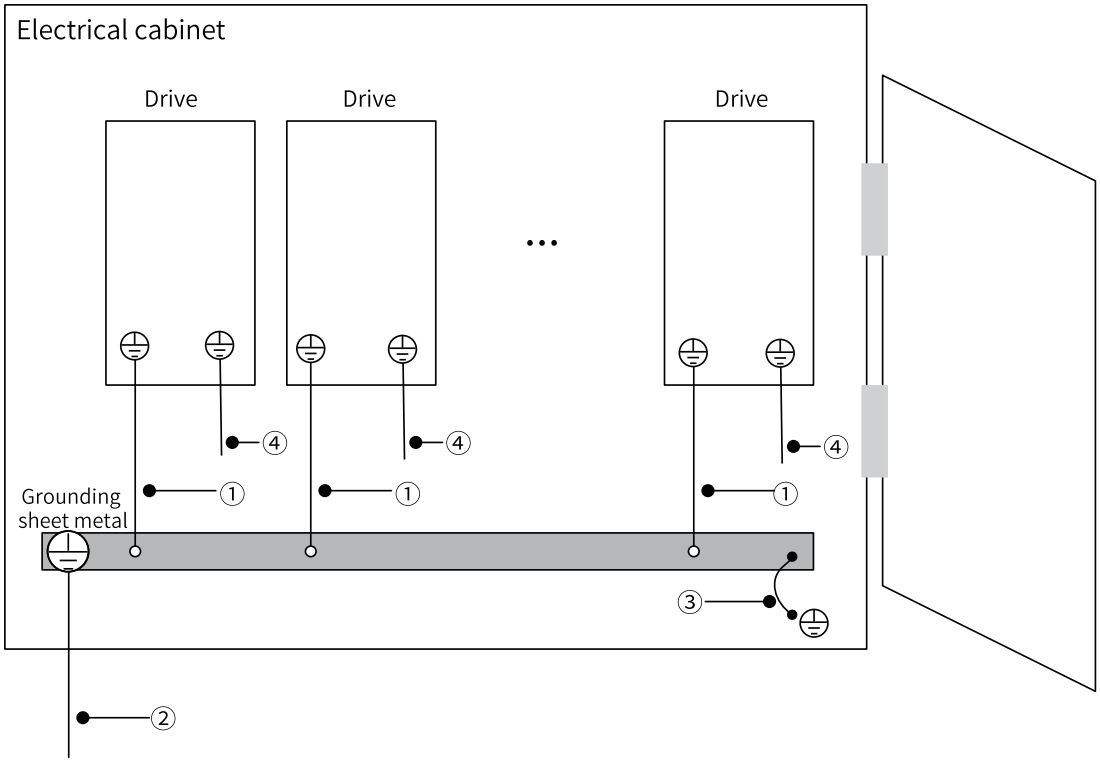


Figure 7-49 Side-by-side installation of multiple drives

Table 7–20 Grounding multiple servo drives installed side by side

No.	Wiring description
①	Connect the main circuit input PE terminal to the grounding sheet metal of the control cabinet through the protective grounding conductor.
②	Connect the PE cable on the input power supply end to the grounding sheet metal of the control cabinet.
③	Connect the grounding sheet metal of the control cabinet to the metal enclosure of the control cabinet through the protective grounding conductor.
④	Connect the motor output cable shield to the output PE terminal of the drive.

7.8.2 Grounding Requirements for the Control Circuit

The control board is not grounded by default. When the control board needs to be grounded, secure the grounding terminal of the control board with an M3 x 8 Phillips pan-head SEMS screw. The following figure shows grounded/ungrounded control boards.

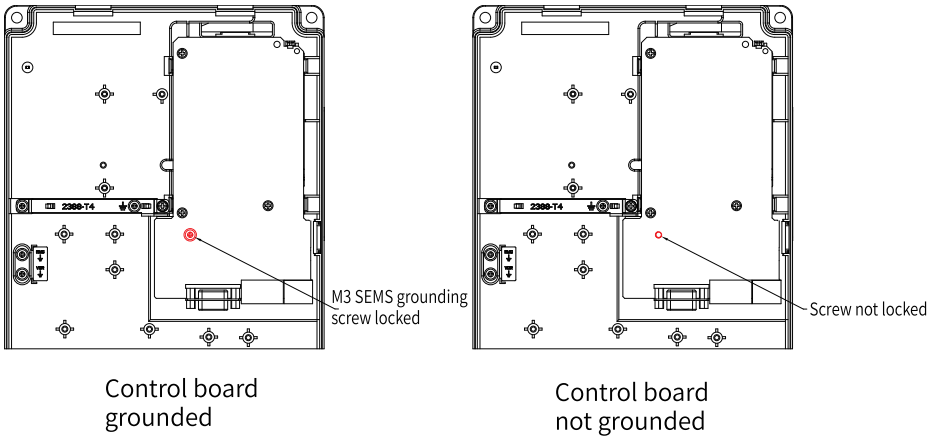


Figure 7-50 T3 and T6 control boards (grounded and ungrounded)

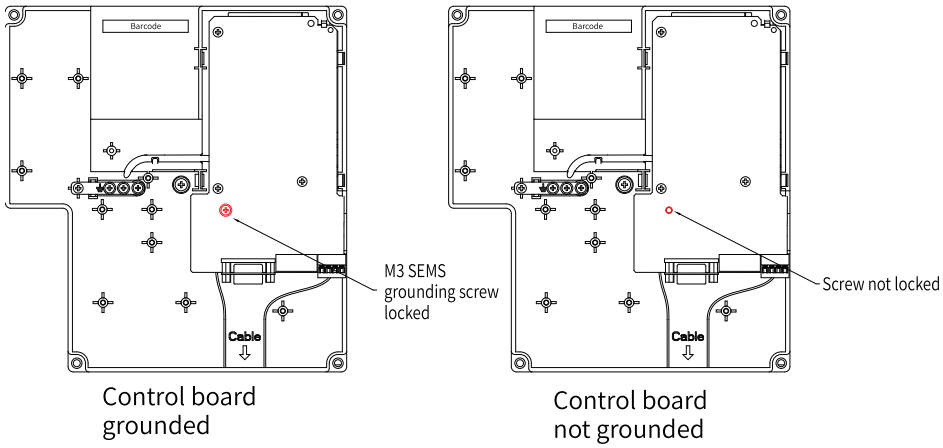


Figure 7-51 Control board grounded and not grounded for T7 to T8 models

7.9 Post-Wiring Inspection

Check the following items after wiring. Sign the "Compliance" column if the check item meets the requirements.

Table 7–21 Wiring checklist

No.	Item	Compliance
1	The drive model is consistent with the model described in the order.	☐
2	The peripheral devices (braking resistor, braking unit, AC reactor, filter, and circuit breaker) meet the design requirements.	☐
3	The installation method and location of the drive meet requirements.	☐
4	The voltage on the input side of the drive is between 323 V to 528 V.	☐
5	The rated voltage of the motor is consistent with the output specifications of the drive.	☐
6	The power supply input cables are connected to R, S, and T terminals.	☐
7	The motor input cables are connected to the U, V, and W terminals.	☐
8	The cross-sectional area of the main circuit cable meets the requirements.	☐
9	The motor output cable does not exceed 50 m. Otherwise, you need to reduce the carrier frequency (F0-15).	☐

No.	Item	Compliance
10	The grounding cable is connected properly.	□
11	The output terminals and control signal cable terminals of the drive are connected properly.	□
12	The braking resistor and braking unit with proper resistance are wired properly.	□
13	Shielded twisted pair cables are used for the control circuit signal cables of the drive, and the shield is connected to the shield bracket.	□
14	The control circuit cables and main circuit power cables are routed through different routes.	□
15	When wiring multiple motors, ensure the wiring is correct and avoid cross-connection between the motor and the drive. Cross-connection may cause motor operation error.	□

8 Models of Options

8.1 Electrical Peripherals

8.1.1 Fuse, Contactor, and Circuit Breaker

The earth leakage current of the drive is higher than 3.5 mA, which requires proper grounding protection.

Caution

When the fuse is damaged or the circuit breaker trips, do not immediately energize the product or operate the peripheral equipment. Wait at least for the time specified on the warning label. Failure to comply will result in personal injury and equipment damage.

To comply with IEC/EN 61800-5-1 and UL 61800-5-1 standards, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit.

Use a B-type (delay-time) RCD because the drive may generate DC leakage current in the protective conductor. When the RCD malfunctions, do as follows:

- Use an RCD of higher rated action current or use a delay-type RCD.
- Reduce the carrier frequency of the drive.
- Shorten the length between the motor and the drive.
- Take additional measures to suppress the leakage current.

Recommended RCD manufacturers are CHINT and Schneider.

Table 8–1 Selection of Fuses, Contactors, and Circuit Breakers

T model	Drive model	Recommended non-semiconductor fuse (UL certified)		Recommended circuit breaker (UL certified)		Recommended contactor current rating (A)
		Class	Rated value	Model	Rated value	
T3	ES680-4T025-XX	CA, CD, CF, J, G, T	60 A, 600 V, 200 kA	Inverse time circuit breaker	40 A, 480 V, 100 kA	38
T4	ES680-4T032-XX	CA, CD, CF, J, G, T	60 A, 600 V, 200 kA	Inverse time circuit breaker	70 A, 480 V, 100 kA	50
	ES680-4T037-XX	CA, CD, CF, J, G, T	60 A, 600 V, 200 kA	Inverse time circuit breaker	70 A, 480 V, 100 kA	65
	ES680-4T044-XX	CA, CD, CF, J, G, T	60 A, 600 V, 200 kA	Inverse time circuit breaker	70 A, 480 V, 100 kA	65
T5	ES680-4T060-XX	CA, CB, J, G, K1, RK1, T	100 A, 600 V, 200 kA	Inverse time circuit breaker	100 A, 480 V, 100 kA	65
T6	ES680-4T075-XX	CF, J, K1, L, RK1, T	150 A, 600 V, 200 kA	Inverse time circuit breaker	125 A, 480 V, 100 kA	80
	ES680-4T091-XX	CF, J, K1, L, RK1, T	150 A, 600 V, 200 kA	Inverse time circuit breaker	125 A, 480 V, 100 kA	95

T model	Drive model	Recommended non-semiconductor fuse (UL certified)		Recommended circuit breaker (UL certified)		Recommended contactor current rating (A)
		Class	Rated value	Model	Rated value	
T7	ES680-4T112-XX	CF, J, K1, L, RK1, T	200 A, 600 V, 200 kA	Inverse time circuit breaker	200 A, 480 V, 100 kA	115
	ES680-4T150-XX	CF, J, K1, L, RK1, T	200 A, 600 V, 200 kA	Inverse time circuit breaker	200 A, 480 V, 100 kA	150
T8	ES680-4T176-XX	CF, J, K1, L, RK1	325 A, 600 V, 200 kA	Inverse time circuit breaker	250 A, 480 V, 100 kA	205
	ES680-4T210-XX	T	400 A, 600 V, 200 kA	Inverse time circuit breaker	400 A, 480 V, 100 kA	245
	ES680-4T253-XX	CF, J, K1, L, RK1	500 A, 600 V, 200 kA	Inverse time circuit breaker	400 A, 480 V, 100 kA	300

Table 8–2 Selection of the fuse that compliant with European standards

T model	Drive model	Rated input current	Rated short circuit current	Recommended fuse	
				Rated value	Model
T4	ES680-4T025-XX	-100 A	-100 kA	32 A, 690 V, 200 kA	170M2609
	ES680-4T032-XX			40 A, 690 V, 200 kA	170M2610
	ES680-4T037-XX			50 A, 690 V, 200 kA	170M2611
	ES680-4T044-XX			63 A, 690 V, 200 kA	170M2612
T5	ES680-4T060-XX			80 A, 690 V, 200 kA	170M2613
T6	ES680-4T075-XX			100 A, 690 V, 200 kA	170M2614
	ES680-4T091-XX			125 A, 690 V, 200 kA	170M2615
T7	ES680-4T112-XX			160 A, 690 V, 200 kA	170M2616
	ES680-4T150-XX			200 A, 690 V, 200 kA	170M2617
T8	ES680-4T176-XX	10 A	-10 kA	250 A, 690 V, 200 kA	170M2618
	ES680-4T210-XX			315 A, 690 V, 200 kA	170M2619
	ES680-4T253-XX			315 A, 690 V, 200 kA	170M2620

8.1.2 AC Input Reactor

Installing the input reactor on the input side of the drive can improve the input power factor, suppress the high harmonics of the input current of the AC drive, and reduce external conduction and radiation interference.

Model

The following table lists the recommended manufacturers and models of input reactors.

MD-ACL -50-0.28-4T-2%
① ② ③ ④ ⑤

Figure 8-1 AC input reactor model

① **Internal code** Inovance AC input reactor	④ **Rated voltage** 4T: 380V
② **Rated current** 50: 50 A	⑤ **Voltage drop percentage** 2%: 2%
③ **Inductance** 0.28: 0.28 mH	-

Table 8–3 Recommended AC input reactor models

T model	Drive model	AC input reactor model (Inovance)
T3	ES680-4T025-XX	MD-ACL-40-1.45-4T
T4	ES680-4T032-XX	MD-ACL-50-1.2-4T
	ES680-4T037-XX	MD-ACL-50-0.28-4T-2%
	ES680-4T044-XX	MD-ACL-60-0.24-4T-2%
T5	ES680-4T060-XX	MD-ACL-80-0.17-4T-2%
T6	ES680-4T075-XX	MD-ACL-90-0.16-4T-2%
	ES680-4T091-XX	MD-ACL-120-0.12-4T-2%
T7	ES680-4T112-XX	MD-ACL-150-0.095-4T-2%
	ES680-4T150-XX	MD-ACL-200-0.07-4T-2%
T8	ES680-4T176-XX	MD-ACL-250-0.056-4T-2%
	ES680-4T210-XX	MD-ACL-250-0.056-4T-2%
	ES680-4T253-XX	MD-ACL-330-0.042-4T-2%

Dimensions

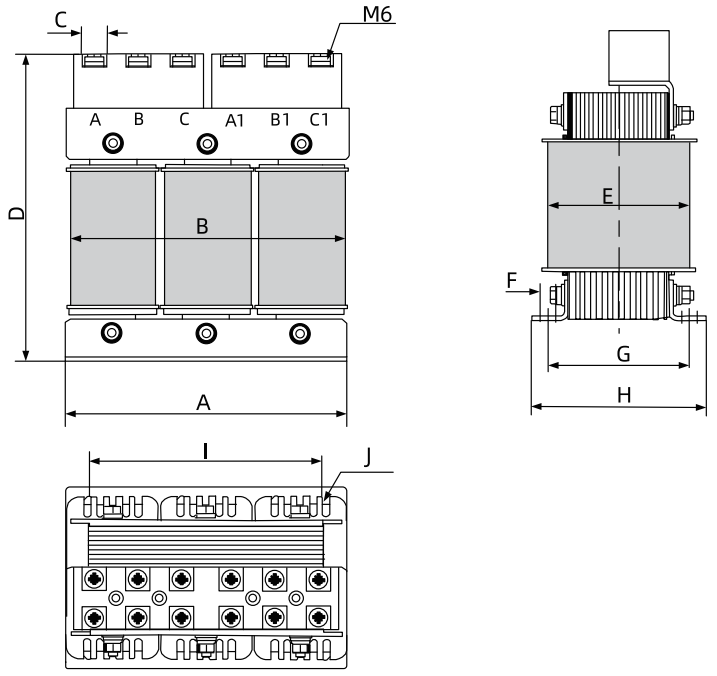


Figure 8-2 Dimensions of AC input reactors (40 A to 50 A, 1.2 mH)

Table 8–4 Dimensions of AC input reactors (40 A to 50 A, 1.2 mH, unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J
40	180±2	185	16	200	105	10	95±2	117±2	150±1	Φ7 × 10
50	200±2	210	16	230	110	10	115±2	130±2	170±1	Φ7 × 10

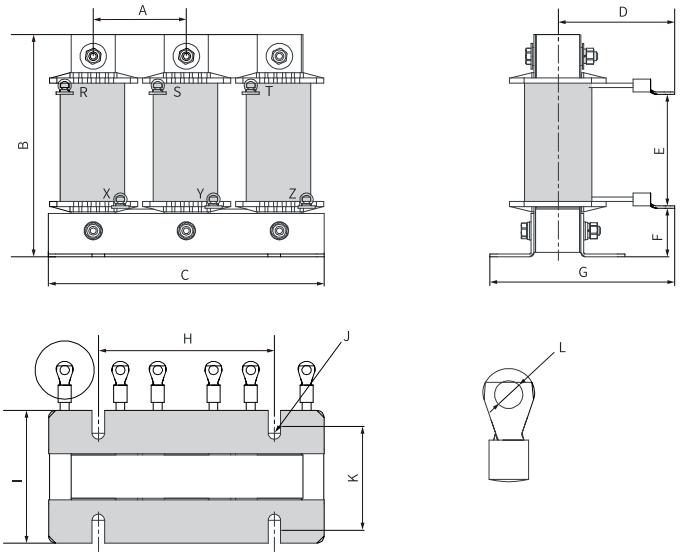


Figure 8-3 Dimensions of 50 A (0.28 mH) to 60 A AC input reactors

Table 8–5 Dimensions of 50 A (0.28 mH) to 60 A AC input reactors (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L
50	64	160	195	80±10	75±5	35±5	135	120±1	92±2	Φ8.5 × 20	72±2	Φ6.4
60	64	160	195	80±10	75±5	35±5	135	120±1	92±2	Φ8.5 × 20	72±2	Φ6.4

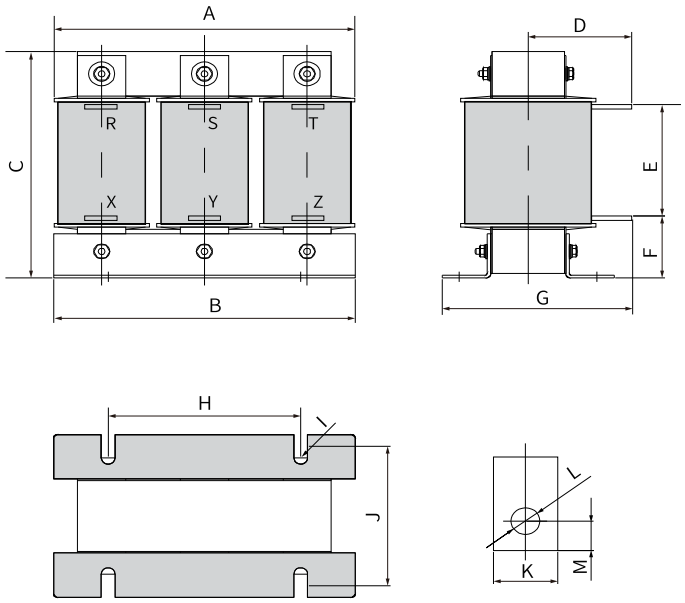


Figure 8-4 Dimensions of AC input reactors of 90 A to 120 A

Table 8–6 Dimensions of AC input reactors of 90 A to 120 A (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M
90	195	188±1	160	-	-	-	150	120±1	Φ8.5 × 20	72±2	-	-	-
120	195	188±1	160	78±10	79±5	40±5	135	120±1	Φ8.5 × 20	92±2	20	Φ9	10

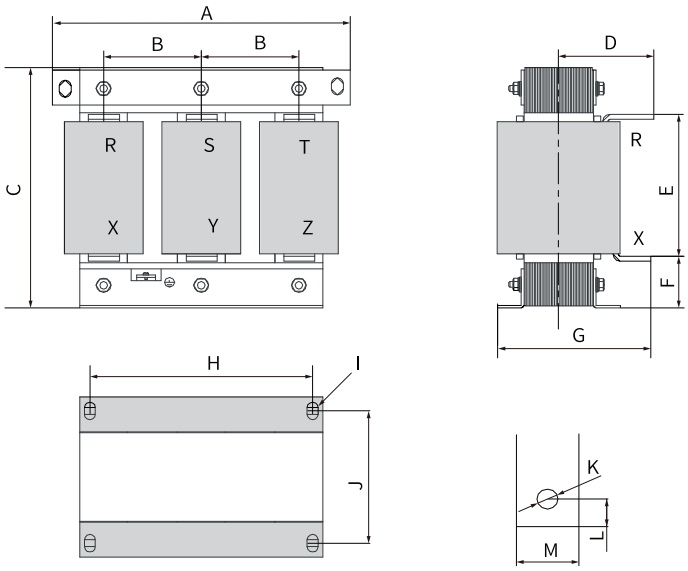


Figure 8-5 Dimensions of AC input reactors (150 A to 330 A)

Table 8–7 Dimensions of AC input reactors (150 A to 330 A, unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M
150	250	81±5	230	92±10	145±5	38±5	155	182±1	Φ11 × 18	76±2	Φ11	13	25
200	250	81±5	230	102±10	145±5	40±5	175	182±1	Φ11 × 18	96±2	Φ11	13	25
250	250	81±5	260	102±10	160±5	50±5	175	182±1	Φ11 × 18	96±2	Φ11	13	25
330	290	95±5	275	107±10	160±5	60±5	180	214±1	Φ11 × 18	100±2	ϕ12	15	30

Note

The dimensions of AC input reactors provided here are for reference only. Actual dimensions may vary with models.

8.1.3 EMC Filter

Models

To comply with the radiated and conducted emission requirements of EN IEC 61800-3, install the EMC filter listed in the following table. The following EMC filters can be used.

Table 8–8 Standard EMC filter model and appearance

Filter model		Appearance
Schaffner	FN3258 series filter	
	FN3359 series filter	

Table 8–9 Recommended manufacturers and models of EMC input filter (three-phase 380–480 V)

T model	Drive model	AC input filter model (Schaffner)
T3	ES680-4T025-XX	FN 3258-42-33
T4	ES680-4T032-XX	FN 3258-42-33
	ES680-4T037-XX	FN 3258-55-34
	ES680-4T044-XX	FN 3258-75-34
T5	ES680-4T060-XX	FN 3258-75-34
T6	ES680-4T075-XX	FN 3258-100-35
	ES680-4T091-XX	FN 3258-100-35
T7	ES680-4T112-XX	FN 3258-130-35
	ES680-4T150-XX	FN 3258-180-40
T8	ES680-4T176-XX	FN 3258-180-40
	ES680-4T210-XX	FN 3359-250-28
	ES680-4T253-XX	FN 3359-250-28

Dimensions

Dimensions of Schaffner FN 3258 series filters (50–180 A)

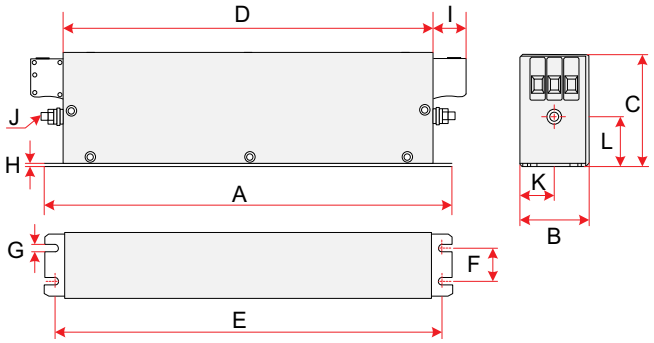


Figure 8-6 Dimensions of FN 3258 series filters (50 A to 180 A, unit: mm)

Table 8–10 Dimensions of FN 3258 series filter (50 A to 180 A)

Rated current (A)	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F (mm)	G (mm)	H (mm)	I (mm)	J	K (mm)	L (mm)
7	190	40	70	160	180	20	4.5	1	22	M5	20	29.5
16	250	45	70	220	235	25	5.4	1	22	M5	22.5	29.5
30	270	50	85	240	255	30	5.4	1	25	M5	25	39.5
42	310	50	85	280	295	30	5.4	1	25	M6	25	37.5
55	250	85	90	220	235	60	5.4	1	39	M6	42.5	26.5
75	270	80	135	240	255	60	6.5	1.5	39	M6	40	70.5
100	270	90	150	240	255	65	6.5	1.5	45	M10	45	64
130	270	90	150	240	255	65	6.5	1.5	45	M10	45	64
180	380	120	170	350	365	102	6.5	1.5	51	M10	60	47

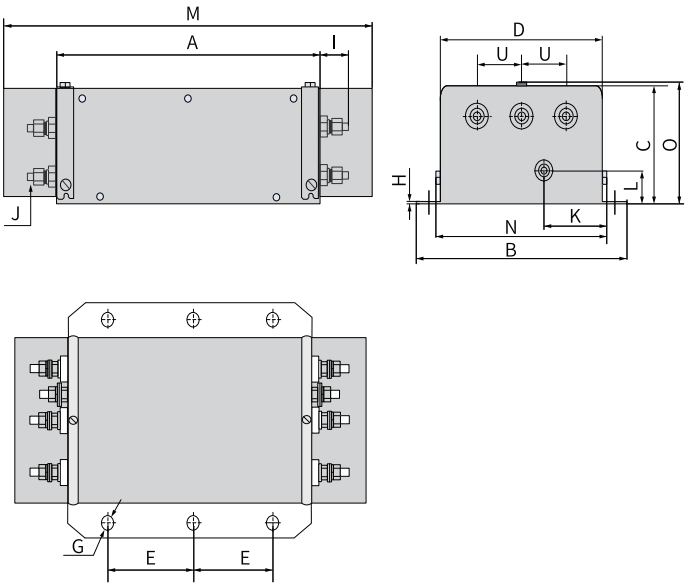


Figure 8-7 Dimensions of FN 3359 series filters (150 A to 250 A)

Table 8–11 Dimensions of FN 3359 series filters (150 A to 250 A, unit: mm)

Name	Rated current		
	150 A	180 A	250 A
A	300	300	300
B	210	210	230
C	120	120	125
D	160	160	180
E	120	120	120
F	185	185	205
G	ϕ12	ϕ12	ϕ12
H	2	2	2
I	33	33	33
J	M10	M10	M10
K	55	55	62.5
L	30	30	35
M	420	420	420
N	171	171	191
O	127	127	132
S	/	/	/

Name	Rated current		
	150 A	180 A	250 A
T	/	/	/
U	50	50	55
V	/	/	/
W	/	/	/
X	/	/	/
Y	/	/	/
Z	/	/	/

8.1.4 Simple Filter

The simple filter can be used to suppress the radio frequency electromagnetic noise generated from the power grid and that escaped from the drive to the outside. In addition, for devices equipped with the residual current device (RCD), if the RCD trips incorrectly, install a simple filter on the input side of the drive for suppression.

Ground the simple filter properly and use a cable shorter than 30 cm to connect the filter and the drive. The grounding terminal of the simple filter must be connected to the grounding terminal of the drive, and the grounding cable must be as short as possible (shorter than 30 cm).

Models

The following table lists the simple filter model which applies to all models of the drive.

Filter manufacturer	Filter model
(JIANLI)	Cxy-1-1

Dimensions

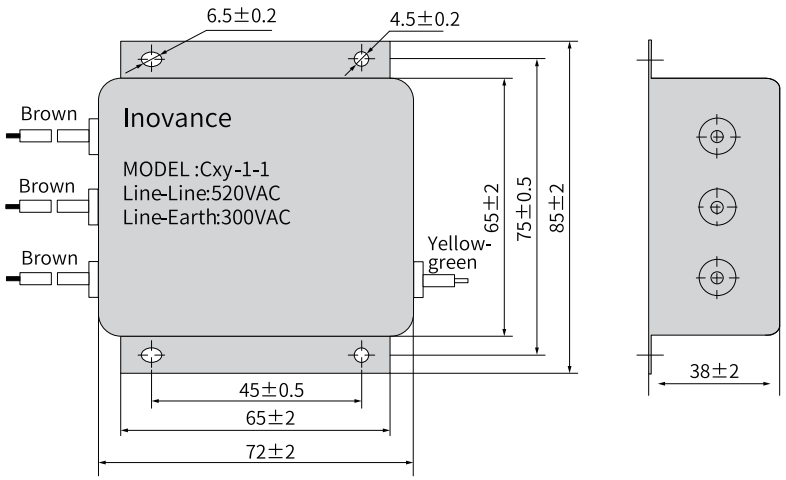


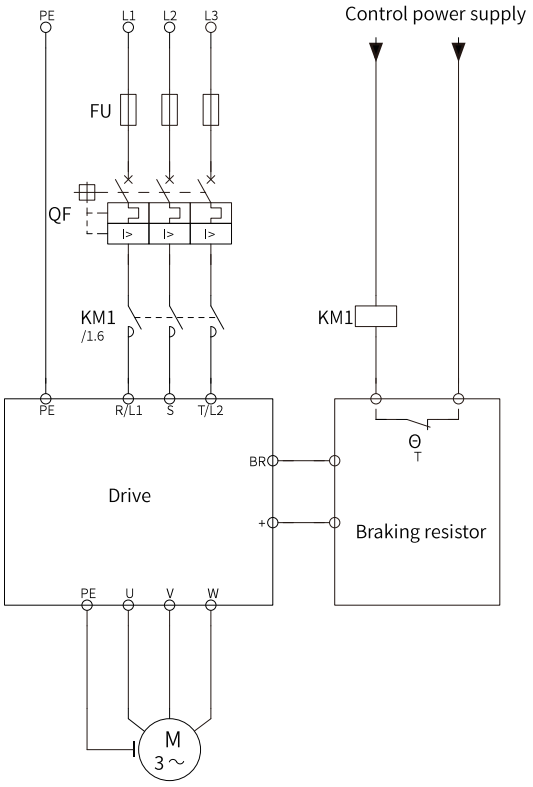
Figure 8-8 Dimensions of the simple filter

8.1.5 Braking Components

Caution

The cable connecting the braking resistor and the drive cannot exceed 10 m.

In applications where a braking resistor is installed, it is recommended to use a resistor with a temperature switch to ensure safety and avoid overtemperature and burning of the braking resistor. Connect the temperature switch output to the electromagnetic contactor control circuit on the front end of the drive (as shown in the following figure) to implement the interlock protection function. When the resistor overheats, a tripping fault occurs, preventing the resistor from being burned.



Models

Table 8–12 Models of braking components (three-phase 380 VAC to 480 VAC, 50/60 Hz)

Model	Drive model	Braking unit	Recommended braking resistor power (kW)	Recommended resistance of the braking resistor (Ω)	Min. resistance of the braking resistor (Ω)
T3	ES680-4T025-XX	Built-in	1.5	≥ 32	28
T4	ES680-4T032-XX	Built-in	1.5	≥ 32	20
	ES680-4T037-XX	Built-in	2.5	≥ 22	20
	ES680-4T044-XX	Built-in	3.2	≥ 28	21
T5	ES680-4T060-XX	Built-in	4.2	≥ 20	12
T6	ES680-4T075-XX	Built-in	5.5	≥ 16	12
	ES680-4T091-XX	Built-in	6	≥ 16	12

Model	Drive model	Braking unit	Recommended braking resistor power (kW)	Recommended resistance of the braking resistor (Ω)	Min. resistance of the braking resistor (Ω)
T7	ES680-4T112-XX	Built-in	6	≥ 16	9
	ES680-4T150-XX	Built-in	8	≥ 12	9
T8	ES680-4T176-XX	Built-in	10	≥ 8	6
	ES680-4T210-XX	Built-in	10	≥ 8	6
	ES680-4T253-XX	Built-in	12	≥ 6	4

Note

- The braking voltage of the built-in braking unit is set to 760 V (F9-08), which is applicable to 380 V power grid. If the drive is used in 480 V power grid, increase the value of F9-08 to prevent the braking transistor from being switched on in advance, and set the braking voltage of the built-in braking unit to a value between 760 V and 780 V.
- The values in the preceding table are for reference only. You can select different resistance and power based on actual conditions. Note that the resistance cannot be lower than the minimum braking resistance listed in the table. The power may be higher than the recommended value in the table. The braking resistor model is dependent on the generating power of the motor in the actual system and is also related to the system inertia, deceleration time and potential energy load. You should select the braking resistor according to actual conditions.
- For systems featuring large inertia and requiring short deceleration time and frequent braking, select a braking resistor with high power and low resistance.

Selecting the braking resistor

Selecting the braking power

Calculating the braking power (Pb) based on the following formula:

$$Pb = P \times Td \times K$$

P: Motor power

K: Mechanical energy conversion efficiency (K = 0.7 generally)

Td: Ratio of braking torque to rated torque of the motor

The value of Td varies with the system, as shown in the following table.

Common applications	Elevator, hoist, crane	Decoiler and recoiler	High-inertia device that requires quick stop	Regular inertia load
Value of Td	100%	120%	120%	80%

Selecting the resistance of the braking resistor

During braking, almost all the regenerative energy of the motor is consumed by the braking resistor. The resistance (R) can be calculated using the following formula:

$$R = U^2/Pb$$

U refers to the braking voltage upon stable braking of the system.

The value of U varies with the system:

- The value of U in 220 VAC system: 380 V
- The value of U in 380 VAC system: 700 V

- The value of U in 480 V system: 800 V
- The value of U in 690 V system: 1200 V

Selecting the power of the braking resistor

In theory, the power of the braking resistor is consistent with the braking power. However, the power of the braking resistor is derated by 70% during actual application. You can calculate the power of the braking resistor according to the following formula:

$$Pr = Pb \times ED \div 0.7$$

Specifically, ED represents the braking frequency, namely the ratio of the braking process to the whole operation process.

Common application occasion	Elevator	Decoiler and recoiler	Crane and centrifuge	Occasional braking load /	Injection molding machine	Regular application
Value of ED	20% to 30%	20% to 30%	50% to 60%	5%	5% to 10%	10%

8.1.6 Output Reactor

Installing an output reactor on the output side of the drive helps reduce excessive dV/dt and voltage stress on the motor winding, protecting the motor winding from insulation breakdown, lowering the motor temperature, and prolonging the service life of the motor as well as reducing interference to neighboring devices.

The cable connecting the drive and the motor cannot be excessively long. An excessively long cable can result in large distributed capacitance and high harmonic current. When the length of the output cable is equal to or higher than the value listed in the following table, install an output reactor near the drive.

Table 8–13 Minimum length of the cable for output reactor

T model	Drive model	Rated voltage (V)	Min. cable length for optional output reactor (m)
T3	ES680-4T025-XX	200–500	110
T4	ES680-4T032-XX	200–500	125
	ES680-4T037-XX	200–500	135
	ES680-4T044-XX	200–500	150
T5 to T8	ES680-4T060-XX ES680-4T075-XX ES680-4T091-XX ES680-4T112-XX ES680-4T150-XX ES680-4T176-XX ES680-4T210-XX ES680-4T253-XX	280–690	150

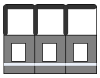
Models

Recommended manufacturers and models of the output reactor are shown in the following table.

Table 8–14 Output reactor model (Schaffner)

T model	Drive model	Reactor	Rated current at 40℃ (A)	Typical rated power of the motor (kW)	Rated inductance (mH)	Loss (W)	I/O selection terminal	Total (kg)
T3	ES680-4T025-XX	RWK 305-32-KL	32	15	0.184	55	KL	3.9
T4	ES680-4T032-XX	RWK 305-32-KL	32	15	0.184	55	KL	3.9
	ES680-4T037-XX	RWK 305-45-KL	45	18.5	0.131	60	KL	6.1
	ES680-4T044-XX	RWK 305-45-KL	45	22	0.131	60	KL	6.1
T5	ES680-4T060-XX	RWK 305-60-KL	60	30	0.098	65	KL	6.1
T6	ES680-4T075-XX	RWK 305-72-KL	72	37	0.082	70	KL	6.1
	ES680-4T091-XX	RWK 305-90-KL	90	45	0.065	75	KL	7.4
T7	ES680-4T112-XX	RWK 305-110-KL	110	55	0.053	90	KL	8.2
	ES680-4T150-XX	RWK 305-156-KS	156	75	0.038	120	KS	10.7
T8	ES680-4T176-XX	RWK 305-182-KS	182	90	0.032	140	KS	16
	ES680-4T210-XX	RWK 305-230-KS	230	132	0.026	180	KS	22
	ES680-4T253-XX	RWK 305-280-KS	280	160	0.021	220	KS	29

Table 8–15 I/O selection terminal corresponding to the reactor

Reactor model	******-KL	******-KS	******-S
I/O selection terminal			

Dimensions

Dimensions of the output reactor are shown in the following table.

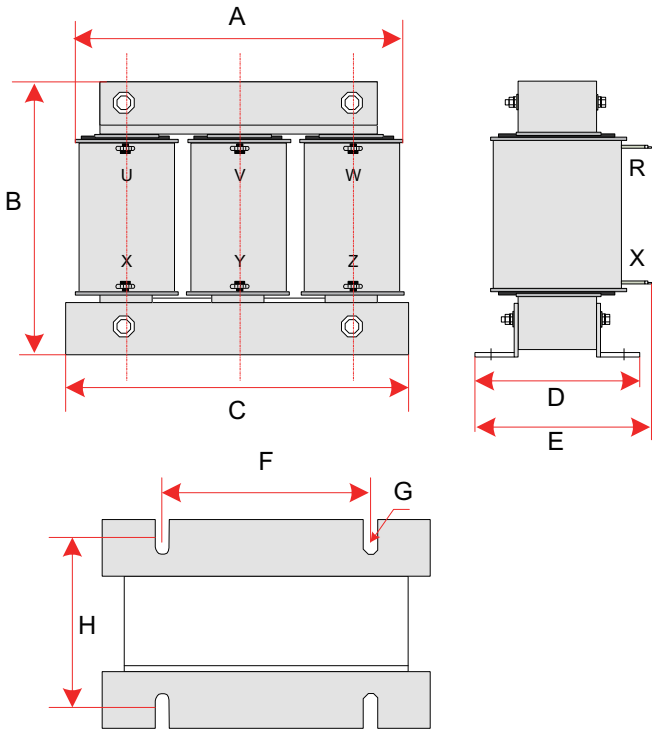


Figure 8-9 Dimensions of AC output reactors (50 A to 60 A)

Table 8–16 Dimensions of AC output reactors (50 A to 60 A, unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H
50	155	130	148±1	95±2	135	95±1	Φ6x15	80±2
60	195	165	188±1	92±2	130	120±1	Φ8.5x20	72±2

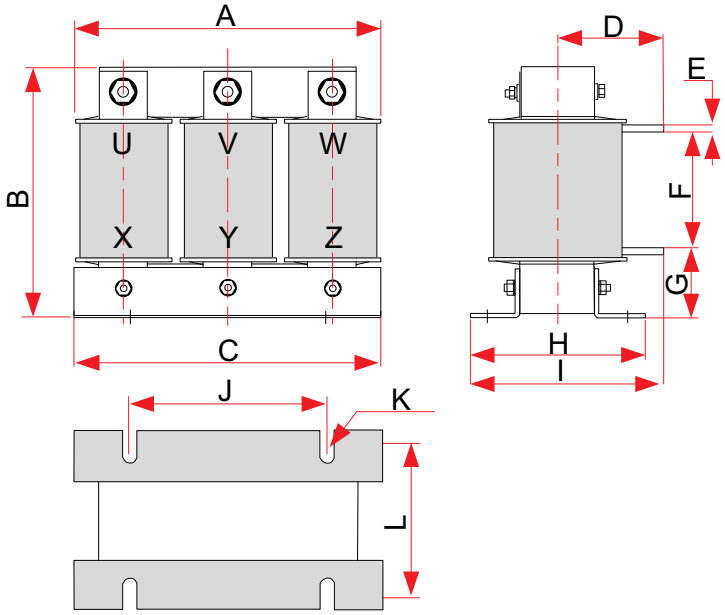


Figure 8-10 Dimensions of AC output reactors (80 A to 120 A)

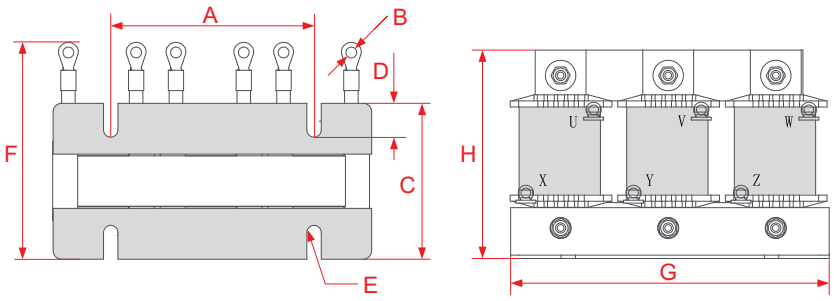


Figure 8-11 Dimensions of AC output reactors (50 A to 90 A)

Table 8–17 Dimensions of AC output reactors (50 A to 90 A, unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H
50	120±1	6×Φ6.4	92±2	20	4xΦ8.5	131±10	200	130
60	120±1	6×Φ6.4	92±2	20	4xΦ8.5	131±10	200	130
80	120±2	6×Φ6.4	92±2	20	4xΦ8.5	125±10	200	165
90	120±2	6×Φ6.4	92±2	20	4xΦ8.5	125±10	200	165

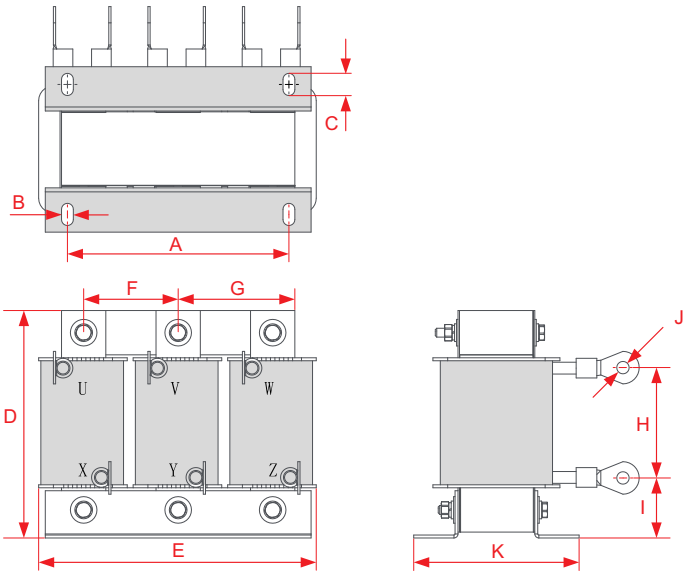


Figure 8-12 Dimension drawing of 120 A AC output reactor

Table 8–18 Dimensions of AC output reactor (120 A, unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K
120	150±1	8	15	165	195	64	79	75±5	40±5	6×Φ8.4	165

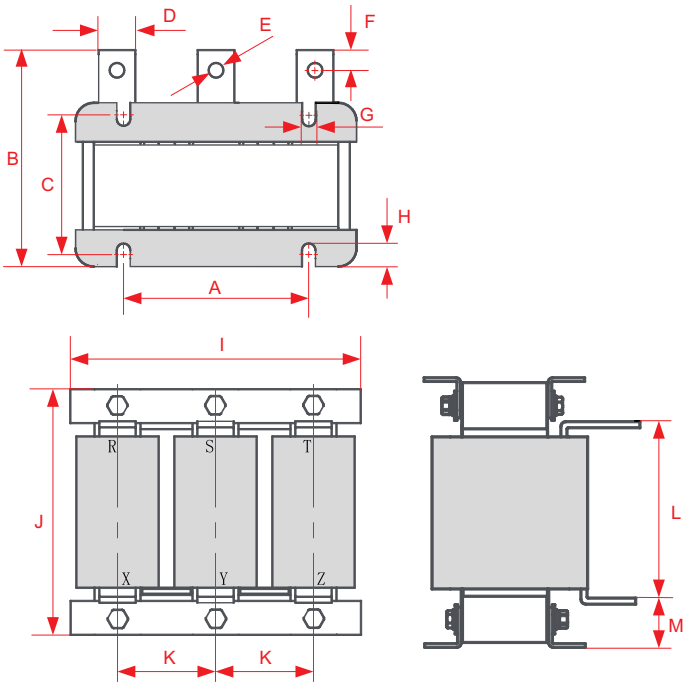


Figure 8-13 Dimensions of AC output reactors (150 A to 200 A)

Table 8–19 Dimensions of AC output reactors (150 A to 200 A, unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M
150	120±1	155	92±2	20	Φ11	10	8.5	20	195	210	64±5	135±5	36±5
200	120±1	165	102±2	20	Φ11	10	8.5	20	195	210	64±5	145±5	30±5

8.1.7 Magnetic Ring and Ferrite Clamp

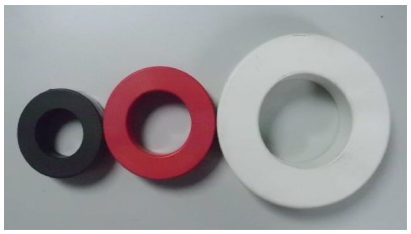
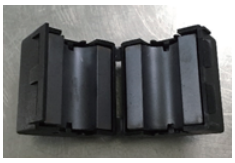
Models

The magnetic ring can be installed on the input or output side of the drive. Install the magnetic ring as close to the drive as possible. Installing the magnetic ring on the input side can suppress the noise in the input power supply system of the drive. When it is installed on the output side, it can reduce the interference generated by the drive to external devices and can reduce the bearing current.

In applications with leakage current and signal cable interference, install a magnetic ring or a ferrite clamp.

- Amorphous magnetic ring: featuring high permeability when the frequency is within 1 MHz and excellent anti-interference performance, but not as low-cost as the ferrite clamp.
- Ferrite clamp: featuring high permeability when the frequency is above 1 MHz and excellent suppression performance on interference generated by low-power drives and signal cables

Table 8–20 Appearance and models of the magnetic ring and ferrite clamp

Category	Model	Appearance
Magnetic ring	DY644020H	
	DY805020H	
	DY1207030H	
Ferrite clamp	DYR-130-B	

Dimensions

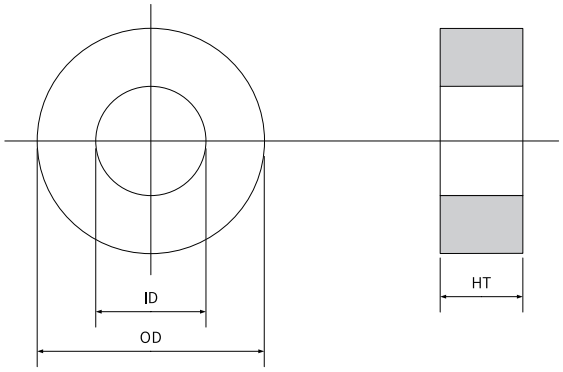


Figure 8-14 Dimensions of the magnetic ring

Table 8–21 Dimensions of the magnetic ring

Model	Dimension (OD x ID x HT) (mm)
DY644020H	64 x 40 x 20
DY805020H	80 x 50 x 20
DY1207030H	120 x 70 x 30

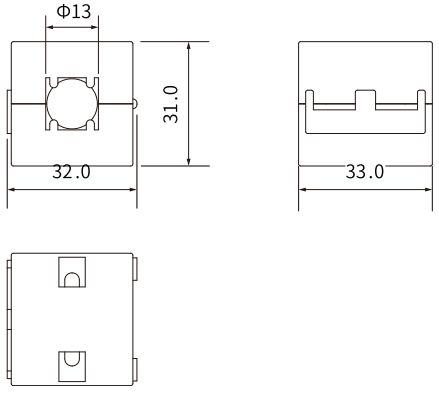


Figure 8-15 Dimensions of the ferrite clamp (unit: mm)

8.2 Expansion Card

8.2.1 CAN Communication Expansion Card (MD38CAN1)

MD38CAN1, a communication expansion card used for CAN communication, allows the drive to be connected to high-speed CANopen network for fieldbus control.

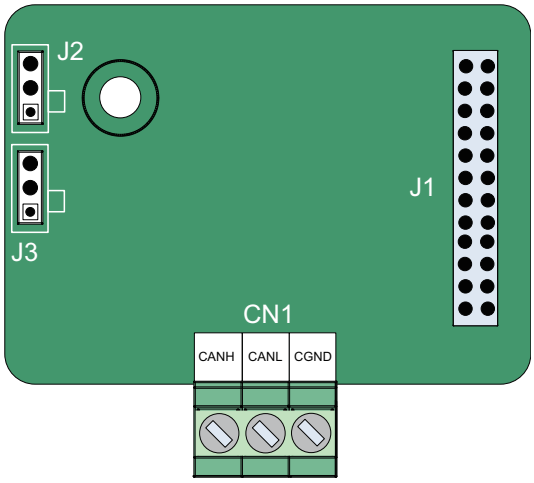
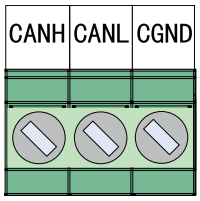


Figure 8-16 Terminal layout of MD38CAN1 card

Table 8–22 Function descriptions of MD38CAN1 terminals

Terminal mark		Terminal name	Function description	Terminal layout
CN1	CANH	Positive CAN input	It is used to connect to the positive end of the CAN bus.	
	CANL	Negative CAN input	It is used to connect to the negative end of the CAN bus.	
	CGND	Power supply ground	It is used to connect to the reference ground of all CAN nodes.	

8.2.2 PROFINET Expansion Card (MD500-PN1)

The MD500-PN1 card is a PROFINET fieldbus adapter card complying with PROFINET Ethernet standards.

It is used to improve the communication efficiency and achieve the networking function of the drive, allowing the drive to act as the fieldbus slave to be controlled by the fieldbus master.

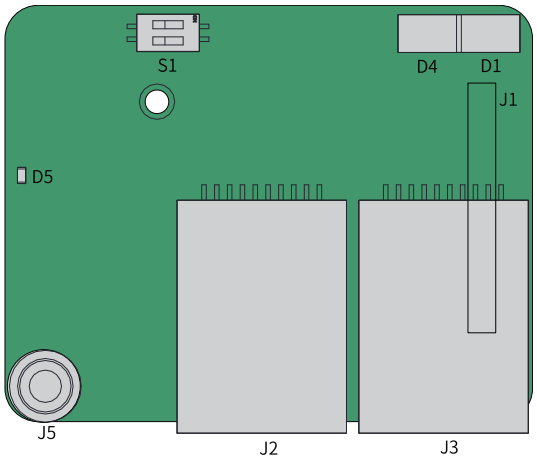


Figure 8-17 Layout of MD500-PN1 terminals

Table 8–23 MD500-PN1 terminal function

Mark	Terminal name	Function description
J1	Pin header	Used to connect to the drive.
J2	Network port	Used to communicate with the PROFINET card (PLC).
J3		
J5	EMC ground terminal	Used to connect the EMC grounding terminal in ES680.

Table 8–24 Status of indicators on the MD500-PN1 card

Indicator symbol	Name	Status
D5	Power supply indicator	Used to indicate the status of the power supply. On: Normal Off: Abnormal. Check whether the card is installed properly.
D1	PLC communication status indicator (PLCLINK)	Steady green: Normal Steady yellow: MAC address error (Replace the PN card.) Flashing in yellow: Servo drive fault (Clear the servo drive faults.) Steady red: Communication error (Set FD-00 to 0 to check whether MD500-PN1 card is supported.)
D4	Communication status indicator (DSPLINK)	Steady green: Normal Flashing in green: Master not found (Check the configuration and check whether the slave is assigned with a device name. Check whether the PN card is connected to the corresponding PLC.) Steady yellow: Configuration error (Check whether GSD is correct.) Steady red: Communication loss (Check circuit connection.)

Table 8–25 DIP switches on the MD500-PN1 card

Indicator symbol	Name	Status
S1	2-pin DIP switch	Used by the manufacturer for upgrade purpose only.

Note

After MD500-PN1 is installed properly, J2 is on the left and J3 on the right when viewed from an angle facing RJ45. It is recommended to use shielded Cat 5e cables to ensure stable operation.

For more details about the PROFINET communication expansion card (MD500-PN1), see MD500 Series PROFINET Expansion Card User Guide (data code: 19011287).

8.2.3 PROFIBUS DP Expansion Card (MD38DP2)

The MD38DP2 card is a PROFIBUS-DP fieldbus adapter card that complies with the international PROFINET fieldbus standards. It is used to improve the communication efficiency and achieve the networking function of the drive, allowing the drive to act as the fieldbus slave to be controlled by the fieldbus master. Besides PROFIBUS DP communication, the MD38DP2 card also provides the CANlink communication interface to implement CANlink communication.

Terminal layout and descriptions

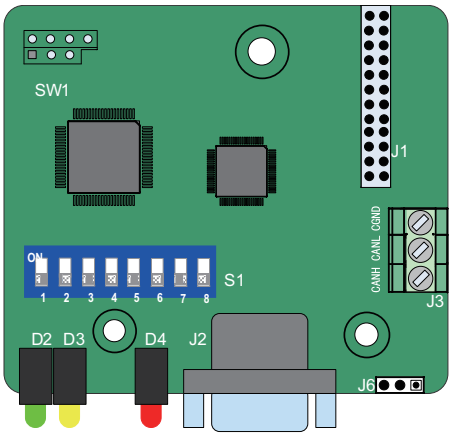


Figure 8-18 Layout of MD38DP2 terminals

Table 8–26 Functions of MD38DP2 terminals

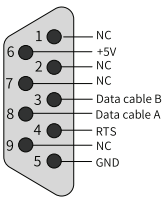
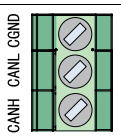
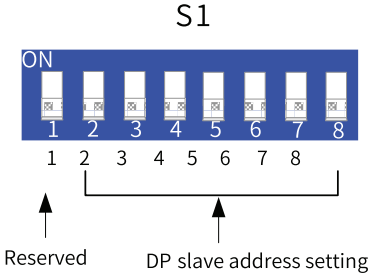
Mark	Pin No.	Pin assignment	Function description	Terminal layout
J2 PROFIBUS-DP communication terminal	1, 2, 7, and 9	NC	Unconnected internally	
	3	Data cable B	Positive pole of the data cable	
	4	RTS	Request for signal transmission	
	5	GND	Isolated 5 V power supply ground	
	6	+5V	Isolated 5 V power supply	
	8	Data cable A	Data cable (-)	
J3 CANlink communication terminal	CANH	Positive CAN input	Positive pole of the data cable	
	CANL	Negative CAN input	Data cable (-)	
	GND	Power supply ground	Isolated 5 V power supply ground	

Table 8–27 Status indicators of the MD38DP2 card

Indicator	Status	Description
D4 Power supply indicator		On: Normal
		OFF: Abnormal (Check whether installation is correct.)
D3 Indicator of communication between the DP card and the master		ON: The communication between the DP card and the master is normal.
		Flashing: The master does not run or a fault occurs during communication between the DP card and PROFIBUS master.
		OFF: The communication between the DP card and PROFIBUS-DP master is unavailable. (Check the connection of PROFIBUS-DP cable and the station number.)
D2 Indicator for communication between the DP card and the drive		Steady ON: The communication between the DP card and the drive is normal.
		Flashing: An interference exists on the communication between the DP card and the drive, or the extension card address is beyond the range of 1 to 125.
		OFF: The communication between the DP card and drive fails. (Check whether the baud rate is set correctly.)

Table 8–28 Descriptions of DIP switches of MD38DP2 expansion card

PROFIBUS DP communication slave address settings								Slave address	DIP switch
1	2	3	4	5	6	7	8		
DP card type switch-over ("OFF: MD38D-P2" by default)	0	0	0	0	0	0	0	Reserved	
	0	0	0	0	0	0	1	1	
	0	0	0	0	0	1	0	2	
		0	0	0	0	1	1	3	
		…						…	
	1	1	1	1	1	0	1	123	
	1	1	1	1	1	1	0	124	
	1	1	1	1	1	1	1	125	

Note

When DIP switch 1 is turned on, it indicates MD38DP1 applies. The change of the DIP switch number is activated at next power-on. The change of slave address DIP switch is activated immediately.

8.2.4 RS485 Communication Expansion Card

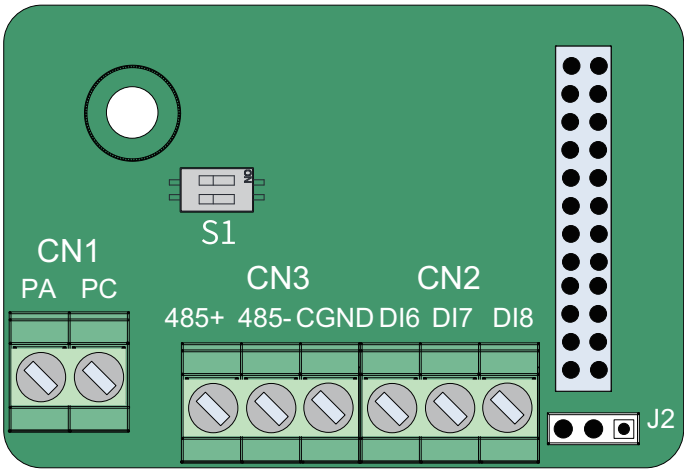
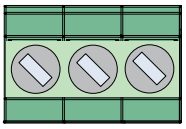
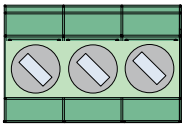
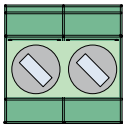
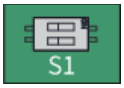


Figure 8-19 Layout of MD38IO3 terminals

Table 8–29 Description of terminals on MD38IO3

Mark		Name	Function description	Terminal layout
CN3	485+	RS485 communication signal (+)	Modbus supported; input isolated	485+ 485- CGND 
	485-	RS485 communication signal (-)		
	CGND	RS485 communication signal (GND)		
CN2	DI6 to DI8	3 DIs	1 .Optocoupler isolation, compatible with bipolarity input, maximum input frequency of 100 Hz 2 .Input impedance: 3.4 kΩ 3 .Voltage range for level input: 9 V to 24 V	DI6 DI7 DI8 
CN1	PA-PC	Normally open terminal	Contact driving capacity: 250 VAC/5 A, 30 VDC/5A	PA PC 
S1	PROFIBUS terminal matching resistor selection	2-bit DIP switch	1 .Both set to ON: matching the termination resistor 2 .Both set to OFF: not matching the termination resistor	

8.3 Through-Hole Mounting Bracket

The through-hole mounting bracket is optional. Purchase a proper model as required.

Applicable models

Table 8–30 Models of through-hole mounting brackets

T model	Drive model	Through-hole mounting bracket model
T3	ES680-4T025-C1	MD500-AZJ-A1T3
T4	ES680-4T032-C1 ES680-4T037-C1 ES680-4T044-C1	MD500-AZJ-A1T4
T5	ES680-4T060-C1	MD500-AZJ-A1T5
T6	ES680-4T075-C1 ES680-4T091-C1	MD500-AZJ-A1T6
T7	ES680-4T112-C1 ES680-4T150-C1	MD500-AZJ-A1T7
T8	ES680-4T176-C1 ES680-4T210-C1 ES680-4T253-C1	MD500-AZJ-A1T8

Mounting hole dimensions

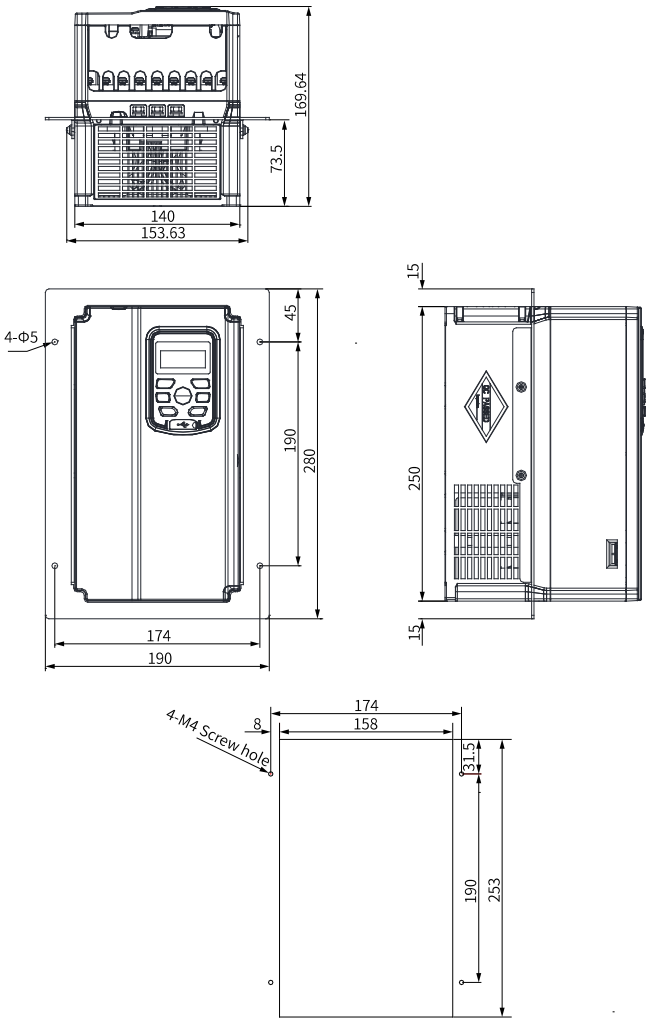


Figure 8-20 MD500-AZJ-A1T3 through-hole mounting bracket and mounting hole dimensions (unit: mm)

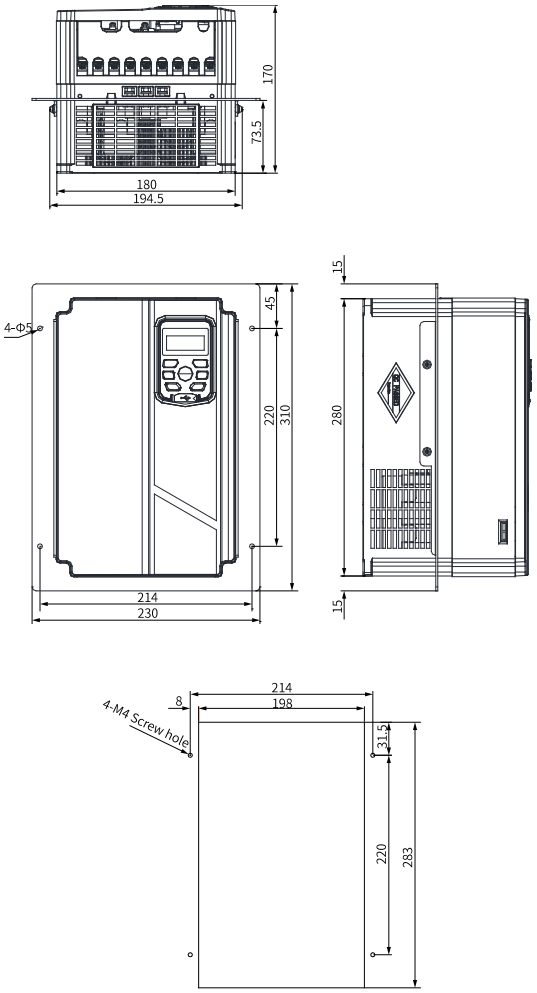


Figure 8-21 MD500-AZJ-A1T4 through-hole mounting bracket and mounting hole dimensions (unit: mm)

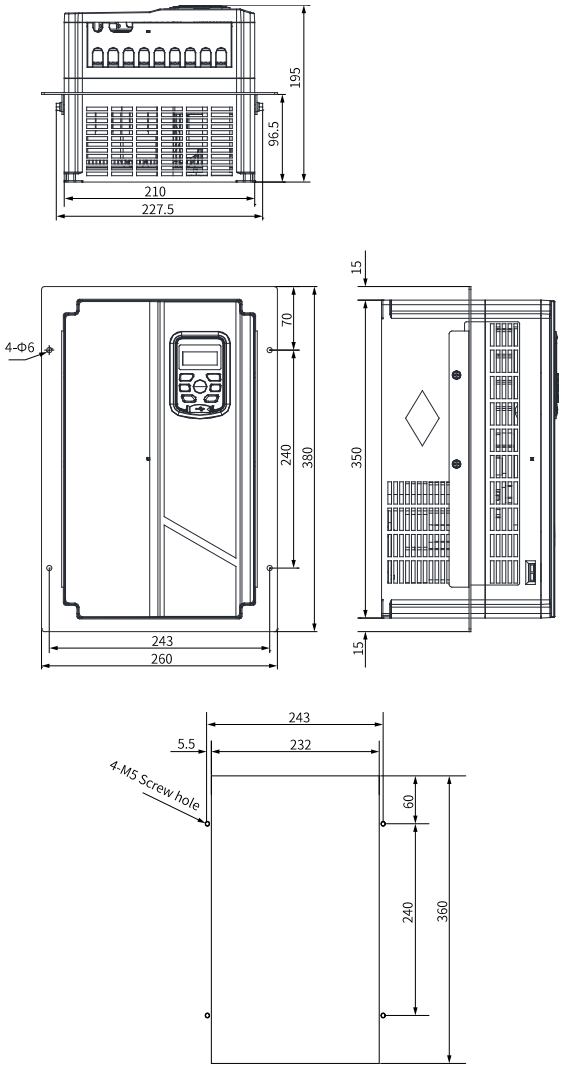


Figure 8-22 MD500-AZJ-A1T5 through-hole mounting bracket and mounting hole dimensions (unit: mm)

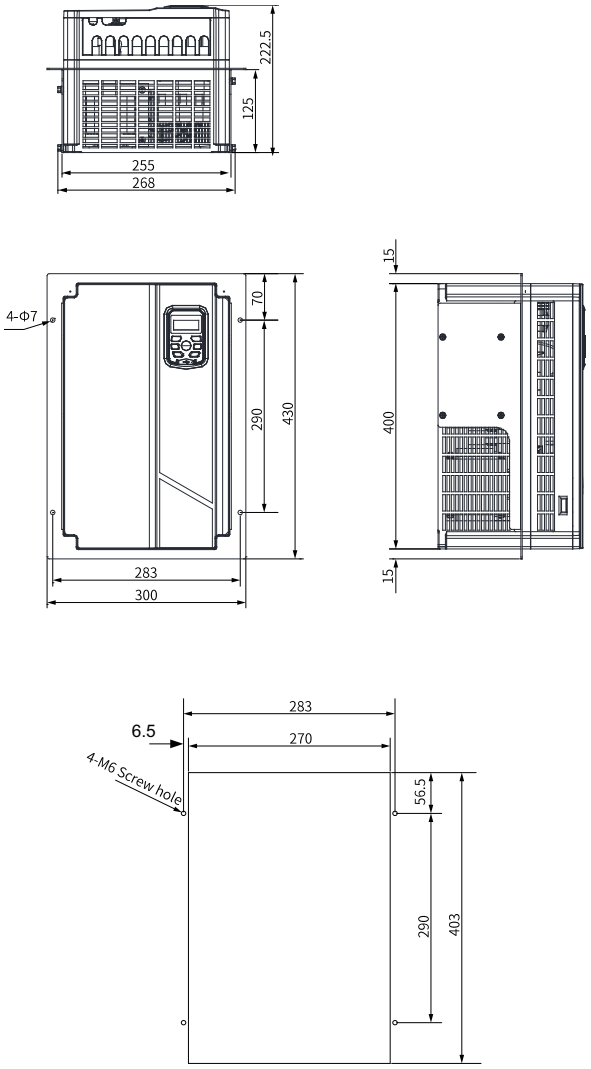


Figure 8-23 MD500-AZJ-A1T6 through-hole mounting bracket and mounting hole dimensions (unit: mm)

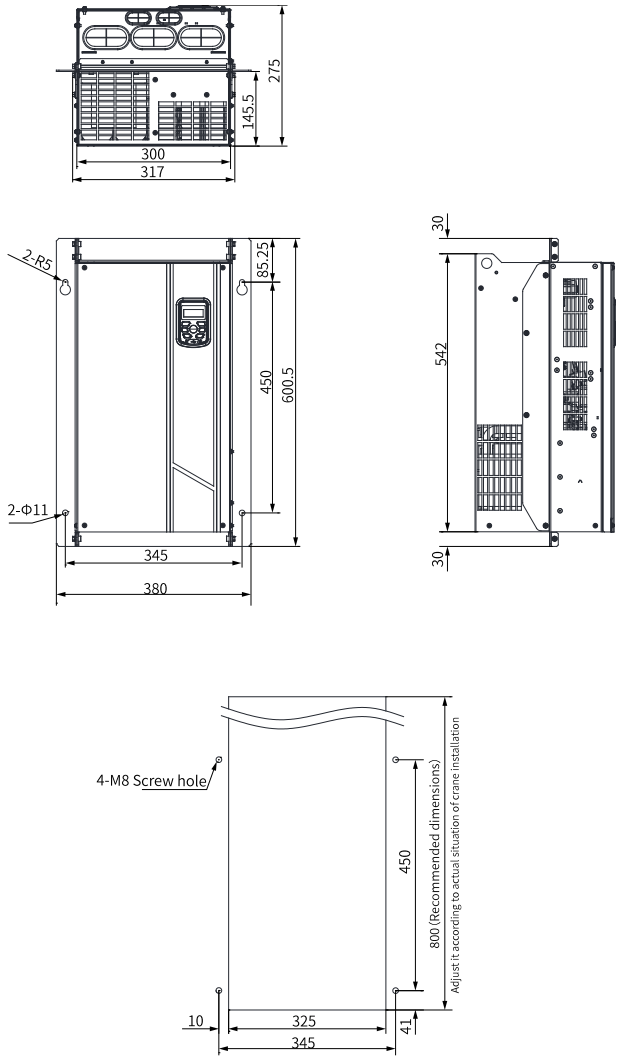


Figure 8-24 MD500-AZJ-A1T7 through-hole mounting bracket and mounting hole dimensions (unit: mm)

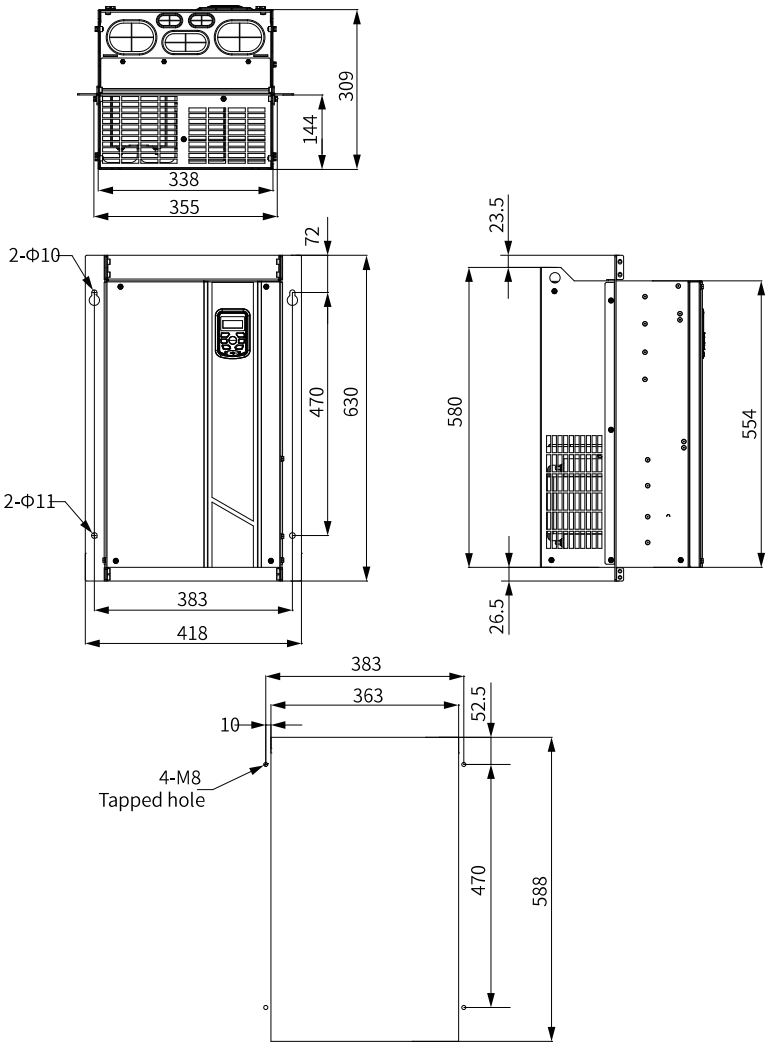


Figure 8-25 MD500-AZJ-A1T8 through-hole mounting bracket and mounting hole dimensions (unit: mm)

8.4 Grounding Bracket of Cable Shield

Use the cable shield grounding bracket to prevent electromagnetic interference, and make a good permanent electrical connection between the shield and the metal housing of the ground or interference source. Take measures to prevent electric shock and ensure normal operation of the power supply system, protecting the circuit and equipment from being damaged. Measures also need to be taken against electrical fire accidents, lightening stroke, and static electricity.

Models

Table 8–31 Grounding bracket models of the cable shield

T model	Drive model	Grounding bracket model of the cable shield
T3	ES680-4T025-C1	MD500-AZJ-A2T3
T4	ES680-4T032-C1 ES680-4T037-C1 ES680-4T044-C1	ES680-AZJ-T4
T5	ES680-4T060-C1	MD500-AZJ-A2T5

T model	Drive model	Grounding bracket model of the cable shield
T6	ES680-4T075-C1 ES680-4T091-C1	MD500-AZJ-A2T6
T7	ES680-4T112-C1 ES680-4T150-C1	MD500-AZJ-A2T7
T8	ES680-4T176-C1 ES680-4T210-C1 ES680-4T253-C1	MD500-AZJ-A2T8

Dimensions

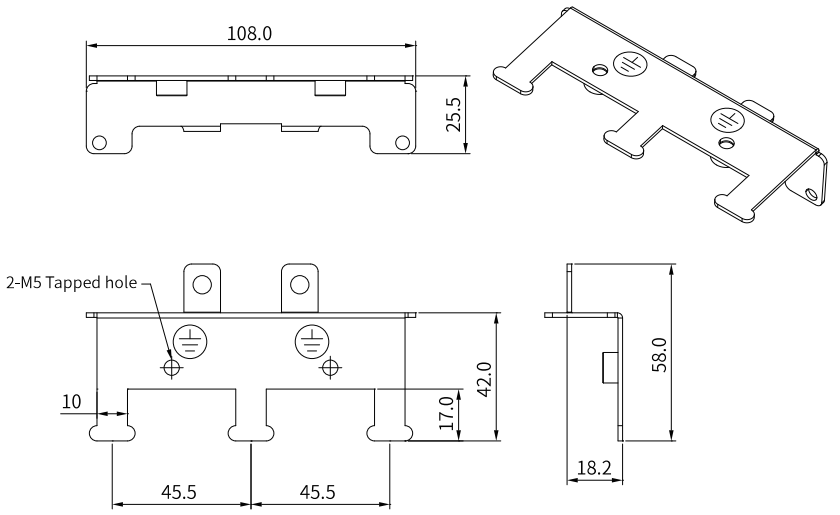


Figure 8-26 MD500-AZJ-A2T3 dimensions (mm)

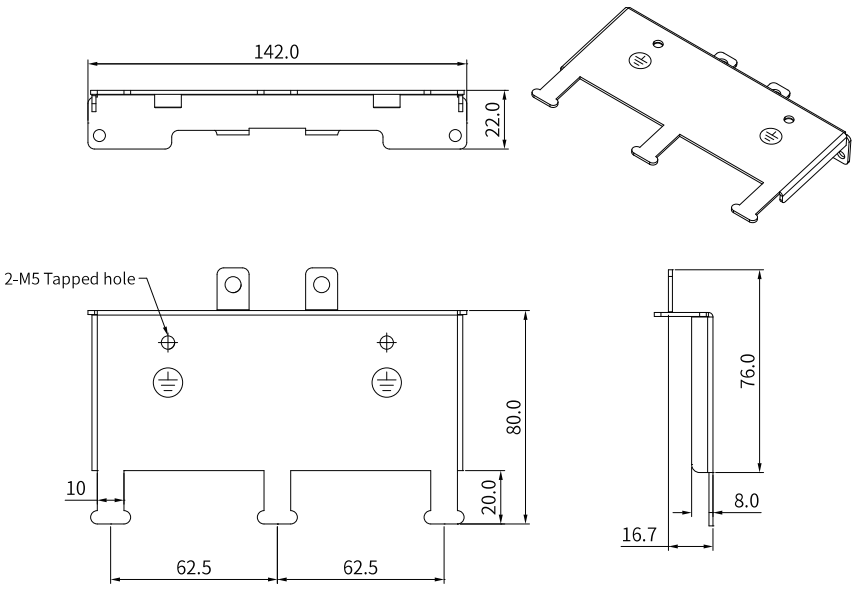


Figure 8-27 ES680-AZJ-T4 dimensions (mm)

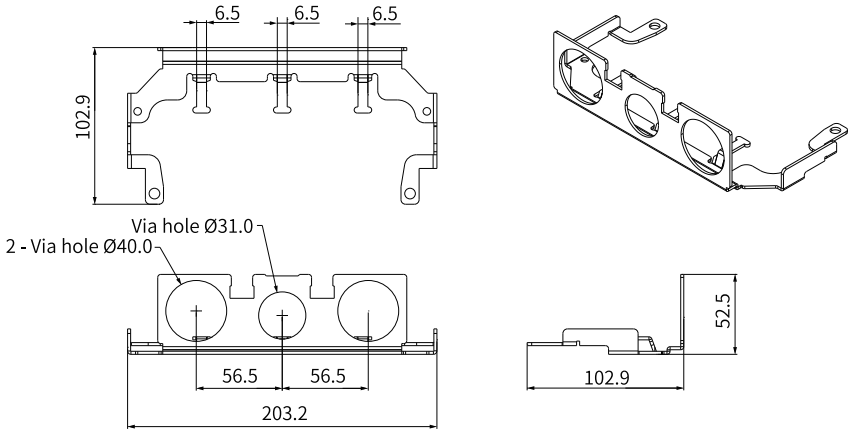


Figure 8-28 MD500-AZJ-A2T5 dimensions (mm)

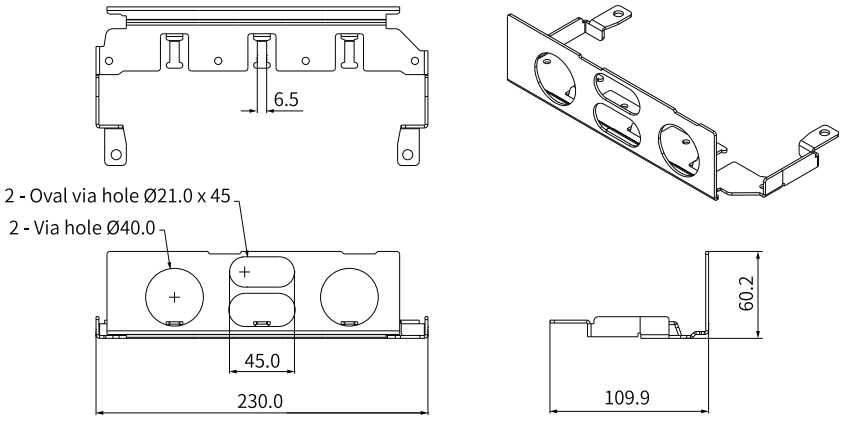


Figure 8-29 MD500-AZJ-A2T6 dimensions (mm)

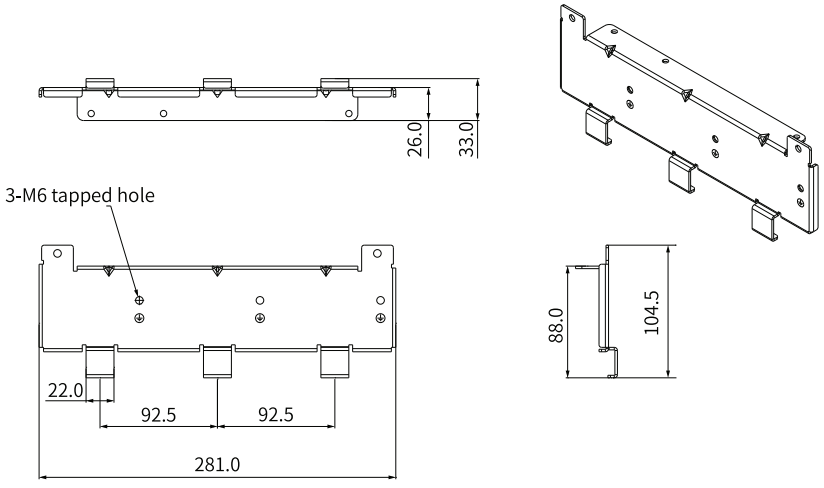


Figure 8-30 MD500-AZJ-A2T7 dimensions (mm)

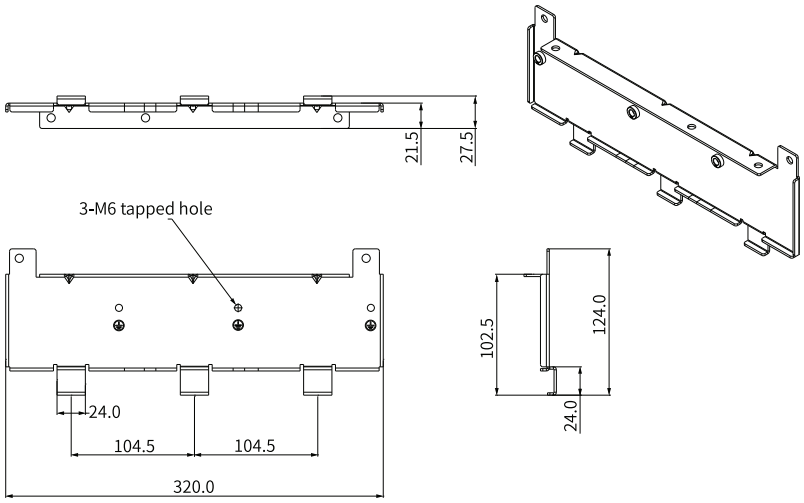


Figure 8-31 MD500-AZJ-A2T8 dimensions (mm)

8.5 External Operating Panel

The external LCD operating panel SOP-20-880 or SOP-20-810 enables you to copy and modify parameters, and access programs. The following figure describes the appearance and dimensions of the panel.

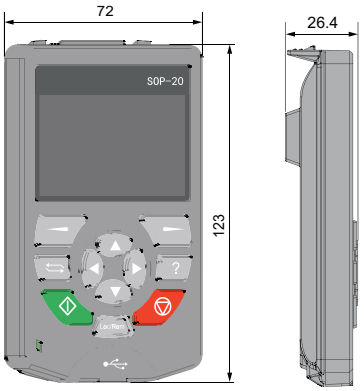


Figure 8-32 Appearance and dimensions of the external operating panel (unit: mm)

9 Commissioning Tool

9.1 Operating panel

Name	Model	Description	Appearance
Local operating panel	-	The LED operating panel that comes with the drive is used to monitor and modify parameters and start/stop the drive. Note: The backend software is connected via a Type-C data cable.	
External Operating Panel	SOP-20-880 and SOP-20-810	SOP-20 is an LCD operating panel (optional) through which you can copy and download parameters. The LCD operating panel offers an easy way of parameter modification and displays information in Chinese and English. It is easy to use. For more information, see the user guide of the operating panel.	

9.2 Local Operating Panel

Components

The local keypad is used to display the running status and fault information, and to set parameters. The following figure shows the keypad.



Figure 9-1 Components

Information of the keys

Table 9–1 Description of the keys

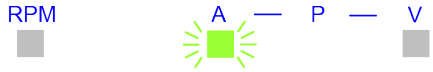
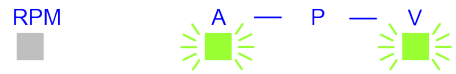
Button		Key Name	Function
	MODE	MODE	Used to enter or exit from the level I menu. In the level 0 menu, long press the key to enter the user-defined parameter password input interface.
	SHIFT	SHIFT	Select the displayed parameters cyclically in the stop or running interfaces. Select the parameter bit to be modified. In the level 0 menu, long press the key to enter the user-defined parameter group (group B).
	△	UP	Data or parameter increment
	▽	DOWN	Data or parameter decrement
	ENTER	Confirmation key	Used to enter each level of menu interface and confirm parameter settings.
	RUN	RUN	Press this key to start the drive when the keypad control mode is used.
	STOP	Stop key	When the drive is running, press this key to stop it. In the level 0 menu, long press the key to reset the software.

Status indicator

The green color indicates that the light turns on, the gray color indicates that the light turns off, and the red color indicates that the light flashes.

Table 9–2 Description of keypad indicators

Indicator status		Status Description
RUN Running indicators		Off: shut down
		ON: running
F/R Forward/Reverse run indicator		OFF: Forward
		ON: Reverse
T/E Parameter auto-tuning/ Fault indicator		OFF: Operating normally
		Slow flash (green): Auto-tuning state (1 time/s)
		Quick blinking (red): fault state (4 times/s)
		Frequency unit (rpm)

Indicator status	Status Description
	Current unit: A
	V: unit of voltage
	Pressure unit (bar)

LED display

There is a five-digit LED display on the keypad. It displays the speed setpoint, output speed, various monitoring data, and alarm codes.

Table 9–3 Physical numbers of the displayed content

Display	Equivalent	Display	Equivalent	Display	Equivalent	Display	Equivalent
0	0	6	6	C	C	n	N
1	1	7	7	c	c	P	P
2	2	8	8	d	D	r	R
3	3	9	9	E	E	t	T
4	4	A	A	F	F	u	u
5	5 or S	b	B	L	L	U	U

9.3 Setting parameters

The keypad adopts three-level menus, which are divided into level 1 menus (Function parameter group), level 2 menus (Parameters) and level 3 menus (Setpoints) After entering the menu, you can press  and  to modify the blinking bit on the operating panel. The following describes the structure:

- Level I: parameter group
- Level II: parameter No.
- Level III: parameter setpoint

To change the value of F3-02 from 100.0 to 150.0, perform settings according to the following figure.

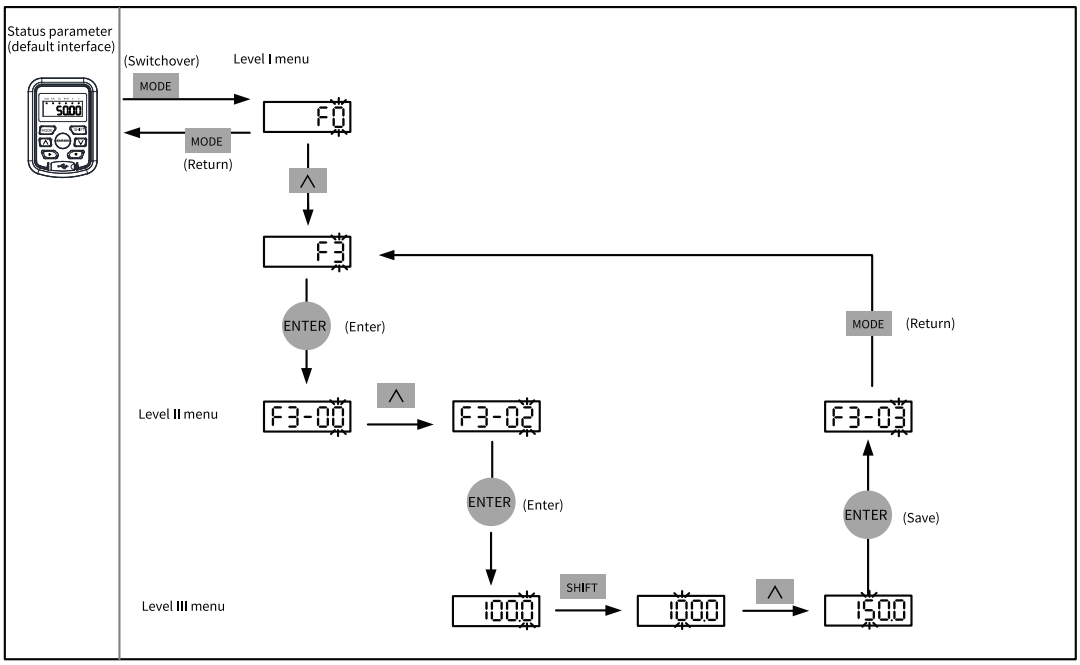


Figure 9-2 Parameter modification example

You can return to the level II menu from the level III menu by pressing MODE or ENTER. The difference between the two keys is as follows:

1. Pressing ENTER returns to the level II menu after saving the current parameter setting, where the next parameter is automatically displayed.
2. After you press MODE, the system does not save the parameter setting, but directly returns to Level II menu and remains at the current parameter number.

If a parameter does not include a blinking digit in Level III menu, the parameter cannot be modified. This may be because:

1. The parameter is an unmodifiable parameter such as the product model, actual detection parameter, and running record parameter.
2. This parameter can be modified only after the AC drive stops.

9.4 Parameter view

View all parameters through the operating panel. The operation procedure is shown in the following figure.

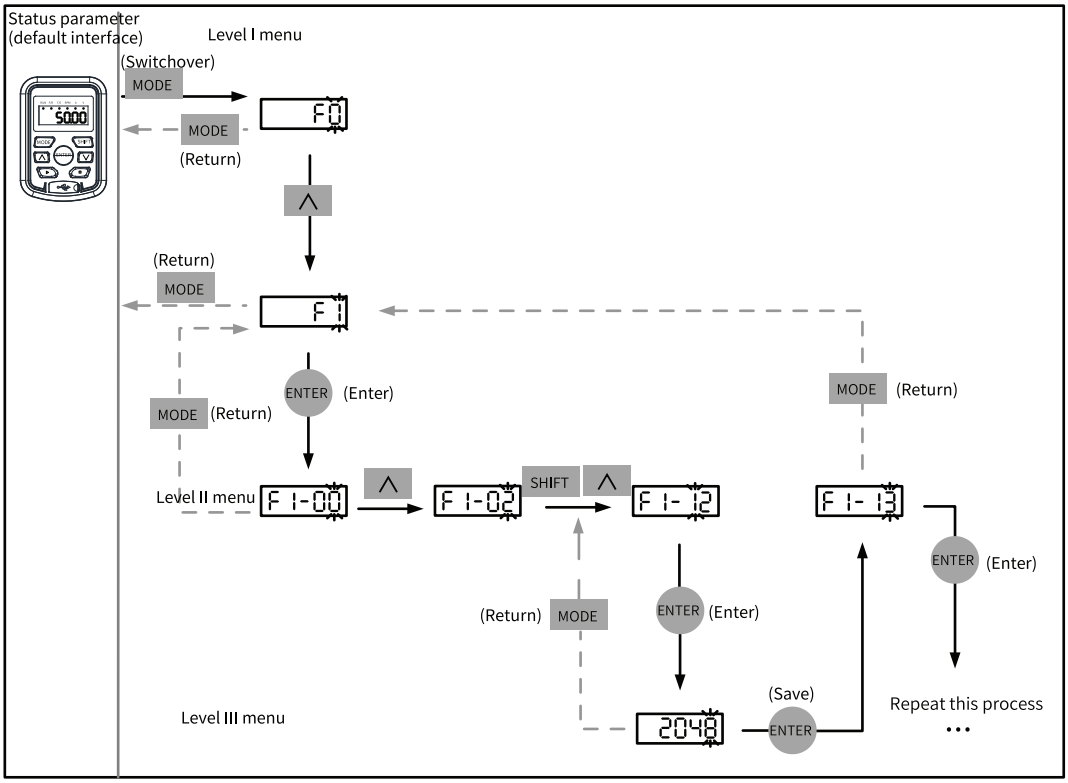


Figure 9-3 Operating process for parameter viewing

9.5 Status parameter display

During operation, press 

to view status parameters. By default, the following status parameters are displayed: operating speed, speed reference, bus voltage, output voltage, output current, AI1 voltage, AI2 voltage, Al3 voltage, and feedback oil pressure. To view more status parameters, see descriptions of F7-04 in *"20.8 Group F7 Operating Panel and Display Parameters" on page 291*.

When the servo drive stops, you can press 

to view status parameters. By default, the following status parameters are displayed: operating speed, speed reference, bus voltage, AI1 voltage, AI2 voltage, Al3 voltage, and feedback oil pressure. To view more status parameters, see descriptions of F7-05 in *"20.8 Group F7 Operating Panel and Display Parameters" on page 291*.

10 Quick Commissioning Guide

10.1 Commissioning Preparation

Power-on check

Check the following items before power-on.

Item	Description
Power supply voltage	Check that the power supply voltage is proper. (3PH 380 VAC to 480 VAC 50/60 Hz)
	Confirm the power input terminals R, S, T are connected reliably.
	Check that the drive and the motor are grounded properly.
Connection between the drive output terminals and motor terminals	Confirm the output terminals U, V, and W of the drive are connected to the motor terminals properly.
Connection of control circuit terminals	Confirm the control circuit terminals of the drive are connected to other control devices properly.
Control terminal status	Check that all the control circuit terminals of the drive are off (not ready to run).
Load	Confirm whether the motor is in the no-load status and not connected to the mechanical system.

Power-on

After power-on, the operating panel displays the following information.

state	Display (example)	Description
In normal status		Displays the default speed set before delivery, in rpm.
In fault status		Displays the fault type when the drive is in the stop state due to a fault.

10.2 Quick Commissioning Flowchart

This drive allows use of the motor without auto-tuning for quick commissioning. See the following flowcharts *"Figure 10-1" on page 158* and *"Figure 10-2" on page 159* for the commissioning procedures.

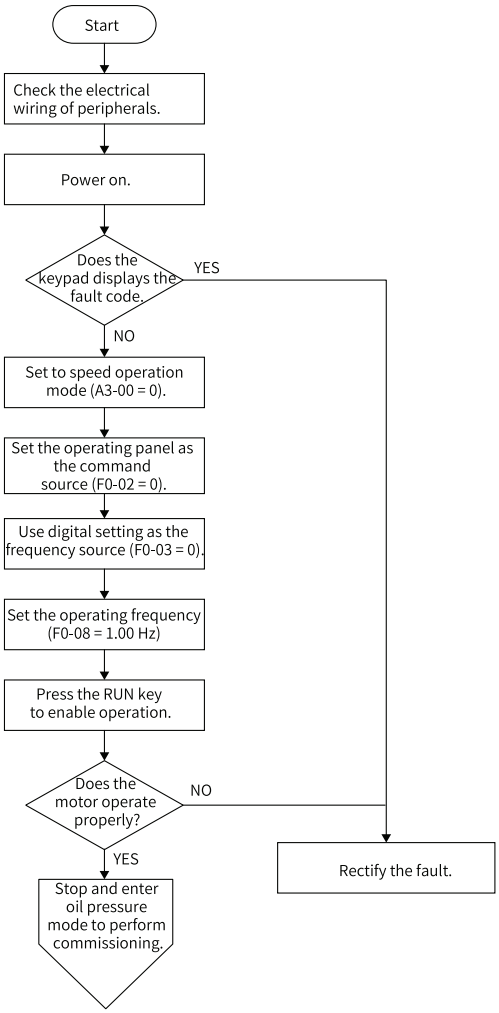


Figure 10-1 Commissioning in the speed mode

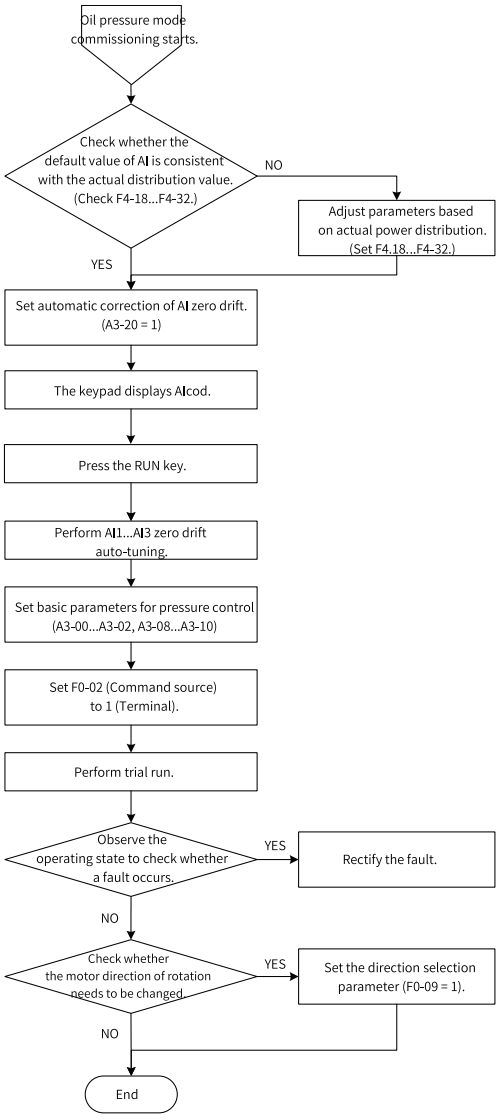


Figure 10-2 Commissioning in the oil pressure mode

10.3 Application Commissioning of Servo Oil Pump

10.3.1 AI Zero Drift Auto Correction

Setting procedure	Related parameters	Description
Set the command source.	F0-02 = 0	Keypad control mode
AI Zero Drift Auto Correction	A3-20 = 1	AI Zero Drift Auto Correction The operating panel displays AI cod. Press the RUN key, AI zero drift will be corrected automatically.

Note

Manual correction: When the drive is not enabled, view the values of U1-04, U1-05, U1-06, U1-16. Add a margin of 0.08 V to the highest values viewed and write them to F4-18, F4-23, and F4-28, and F4-33 respectively.

After the AI zero drift is corrected automatically, the value of A3-20 will be restored to 0 automatically.

10.3.2 Oil Pressure Mode Selection and Parameter Setting

Parameter	Description	Application Scenario
A3-00: Oil pressure mode selection	0: Speed mode	Applicable to cases where oil pressure mode is not used.
	2: Analog reference	AI1 provides oil pressure references, AI2 provides flow references, and AI3 provides oil pressure feedback references. The drive performs oil pressure control.
	4: Oil pressure PN mode	The PN communication channel provides oil pressure references and flow references. AI3 provides oil pressure feedback references and the drive performs oil pressure control.
	6: CANopen communication setting	The CANopen communication channel provides oil pressure references and flow references. AI3 provides oil pressure feedback references and the drive performs oil pressure control.

When switching from non-oil pressure mode (A3-00 = 0) to the oil pressure mode (A3-00 ≠ 0), related parameters will be set automatically, as shown in the following table.

If you modify the following parameters in oil pressure control mode, the modifications are retained upon power failure. If the control mode is switched from the oil pressure control mode to a non-oil pressure control mode, the following parameters will be restored to the value before switching to the oil pressure control mode.

Related parameters	Description	Setting	
F0-01	Control mode	1 (closed-loop vector)	
F0-02	Command source	Mode 2, mode 4	1 (terminal setting)
		Mode 4, mode 6	2 (communication setting)
F0-03	Main frequency source	Mode 2	3 (AI2 setting)
		Mode 6	9 (communication setting)
F0-17	Acceleration time	0ms	
F0-18	Deceleration time	0ms	

10.3.3 Oil Pressure Parameter Setting

Relationship between system oil pressure and flow

Table 10–1 System flow and pressure setting

Related parameters	Description	Setting
A3-01	Maximum speed	Defines the maximum speed of the motor, that is, the motor speed corresponding to 100% of the flow reference.
A3-02	System oil pressure	Defines the maximum pressure of the system, ranging from 0 to the maximum oil pressure (A3-03).
A3-03	Maximum oil pressure	Defines the measuring range of a 0 VDC–10 VDC output type pressure sensor.

Table 10–2 Settings for AI1 oil pressure references

Related parameters	Description	Setting
F4-18	AI1 minimum input	Defines the minimum voltage input of oil pressure references, which corresponds to AI1 zero drift.
F4-19	Corresponding setting of AI1 minimum input	Defines the minimum oil pressure reference, which is 0.0% (zero pressure) by default.
F4-20	AI1 maximum input	Defines the maximum voltage input of oil pressure references, which is normally 10 V.
F4-21	Corresponding setting of AI1 maximum input	Defines the maximum oil pressure reference. The value 100.0% corresponds to A3-02 (System oil pressure).

Sets the relationship between AI1 oil pressure reference 0 V to 10 V (or other range) and 0 kg/cm^2 to A3-02.

Table 10–3 Settings for AI2 flow references

Related parameters	Description	Setting
F4-23	AI2 minimum input	Defines the minimum voltage input of flow references, which corresponds to AI1 zero drift.
F4-24	Corresponding setting of AI2 minimum input	Defines the minimum flow reference, which is 0.0% (zero flow) by default.
F4-25	AI2 maximum input	Defines the maximum voltage input of oil pressure references, which is normally 10 V.
F4-26	Corresponding setting of AI2 maximum input	Defines the maximum oil pressure reference. The default value 100.0% corresponds to the maximum speed (A3-01).

Sets the relationship between AI2 flow reference 0 V to 10 V (or other range) and 0 rpm to the maximum speed (A3-01).

Table 10–4 Settings for AI3 oil pressure feedback

Related parameters	Description	Setting
F4-28	AI3 minimum input	Oil pressure feedback minimum voltage input, corresponding to AI3 zero drift
F4-29	Corresponding setting of AI3 minimum input	Defines the minimum oil pressure feedback, which is 0.0% (zero pressure) by default.

Related parameters	Description	Setting
F4-30	AI3 maximum input	Defines the maximum voltage input of oil pressure feedback, which is normally 10 V.
F4-31	Corresponding setting of AI3 maximum input	Defines the maximum oil pressure feedback. The default value 100.0% corresponds to the maximum oil pressure (A3-03).

Sets the relationship between AI3 oil pressure feedback 0 V to 10 V (or other range) and 0 kg/cm^2 to maximum oil pressure (A3-03).

Pressure relief setting (A3-08)

Related parameters	Description	Setting
A3-08	Maximum reverse speed	Defines the maximum reverse speed during pressure relief, which is a percentage to the maximum speed (A3-01). Sets the maximum reverse motor speed. The larger the setpoint, the faster the pressure is relieved. But a large setpoint can lead to oil pump noise.

Base flow and base pressure setting (A3-09 and A3-10)

The base flow and base pressure is used to prevent noise and unstable operation caused by the air in the oil circuit. As internal leakage is unavoidable in the oil pump, when no flow or pressure reference is sent by the system, the hydraulic fluid can flow back into the fuel tank, forcing the air to enter the oil circuit.

Related parameters	Description	Setting
A3-09	Base flow	The setting range is 0.0% to 50.0%, corresponding to the percentage of the maximum speed (A3-01).
A3-10	Base pressure	Setting range: 0.0 kg·cm^2 to 50.0 kg·cm^2

Oil pressure and flow reference filter time

- Oil pressure reference filter time (F4-22, A3-04, A3-25, and A3-26)

Related parameters	Description	Setting
F4-22	AI1 filter time	0.000s to 10.000s
A3-04	Rise time of 1st group of oil pressure references	0.000s to 2.000s
A4-02	Fall time of 1st group of oil pressure references	0.000s to 2.000s
A3-25	Rising S-curve filter time of 1st group of oil pressure references	0.000s to 1.000s
A3-26	Falling S-curve filter time of 1st group of oil pressure references	0.000s to 1.000s

  The shorter the filter time, the faster the oil pressure response and the larger the overshoot magnitude. The longer the filter time, the slower the oil pressure response and the smaller the overshoot magnitude.

- Flow reference filter time (F4-27, A4-04)

Related parameters	Description	Setting
F4-27	AI2 filter time	0.000s to 10.000s
A4-03	Rise time of 1st group of flow references	0s to 5.000s
A4-04	Fall time of 1st group of flow references	0s to 5.000s

The shorter the filter time, the faster the oil pressure response and the larger the operation impact. The longer the filter time, the slower the oil pressure response and the more smooth the operation effect.

10.3.4 Adjustment of Oil Pressure Loop PID Response

Oil pressure loop PID mode selection

- **Oil pressure PID mode 1: PID mode defined by DI**

  The drive provides four PIDs. You can select the mode through the No. 48 and 49 DI terminals.

DI3 (DI function 49)	DI2 (DI function 48)	PID Group
0	0	First group of PID: A3-05, A3-06, A3-07
0	1	Second group of PID: A3-11, A3-12, A3-13
1	0	Third group of PID: A3-14, A3-15, A3-16
1	1	Fourth group of PID: A3-17, A3-18, A3-19

  The higher the value of the proportional gain (Kp), the shorter the integral time (Ki), and the longer the derivative time (Kd) and the faster the response will be. Note that excessively fast response may easily incur overshoot, leading to system oscillation during operation.

  On the contrary, the lower the value of proportional gain (Kp), the longer the integral time (Ki), and the shorter the derivative time (Kd) and the slower the response will be. Note that excessively slow response can result in efficiency reduction and unstable manufacturing quality.

- Oil pressure loop PID proportional gain (parameters: A3-05, A3-11, A3-14, A3-17)

  The larger the proportional gain, the faster the pressure response. But large proportional gain can result into system oscillation. See the following figure for details.

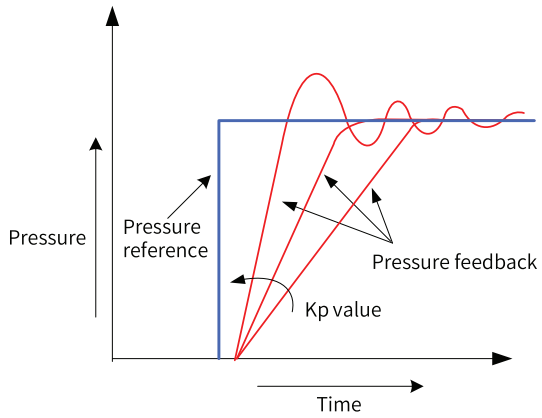


Figure 10-3 Oil pressure loop PID proportional gain

- Oil pressure loop PID integral time (parameters: A3-06, A3-12, A3-15, A3-18)

The shorter the integral time, the quicker the pressure response. But short integral time can easily cause overshoot and system oscillation. On the other hand, long integral time can cause unstable pressure. See the following figure for details.

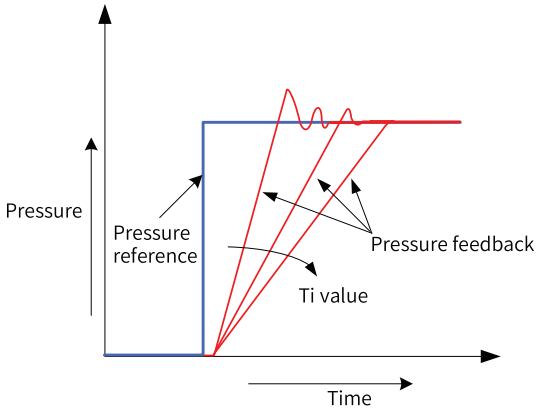


Figure 10-4 Oil pressure PID integral time

Oil pressure loop PID response gain (A3-29)

It is used to adjust the response of the whole oil pressure loop control. The larger the oil pressure loop gain, the stronger the response. But strong response can lead to system oscillation.

Reduce the value of A3-29 in case of large oil pressure system inertia or long and thin oil pipes.

Parameter	Name	Value Range	Unit	Default	Change
A3-29	Oil pressure loop gain coefficient	0.2% to 5.00%	%	1.00	Real-time

10.3.5 Pressure Holding Stability Test

Adjusting the speed loop stiffness level

If large pressure holding fluctuation is detected during commissioning, increase the first stiffness level (low speed loop) to increase the pressure stability, that is, increase the value of F2-12 properly without causing motor oscillation.

Parameter	Name	Value	Default	Unit	Change
F2-12	Stiffness level of 1st gain set	0 to 31	12	-	Real-time

Switching pressure loop PI control parameter based on the set pressure

Parameter	Name	Value	Default	Unit	Change
A3-63	High-voltage/Low-voltage PI parameter switchover Kp	0 to 1	0	-	Real-time
A3-64	1st group of low pressure control Kp	0.0 to 800.0	210	-	Real-time
A3-65	1st group of low pressure control Ti	0.001 to 10.000	0.5	-	Real-time
A3-66	1st group of high pressure control Kp	0.0 to 800.0	260	-	Real-time

Parameter	Name	Value	Default	Unit	Change
A3-67	1st group high pressure control Ti	0.001 to 10.000	0.02	-	Real-time
A3-68	Low pressure threshold	0.0 to [A3-69]	50	-	Real-time
A3-69	High pressure threshold	[A3-68] to [A3-02]	100	-	Real-time

When A3-63 is set to 1, high-pressure/low-pressure PI parameter switchover function is enabled. In this case, the values of A3-05 and A3-06 change automatically based on the set pressure.

- When the set pressure is higher than the value of A3-69, use A3-66 and A3-67 for pressure loop control.
- When the set pressure is lower than the value of A3-69, use A3-64 and A3-65 for pressure loop control.
- When the set pressure is between A3-68 and A3-69, the corresponding pressure loop IP parameter is calculated through linear interpolation.

Note

The preceding PI parameter switchover function is activated only when the first group of PID parameters are used, which is when No. 49 and No. 48 DI functions are both set to 0.

Pressure build-up and pressure holding switchover pressure loop PI control parameter

Parameter	Name	Value	Default	Unit	Change Mode
A4-44	Pressure build-up and pressure holding PID switchover	0 to 7	0	-	Real-time
A4-45	Filter time of feedback pressure upon pressure holding switchover	0.000s to 5.000s	0.005	s	Real-time
A4-46	Pressure deviation upon pressure holding switchover	0.0 kg/cm^2 to 10.0 kg/cm^2	1	kg/cm^2	Real-time
A4-47	Speed upper limit upon pressure holding switchover	0 rpm to 1000 rpm	200	rpm	Real-time
A4-79	Pressure holding judgment associated with pressure setpoint change	0 to 1	1	-	Real-time

The software identifies dynamically whether the pressure holding state applies. If yes, it switches the pressure loop control parameters automatically. The pressure holding state applies when the following conditions are met:

- The speed setpoint is within the value of A4-47 (200 rpm by default).
- The pressure setpoint is higher than the base pressure by more than 30 kg.
- The filtered feedback pressure deviation is lower than A4-46.

You can view U0-75 to judge whether the pressure holding state applies. If the value of U0-75 is 1, it indicates the software identifies the pressure holding state.

The higher the filter time (A4-45), the higher the accuracy. Note that the longer the filter time, the better the filtering effect, but the slower the pressure holding state identification will be. The value of A4-45 needs to be determined through commissioning.

When the software recognize the pressure holding state and the value of A4-44 is not 0, PID control parameters will be switched based on the internal setting.

DI3 (DI function 49)	DI2 (DI function 48)	Pressure build-up PID group	Pressure build-up PID group
0	0	First group of PID: A3-05, A3-06, A3-07	First group of PID: A4-48, A4-49, A4-50
0	1	Second group of PID: A3-11, A3-12, A3-13	Second group of PID: A4-51, A4-52, A4-53
1	0	Third group of PID: A3-14, A3-15, A3-16	Third group of PID: A4-54, A4-55, A4-56
1	1	Fourth group of PID: A3-17, A3-18, A3-19	N/A

Note

When A3-63...A3-69 are activated simultaneously with A4-44, A4-45, A4-46, A4-47, and A4-79, A4-44...A4-47 and A4-79 will be executed first.

Adjusting system inertia ratio based on the set pressure during low-speed pressure holding

Parameter	Name	Value	Default	Unit	Change Mode
A4-80	Low-voltage threshold for inertia ratio auto adjustment	0.0 to A4-81	10	kg/cm²	Real-time
A4-81	High-voltage threshold for inertia ratio auto adjustment	A4-80 to A3-02	20	kg/cm²	Real-time
A4-82	Inertia ratio corresponding to low pressure threshold	0.2 to F2-13	0.5	-	Real-time

When the low pressure threshold is not 0, it indicates the system inertia ratio will be adjusted automatically based on the set pressure during low-speed pressure holding.

- When the pressure setpoint is higher than A4-81, the inertia ratio is F2-13 (1.00 by default).
- When the pressure setpoint is lower than A4-80, the inertia ratio is A4-82.
- When the pressure setpoint is between A4-80 and A4-81, the actual inertia ratio will be calculated through linear interpolation.

Note

When the speed is lower than F2-02, the low-speed pressure holding can be activated only when system inertia ratio is adjusted based on the set pressure.

11 Function Description

11.1 Parameters Initialization

Restore the drive settings to default values. After parameter initialization, the value of FP-01 is restored to 0 automatically.

Parameter	Name	Value range	Unit	Default	Change
FP-01	System parameter initialization	0: No auto-tuning 1: Restore factory settings 2: Clear fault logs 3: Restore user backup parameters 4: Reserved 5: Restore all parameters to default values (FP and FA are not restored. Remember to back up them.)	1	0	At stop

- 1: Restore default settings (motor parameters excluded)
  After you set FP-01 to 1, most drive function parameters are restored to factory settings except the following: manufacturer parameters (FF), user parameters (FP), motor parameters (F1), fault logs (F8-36 to F8-57, F9-18 to F9-50), business timing (FA), PT1000 and AI/AO correction parameters (F4-38 to F4-58, F5-23 to F5-30), software version number (FD-06, FD-07, F7-10 to F7-13), running direction (F0-09), Modbus station number (F7-09), phase sequence auto-tuning attempts (A0-41) and phase sequence auto-tuning result (A0-45).
- 2: Clear fault records
  Clears fault records, and accumulative running time (F7-09).
- 3: Restore user backup parameters
  Restores user parameters that are backed up when FP-05 is set to 1.
- 5: Restore all parameters
  After you set FP-01 to 5 through the keypad, the password input interface appears. You need to enter the correct password to return to the setting interface of FP-01. Press **OK** to begin restoring parameters. Pressing the Mode key during this process brings you back to the level-2 menu. If you set through communication, you must first set the correct password through FF-00 and then set FP-01 to 5 in 1 minute. Otherwise, the setting fails. Most drive function parameters are restored to factory settings except the following: manufacturer parameters (FF), user parameters (FP), fault logs (F8-36 to F8-57, F9-18 to F9-50), business timing (FA), PT1000 and AI/AO correction parameters (F4-38 to F4-58, F5-23 to F5-30), software version number (FD-06, FD-07, F7-10 to F7-13), and accumulative running time (F7-09).

11.2 Running Command Setting

Running commands are used to control start, stop, forward run, and reverse run of the drive. Commands can be given by the software/iPanel, terminal, and communication. You can select the required control mode in function parameter F0-02.

Parameter	Name	Value Range	Default	Change Mode
F0-02	Command source	0: Keypad 1: Terminal 2: Communication reference	0	Real-time

Sending running commands through the keypad

Set F0-02 to 0 to enable keypad control (and) of drive operation.

Press to run the drive and the RUN indicator is on. Press while the drive is running to stop the drive and the RUN indicator is off.

Sending running commands through terminals

Set F0-02 to 1 to enable terminal control of drive start and stop. (Only one terminal of DI1 to DI5 can be set to 1.)

Sending running commands through communication

Set F0-02 to 2 to enable communication control of drive operation. You can start and stop the drive. You can access different communication addresses with different communication protocols. For details, see Section "Communication".

11.3 Start/Stop Method

The startup method of the drive is direct startup. The stop method is described in the following table.

Parameter	Name	Value Range	Default	Change Mode
F6-10	Stop Mode	0: Decelerate to stop 1: Coast to stop	0	At stop

Decelerate to stop

F6-10 = 0: Decelerate to Stop Once the stop command is input, the drive decreases the output frequency based on the deceleration time to 0.

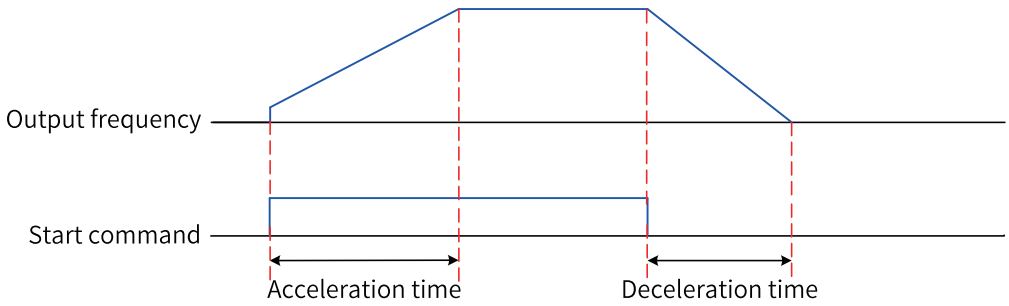


Figure 11-1 Sequence diagram for decelerate-to-stop

Coast to stop

F6-10 = 1: Coast to Stop The drive stops output immediately and the motor coasts to stop based on the mechanical inertia.

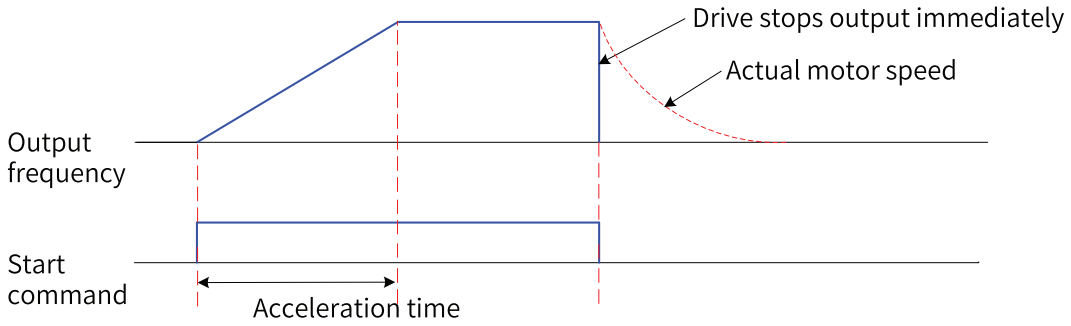


Figure 11-2 Sequence diagram for coast-to-stop

11.4 Setting of Acceleration/Deceleration Time

Acceleration time indicates time required by the drive to accelerate from 0 Hz to the maximum frequency (F0-10). Deceleration time indicates time required by the drive to decelerate from the maximum frequency (F0-10) to 0 Hz.

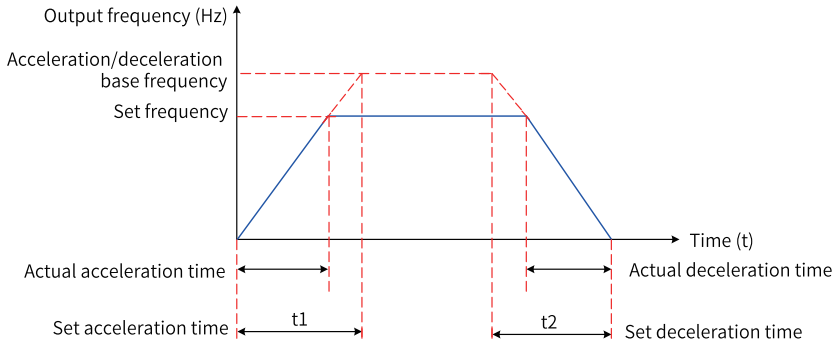


Figure 11-3 Acceleration/Deceleration time

Parameter	Name	Value Range	Default	Change Mode
F0-10	Max. Frequency	50.00 Hz-300.00 Hz	200.00 Hz	At stop
F0-17	Acceleration time	0 ms-65000 ms	20000ms	Real-time
F0-18	Deceleration time	0 ms-65000 ms	20000ms	Real-time

11.5 Control Interface

11.5.1 Digital Input (DI) Terminal Functions

The drive is equipped with multiple multi-functional DI terminals by default. You can assign any one of the DI functions to a DI terminal.

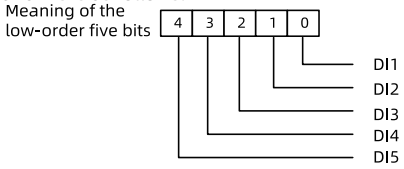
Parameters	Name	Setpoint	Default value	Unit	Change mode
F4-00	DI1 function selection	0: Not assigned 1: Forward run 2: Reverse run 3-7: Reserved 8: Coast to stop 9: Fault reset 10: Reserved 11: External fault NO input 12: Multi-reference terminal 1 13: Multi-reference terminal 2 14: Multi-reference terminal 3 15: Multi-reference terminal 4 16 to 31: Reserved 32: Mold-opening signal flag 33: External fault normally closed (NC) input 34: Target position flag of mold opening 35 to 47: Reserved 48: Servo oil pump PID selection terminal 1 49: Servo oil pump PID selection terminal 2 50: CAN communication 51: Slave used as master 52: Switching from pressure mode to speed mode 53: Slave pump address selection terminal 1 54: Slave pump address selection terminal 2 55: Switching from injection mode to pressure holding mode 56: Fault reset terminal 2 (overcurrent fault cannot be reset) 57: Switching from pressure mode to speed mode (torque upper limit = F2-10) 58 to 61: Reserved	1	-	Change at stop
F4-01	DI2 function selection		48	-	Change at stop
F4-02	DI3 function selection		53	-	Change at stop
F4-03	DI4 function selection		9	-	Change at stop
F4-04	DI5 function selection		50	-	Change at stop
F4-15	DI filter time	0.00 to 500.00	0.5	ms	Real time
F4-16	Active state of DI	0 to 1023	0	-	Change at stop

Table 11–1 Description of DI terminal functions

Setpoint	Function	Description
0	No function	Set 0 for reserved terminals to avoid malfunction.
1	Forward run (FWD)	Forward run
2	Reverse run (REV)	Reverse run
8	Coast to stop	The drive stops and the motor coasts to stop.
9	Fault reset (RESET)	Reset the drive faults. Remote fault reset can be implemented through this terminal.

Setpoint	Function	Description
11	NO input of external fault	When an external signal is delivered to the drive, the drive reports fault E15.00.
12	Multi-reference terminal 1	The setting of 16 multi-references or 16 other references can be implemented through combinations of 16 states of these four terminals. For details, see the corresponding relationship between DI terminals and speed in the parameter list.
13	Multi-reference terminal 2	
14	Multi-reference terminal 3	
15	Multi-reference terminal 4	
33	NC input of external fault	When an external signal is delivered to the drive, the drive reports fault E15.01.
48	Servo oil pump PID selection terminal 1	Used to switch PID parameters.
49	Servo oil pump PID selection terminal 2	Used to switch PID parameters.
50	CAN communication enable	See the multi-pump mode for details.
51	Slave used as the master	See the multi-pump mode for details.
52	Switching from pressure mode to speed mode (torque upper limit = AI1/max. voltage x A3-30)	Pressure closed loop is not applied and the speed mode applies.
53	Slave pump address selection terminal 1	See the multi-pump mode for details.
54	Slave pump address selection terminal 2	See the multi-pump mode for details.
55	Switching from injection mode to pressure holding mode	-
56	Fault reset terminal 2 (overcurrent fault cannot be reset)	-
57	Switching from pressure mode to speed mode (Torque upper limit = F2-10)	Pressure closed loop is not applied and the speed mode applies.

Table 11–2 DI state monitoring

Parameters	Name	Min. unit	Value range	Description
U0-07	DI state	1	0 to 32767	Displays the current DI status. After the value is converted into a binary number, each bit corresponds to a DI. “1” indicates high level signal, and “0” indicates low level signal. The corresponding relationship between bits and DIs is as follows. 

11.5.2 Digital Output (DO) Terminal Function

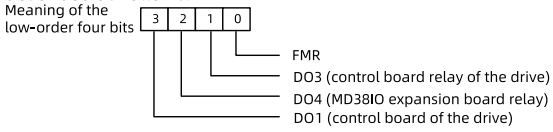
Param.	Function	Value range	Default value	Unit	Change mode
F5-01	DO1 function selection	0: No output 1: Drive operating 2: Fault output 3-6: Reserved 7: Drive overload pre-warning 8-11: Reserved 12: Operating time reached 13-14: Reserved 15: Ready to run 16: Calibrated AI1 absolute value higher than AI2 absolute value 17-19: Reserved 20: Communication 21-22: Reserved 23: Swashplate switchover 1 of double-discharge piston pump 24: Pressure controls state 25: Slave pump warning 26: Swashplate switchover 2 of double-discharge piston pump 27: Bus voltage established 28: Business operating time reached 29: Business operating time less than 24 h 30: Max. reverse speed DO 31: Warning 32: Motor temperature reached 33: Reserved 34: Mold opening back pressure valve start DO 35: Reserved	2	-	Real time
F5-02	DO2 output		23	-	Real time
F5-03	DO3 output (expansion card)		24	-	Real time

Table 11–3 Descriptions of DO functions

Value range	Function	Description
0	No output	Terminal has no function.
1	Drive running	When the drive is operating and frequency (can be zero) is output, the terminal outputs an active signal.
2	Fault (coast-to-stop fault)	An “active” signal can be outputted when the drive stops upon fault.
6	Motor overload pre-alarm	The drive determines whether the motor load exceeds the overload pre-alarm threshold according to the overload pre-alarm coefficient (F9-02) before triggering protection. The DO outputs an active signal when the overload pre-alarm threshold is exceeded.
7	Drive overload pre-warning	The terminal outputs an active signal 10s before overload protection for the drive applies.
12	Cumulative operating time arrival	If the cumulative running time of the drive exceeds the time specified by F8-17, the terminal outputs an active signal.
15	Ready to run	When the drive is powered on and operates in the normal state, the terminal outputs an active signal.

Value range	Function	Description
16	AI1 > AI2	The terminal outputs an active signal when the value of AI1 is greater than that of AI2.
20	Communication setting	The active or inactive state of the terminal is controlled by the setpoint of communication address 0x2001.
23	Duplex pump displacement switchover 1	This signal can be outputted when the pressure is higher than A3-23 and the flow is lower than A3-22.
24	Pressure control state output	This signal is outputted when the feedback pressure is lower than 90% of the setpoint of A3-23 or 90% of the feedback flow is higher than A3-22.
25	Slave pump alarm output	This signal can be outputted when the master pump receives alarm information from the slave pump.
26	Swashplate switchover 2 of double-discharge piston pump	Reserve
27	Bus voltage establishment	-
28	Business operating time reached	-
29	Business operating time less than 24 hours	-
30	Max. reverse speed DO	-
31	Alarm output	The terminal outputs an active signal when a fault occurs and the drive continues operating. For details about the fault protection action, see F9-61 to F9-74.
32	Digital output when motor temperature reached	The terminal outputs an active signal when the motor temperature reaches the value of F9-51. (You can check the motor temperature through U0-45.)

Table 11–4 DO state monitoring

Param.	Name	Min. unit	Value range	Description
U0-08	DO state	1	0 to 32767	Displays the current DO status. After it is converted into binary data, every bit corresponds to one DO signal. "1" indicates high level signal, and "0" indicates low level signal. The corresponding relationship between bits and DOs is described as follows. 

11.6 Speed loop

Parameter	Name	Value Range	Default	Unit	Change Mode
F2-00	Speed loop proportional gain 1	0.1 to 2000.0	25	-	Real-time
F2-01	Speed loop integral time 1	0.15 to 512.00	31.83	-	Real-time
F2-02	Speed loop switchover speed 1	0 rpm to [F2-05]	75	rpm	Real-time
F2-03	Speed loop proportional gain 2	0.1 to 2000.0	14	-	Real-time

Parameter	Name	Value Range	Default	Unit	Change Mode
F2-04	Speed loop integral time 2	0.15 to 512.00	26.53	-	Real-time
F2-05	Speed loop switchover speed 2	[F2-02] to 20000 rpm	150	rpm	Real-time
F2-07	Speed feedback filter time constant	0.1 ms–100.0 ms	2	ms	Real-time
F2-08	Servo performance mode selection	0: Normal mode 1: Performance boost mode 2: High performance mode	0	-	Real-time
F2-12	Stiffness level of 1st gain set	0 to 31	12	-	Real-time
F2-14	Second stiffness level Kp	0 to 31	10	-	Real-time
F2-15	Second stiffness level Ki	0 to 31	13	-	Real-time

It is recommended to use the stiffness table to adjust the proportional gain and integral time of the speed loop. F2-12 indicates the stiffness level of group 1, which corresponds to F2-00 proportional gain and F2-01 integral time. F2-14 indicates the stiffness level of group 2 proportional gain, which corresponds to F2-03 proportional gain. F2-15 indicates the stiffness level of group 2 integral time, which corresponds to F2-04 integral time. When you adjust the stiffness level, the corresponding speed loop proportion or integral value is automatically adjusted. You can also modify F2-00, F2-01, F2-03, F2-04 and retain the modifications after power failure.

F2-00 to F2-05 are speed loop PI parameters. If the operating speed is lower than F2-02 (switchover speed 1), PI parameters are F2-00 and F2-01. If the operating speed is higher than switchover speed 2, PI parameters are F2-03 and F2-04. If the operating speed is between switchover speeds 1 and 2, PI parameters are obtained from linear switchover between two groups of PI parameters, as shown below.

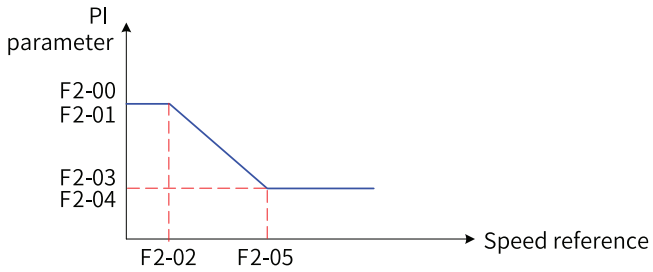


Figure 11-4 Speed loop PI parameters

You can adjust the dynamic response characteristics of the speed loop in vector control by setting the proportional coefficient and integral time of the speed regulator or adjusting the speed loop stiffness level. Increasing the proportional gain or reducing the integral time (increasing the speed loop stiffness level) can quicken the dynamic response of the speed loop. However, too large proportional gain or too small integral time (high stiffness level) may cause system oscillation.

F2-08 is used to select the drive performance mode.

- The default value of F2-08 is 0, indicating normal mode. The overall stiffness is weak in this mode.

- F2-08 = 1 indicates the enhanced mode. The first group of stiffness level is 13, the second group of KP stiffness level is 11, and the second group of KI stiffness level is 14.
- F2-08 = 2 indicates the performance mode. The first group of stiffness level is 15. The second group of KP stiffness level is 12 and the second group of KI stiffness level is 15.

After you modified F2-08, you can still manually modify the stiffness level or speed loop proportional and integral parameters, which will be effective and retentive upon power failure.

We recommend that you adjust these parameters as follows:

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

Note

If the PI parameter is set improperly, speed overshoot, or even overvoltage fault may occur when overshoot drops.

Increasing F2-07 improves motor stability but weakens dynamic responsiveness. Decreasing F2-07 weakens motor stability but improves dynamic responsiveness. Note that setting F2-07 to an excessively low value may cause motor oscillation. The default value of F2-07 applies to most of applications.

12 Communication

12.1 Introduction to Parameters

The drive supports Modbus-RTU, CANopen, and PROFINET. The host controller allows users to control the drive, such as monitoring states, or viewing and changing parameters through the protocol. The communication data can be divided into parameter data and non-parameter data. The latter includes the operation commands, operation status, operation parameters and alarms.

Parameter Data

Table 12–1 Parameter Data

Group F (read-write)	F0, F1, F2, F3, F4, F5, F6, F7, F8, F9, FA, Fd, FE, FF, FP
Group A (read-write)	A0, A1, A2, A3, A4, A5, A6, A7, AF
Group B (Read-write)	B0, B1, B2, B3

Parameters in group B (sub-divided into groups B0, B1, B2, and B3) are user-defined parameters used to allow continuous access to parameters with discontinuous addresses.

- Mapped parameter group: groups B0 and B2
- Data function parameter group: groups B1 and B3

Parameters values in group B1 correspond to the mapped parameter values in group B0. Parameter values in group B3 correspond to mapped parameter values in group B2. Parameters in group B1 are R/W parameters. The actual R/W property is determined by the parameter property mapped in group B0, allowing you to configure parameter objects to be read/written continuously. Parameters in group B3 are read-only and not related to the parameter property mapped in group B2, allowing you to configure parameter objects to be monitored.

For example, to operate F0-08 and F2-10 and observe U0-37 and U1-00, which are discontinuous parameters, configure as shown in the following figure.

Parameter Mapping	Content of the mapped parameter	Data Parameter	Content of the Data Parameter
B0-00	0xF008	B1-00	Equivalent to F0-08
B0-01	0xF00A	B1-01	Equivalent to F0-10
B2-00	0x7025	B3-00	Equivalent to U0-35
B2-01	0x7100	B3-01	Equivalent to U1-00

The definition of parameter data communication address is as follows:

1. For parameter data read through communication

   For parameters in groups F0 to FP, A0 to AF, and B0 to B3, the high-order eight bits of the communication address indicate the group number and the low-order eight bits indicate the parameter number in the group.

   The communication address of F0-16 is F010H, where F0 represents group F0 and 10 is the hexadecimal data format of serial number 16 in the group.

   The communication address of AC-08 is AC08H, where ACH represents group AC and 08 is the hexadecimal data format of serial number 8 in the group.

The communication address of B1-04 is B104H, where B1 represents group B1 and 04 is the hexadecimal data format of serial number 4 in the group.

2. For parameter data written through communication
For parameters in groups F0 to FP, the high-order eight bits of the communication address are 00 to 0F or F0 to FF, depending on whether the parameter is written to the EEPROM. The low-order eight bits indicate the parameter number in the group.

Take writing F0-16 as an example.

If F0-16 does not need to be written to the EEPROM, its communication address is 0010H.

If F0-16 needs to be written to the EEPROM, its communication address is F010H.

For parameters requiring retention at power failures, the EEPROM communication address format can be used. However, due to EEPROM chip lifespan considerations, the host controller must strictly limit the write frequency. For parameters not requiring retention at power failures, the non-EEPROM communication address format can be used.

For parameters in groups A0 to AF, the high-order 8 bits of the communication address are 40 to 4F and A0 to AF, depending on whether the parameter is written to the EEPROM. The low-order 8 bits indicate the parameter number in the group.

Take writing AC-08 as an example.

If AC-08 does not need to be written to the EEPROM, the communication address is 4C08H.

If AC-08 needs to be written to the EEPROM, the communication address is AC08H .

For parameters in groups B0 to B3, the high-order 8 bits of the communication data are 60 to 63 and B0 to B3, depending on whether the parameter is written to the EEPROM. The low-order 8 bits indicate the parameter number in the group, as shown in the following example.

Writing B1-04:

If B1-04 does not need to be written to the EEPROM, the communication address is 6104H. The communication address is B104H when B1-04 needs to be written to EEPROM.

Non-parameter data

Table 12–2 Non-parameter data

Status data (read-only)	Monitoring parameters in group U, descriptions of drive faults, and operation status of the drive
Control parameters (write-only)	Control commands, communication references, DO terminal control, AO1 control, AO2 control, and parameter initialization

1. Status data
Monitoring parameters in group U, descriptions of drive faults, and operation status of the drive

- Monitoring parameters in group U
For group U0 to U1, the high-order 8 bits of the communication address are 70 to 71, and the low-order 8 bits indicate the parameter number in the group. For example, the communication address of U0-11 is 700BH.
- Drive fault description

When the drive fault description is read through communication, the communication address is fixed to 8000H. The host controller can obtain the current fault code of the drive by reading the address.

- AC drive running status
  The communication address is fixed to 3000H when you read fault descriptions through communication. The host controller can get the present operation status of the drive through reading the address data, as defined below.

Communication address of drive operation status	Definition of the status word
3000H	0: Not ready
	1: Forward run
	2: Reverse run
	3: At stop
	7: Fault state (CAN communication)
	8: Fault status

2. Control parameters
   Control parameters are divided into control commands, communication setpoint, DO control, AO1 control, AO2 control, and parameter initialization.

- Control command
  When F0-02 (Command source) is set to 2: The host controller can start/stop the drive through this communication address during communication control. The definition of the control command is as follows.

Communication address of drive operation status	Definition of the status word	Remarks
2000H	1: Forward run 2: Reverse run 5: Coast to stop 6: Decelerate to stop 7: Reset upon fault	When you read 2000H address, the manufacturer-defined parameters will be returned.

- Reference set through communication
  The communication references applies when the source of the frequency, torque upper limit, PID reference and PID feedback is communication. The communication address is 1000H. The range is -10000 to +10000 and corresponding value range is -100.00% to +100.00%.

- DO control
  When the DO terminal function is set to 20 (Communication setting), the host controller can control the DO terminals of the drive through the communication address, as defined below.

Communication Address of DO Terminal Control	Command
2001H	BitO1 output control BitO2 output control

- AO1 and AO2 control
  When the function of AO1 and AO2 is set to 14 (Communication control), the host controller can control the AO terminals of the drive through the communication address, as defined below.

Output Control Communication Address		Command
AO1	2002H	0 to 7FFF represent 0% to 100%.
AO2	2003H	0 to 7FFF represent 0% to 100%.

- Parameter initialization
  The function of parameter initialization applies when you need to initialize parameters through the host controller.

  Before setting FP-01 to 5, input the correct password through FF-00 first and then set FP-01 to 5 within one minute. FP-01 is used to initialize parameters. The command address of FP-01 is 1F01H, as defined in the following table.

Communication Address of Parameter Initialization	Command function
1F01H	1: Restore system default parameters 2: Clear fault records 3: Restore backup parameters 4: Reserved 5: Restore all parameters to default

12.2 Parameter Address Expression Rules

The parameter address is presented by the parameter group number and serial number.

High-order bits: F0 to FF (group F), A0 to AF (group A), 70 to 71 (group U), B0 to B3 (group B)

Low order bytes: 00 to FF

For example, to access F3-12, the communication address of F3-12 is expressed as 0xF30C.

Group U: Parameters in group U are read-only.

Some parameters can be modified at any time. Some parameters can be modified only when the drive is not operating. Some parameters cannot be modified at all. Pay attention to the value range, unit, and related descriptions when modifying parameters.

Parameter Group No.	Visited Address	Parameter Address in RAM
F0 to FE	0xF000 to 0xFEFF	0x0000 to 0x0EFF
A0 to AC	0xA000 to 0xACFF	0x4000 to 0x4CFF
B0 to B3	0xB000~0xB3FF	0x6000~0x63FF
U0 to U1	0x7000~0x71FF	-

Note

Frequent writing to EEPROM reduces the service life of EEPROM. For some parameters in the communication mode, you only need to change the value in RAM.

To implement the function of the parameter in group F, change the high order F of the parameter address to 0. For parameters in group A, if you want to change a parameter through communication without storing it to the EEPROM, change the high-order A of the parameter address to 4.

The corresponding parameter addresses are expressed as follows:

High-order bytes: 00 to 0F (group F) and 40 to 4F (group A)

Low order bytes: 00 to FF

Example:

When the value of F3-12 after change does not need to be saved to EEPROM, the address is expressed as 0x030C. When the value of A0-05 after change does not need to be changed to EEPROM, the address is expressed as 0x4005. The address indicates that it can be only written to the RAM. When the address is read from the RAM, it is invalid.

The following table lists some stop/run parameters.

Parameter address	Description	Parameter address	Description
1000H	Communication setpoint (decimal) -10000 to +10000	100FH	Reserve
1001H	Operating speed	1010H	Reserve
1002H	Bus voltage	1011H	Reserve
1003H	Output voltage	1012H	Reserve
1004H	Output current	1013H	Real-time angle
1005H	Output power	1014H	Reference hydraulic pressure
1006H	Output torque	1015H	Hydraulic pressure feedback
1007H	Running speed	1016H	Motor operating speed
1008H	DI input indication	1017H	Reference flow PID calculation value
1009H	DO output indication	1018H	Flow feedback
100AH	Calibrated AI1 voltage	1019H	Uncalibrated AI1 voltage
100BH	Calibrated AI2 voltage	101AH	Uncalibrated AI2 voltage
100CH	Calibrated AI3 voltage	101BH	Uncalibrated AI3 voltage
100DH	Calibrated AI4 voltage	101CH	AI4 voltage before calibration
100EH	Reserve	-	-

Note

The communication setpoint is a relative value in percentage. For example, the value 10000 corresponds to 100.00% and the value -10000 corresponds to -100.00%. This percentage is a ratio to the maximum frequency (F0-10). For torque dimension data, this percentage is a ratio to the torque upper limit (F2-10).

Control command inputted to the drive: (read/write)

Command word address	Command function
2000H	0001: Forward run
	0002: Reverse run
	0005: Coast to stop
	0006: Decelerate to stop
	0007: Fault reset
Description: The manufacturer parameter is returned when reading address 2000H.	

Reading drive status: (read-only)

State word address	State word function
3000H	0000: Not ready
	0001: Forward run
	0002: Reverse run
	0003: Stop
	0007: Fault status (CAN communication)
	0008: Fault state

DO control (write-only)

Command address	Command
2001H	Bit 0: DO1 output control Bit 1: DO2 output control

AO1 and AO2 control (write-only):

Command address	Command
2002H	0 to 7FFF indicates 0% to 100%.
2003H	0 to 7FFF indicates 0% to 100%.

Drive fault description:

Fault Address	Fault information	
8000H	0000: Normal 0002: Output overcurrent 0005: Bus overvoltage 0008: Pre-charge resistor fault 0009: Undervoltage 000A: Drive overload 000C: Input phase loss 000D: Output phase loss 000E: Drive overtemperature 000F: External device fault 0010: Communication fault 0011: Contactor fault 0013: Motor parameter auto-tuning fault 0015: EEPROM read/write operation fault 0017: Drive output short-circuited to ground 001A: Accumulative running time reach 001B: Business time reached 001C: Internal fault 001E: Motor fan speed regulation fault 001F: DI function assignment fault 0020: STO data check fault 0029: Slave pump stuck	002A: CAN communication fault 002C: Excessive speed deviation 002D: Motor temperature fault 002E: Pressure sensor fault 002F: Slave fault in multi-pump convergent flow mode 0030: Station number conflict 0031: Encoder fault 0032: Encoder fault 2 0034: Multi-master fault in multi-pump convergent flow mode 003A: User parameter restoration error 003D: Braking protection duration too long 003F: Reverse run time reached 0040: Drive EEPROM fault 0043: Parameter initialization error 0045: Motor stall 0046: Motor ROM data error 0048: CANopen position sensor fault 0049: Output wiring error 005F: Pressure beyond limit during mold opening 0061: Motor parameter modification fault 0062: Restart required after parameter modification 0063: Abnormal number of software-defined parameters

12.3 Modbus Communication

12.3.1 Communication

The drive provides the RS485 communication interface and supports the Modbus-RTU slave communication protocol. You can carry out centralized control by using a PC or PLC and set the running commands, modify or read parameters, and read the operating status and fault information of the drive through the communication protocol.

This protocol defines content and format of transmitted messages during serial communication, including the master polling (or broadcasting) format and master coding method for the action, transmission data, error check, and so on. Slave response uses the same structure including action confirmation, returned data and error check. If an error occurs when the slave receives a message,

or the slave cannot perform the action required by the master, the slave returns a fault message as a response to the master.

12.3.2 Hardware Interface and Specifications

Hardware interface

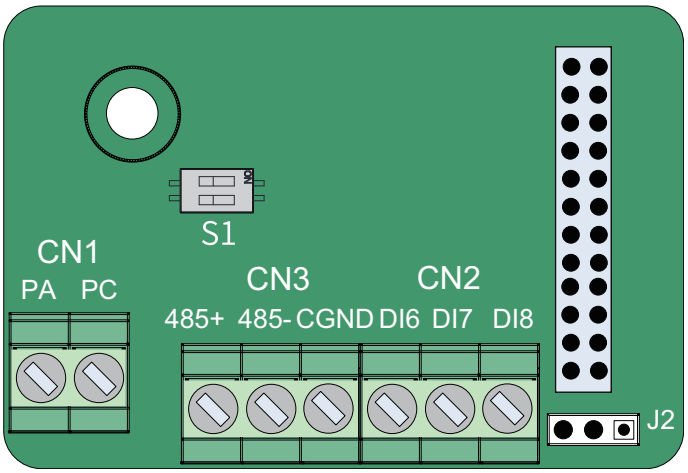
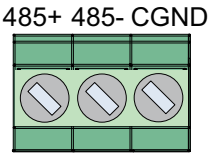
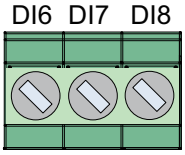
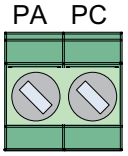


Figure 12-1 Layout of MD38IO3 terminals

Table 12–3 Description of terminals on MD38IO3

Mark		Name	Description	Terminal Layout
CN3	485+	RS485 communication signal (+)	Modbus supported; input isolated	
	485-	RS485 communication signal (-)		
	CGND	RS485 communication signal (GND)		
CN2	DI6 to DI8	3 DIs	• Optocoupler isolation, compatible with bipolarity input, maximum input frequency of 100 Hz • Input impedance: 3.4 kΩ • Voltage range for level input: 9 V to 24 V	
CN1	PA-PC	Normally open terminal	Contact driving capacity: 250 VAC/5 A, 30 VDC/5A	
S1	RS485 termination resistor selection	2-bit DIP switch	• Both set to ON: matching the termination resistor • Both set to OFF: not matching the termination resistor	

Specifications

Item	Specification
Link layer protocol	RS485 bus
Application layer protocol	Modbus RTU
Baud rate	9600 bps (default)
	115200 bps, 57600 bps, 38400 bps, 19200 bps, 9600 bps, 4800 bps, 2400 bps
Data format	8-N-1; 8-N-2; 8-E-1; 8-O-1
	(1) 8 data bits, (2) check, (3) stop bit
Maximum number of stations	128 nodes at the speed of 9.6 kbps
Max. speed	115200 bps
Maximum transmission distance	The maximum transmission distance at the baud rate of 9.6 kbps is 1 km.
Supported command code	Multi-read (0x03), multi-write (0x10), single-write (0x06)

12.3.3 Network Topology

To use RS485 communication, install an RS485 expansion card (MD38IO3) to the drive. For details on the RS485 expansion card, see *MD38IO3 I/O Expansion Card User Guide.*

Communication networking

If multiple nodes are deployed, use the daisy chain topology for the RS485 bus, as shown in the following figure.

- Shielded twisted pair cables are recommended for connecting the RS485 bus. Twisted pair cables are recommended for connecting 485+ and 485-.
- Connect a 120 Ω termination resistor on each end of the bus to prevent signal reflection.
- Connect the RS485 signal reference ground of all nodes (up to 128 nodes) together, with the length of each node branch less than 3 m.

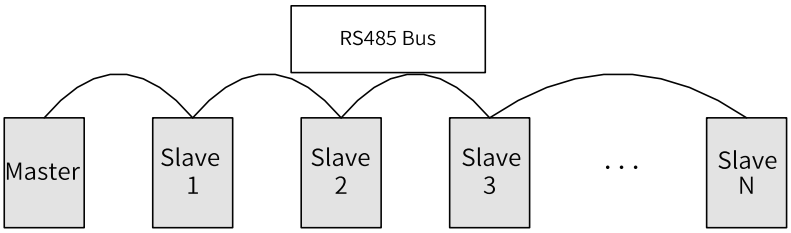


Figure 12-2 Daisy chain topology

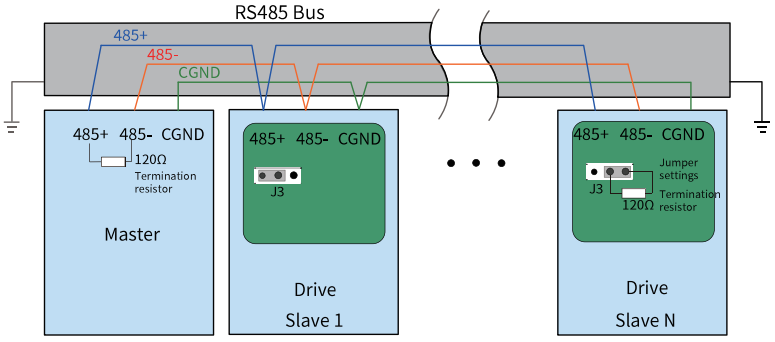


Figure 12-3 RS485 bus topology

Transmission distance

The maximum number of nodes and transmission distance of a standard RS485 circuit vary with the transmission rate, as listed in the following table.

Table 12–4 Transmission distance and number of nodes

Transmission distance (m)	Transmission rate (kbps)	Number of nodes	Wire diameter (AWG)
100	115.2	128	26
1000	19.2	128	26

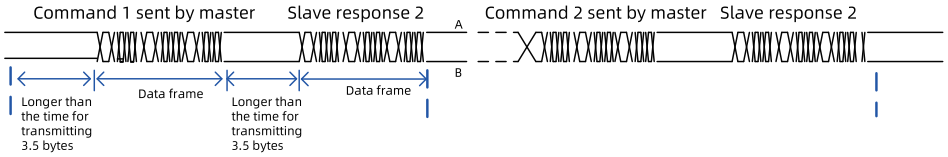
Termination resistor settings

Table 12–5 Termination resistor settings

Mark	Name	Description	Position of the Jumper/DIP Switch
S1	DIP switch for RS485 termination resistor connection	Termination resistor is connected.	
		Termination resistor is not connected.	

12.3.4 Communication transmission mode

The asynchronous serial and half-duplex transmission mode is used. During asynchronous serial communication, data is sent frame by frame in the form of packets. According to the Modbus RTU protocol, an interval that is longer than the transmission time of 3.5 bytes on the communication data line marks the start of a new communication frame.

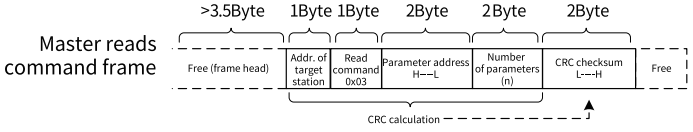


The built-in communication protocol of the servo drive is the Modbus RTU slave communication protocol, which allows the servo drive to respond to the query command from the master or execute the action according to query command from the master and respond with communication data.

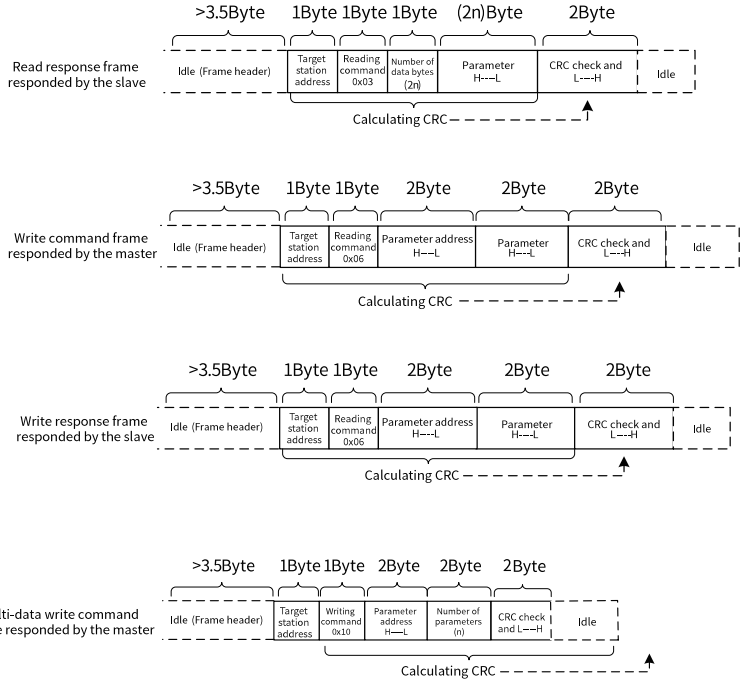
A master can be a PC, an industrial control device or a PLC. A master can separately communicate with a slave or send broadcast information to all slaves. When the master sends a query command to a single slave, the slave needs to return a response frame. For a broadcast message sent by the master, the slaves do not need to return a response to the master.

12.3.5 Communication Data Frame Structure

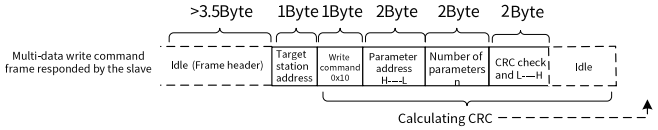
The communication data format of Modbus-RTU protocol is as follows. The drive only supports read-write of word-type parameters. The read command is 0x03 and the write command is 0x06. The command for writing multiple parameters is 0x10. Bytes or bits cannot be read or written.



In theory, the host controller can read or write a maximum of 12 consecutive parameters. However, these parameters must be in the same group. Otherwise, an error will be reported in the response.



A maximum of 12 consecutive parameters can be read or written.



If the slave detects a communication frame error or reading/writing failure caused by other reasons, an error frame will be returned.

Note

CRC check errors will not be responded.

The command for a reading error responded by the slave is 0x83. The command for a writing error responded by the slave is 0x86. The command for a multi-write error responded by the slave is 0x90.

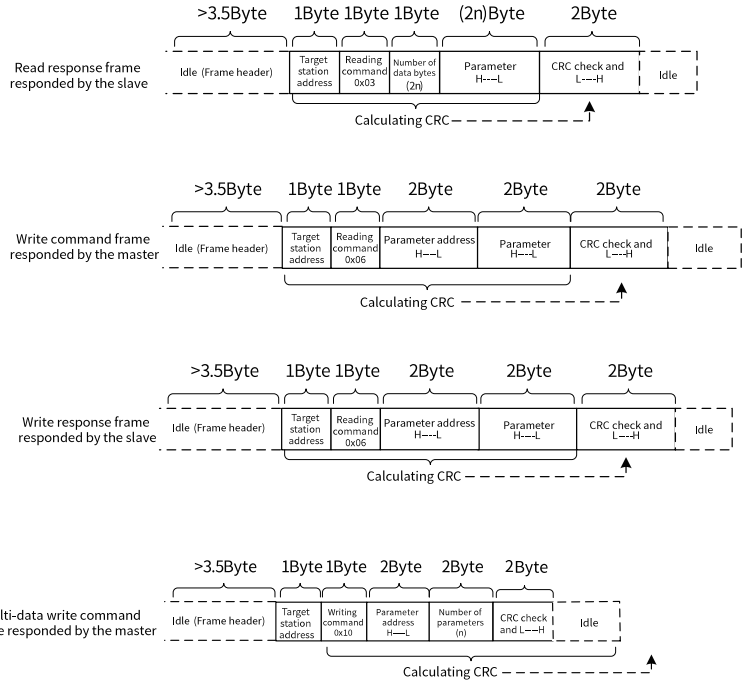


Table 12–6 Description of data frame field

Frame header (START)	Longer than the time for transmitting 3.5 bytes			
Slave address (ADR)	Communication address range: 1 to 247; 0 = Broadcast			
Command code: CMD	-	03H: Read slave parameters	06: Write slave parameters	10: Read/ Write slave parameters
Parameter address (H)	Parameter addresses of the drive are represented in hexadecimal, which are divided into parameter type and non-parameter type (such as operating state parameters or operating commands). For details, see address definitions in *"12.1 Introduction to Parameters" on page 176*. Low-order bytes follow high-order bytes during transmission.	√	√	√
Parameter address (L)				
Number of parameters (H)	It is the number of parameters read by this frame. If it is 1, one parameter is read. Low-order bytes follow high-order bytes during transmission. For this protocol, only one parameter can be rewritten at a time without this field.	√	/	√
Number of parameters (L)				
Data bytes	The data length is twice the number of parameters.	/	/	√
Data (H)	Response data or data to be written. Low bytes follow high bytes during transmission.	/	√	√
Data (L)				
CRC low-order bit	Detection value: CRC16 check value. During transmission, high-order bytes follow low-order bytes. For the calculation method, see the details of CRC.	√	√	√
CRC high-order bit				
END	Time for transmitting 3.5 bytes			

CRC check mode:

The cyclical redundancy check (CRC) adopts the RTU frame format. A Modbus message includes a CRC-based error check field. The CRC field detects the content of the entire message. The CRC field consists of two bytes, including a 16-bit binary value. It is added to the message after being calculated by the transmission device. The reception device recalculates CRC of received messages that is compared with the value in the received CRC domain. If both CRC values are unequal, it indicates that a transmission error occurs.

The CRC calculation initializes the register with 0xFFFF, then executes a process that sequentially processes consecutive 8-bit bytes of the message using the current register value. Only the 8-bit data in each byte is valid for the CRC. The start bit, stop bit and the parity bit do not apply to the CRC.

During generation of CRC, each eight-bit byte is in exclusive or (XOR) with the content in the register. The result is shifted to the least significant bit (LSB), and 0 is filled in the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB is 1, the register then performs XOR with a preset value. If the LSB is 0, no XOR is performed. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit byte is in XOR with the register's current value, and the process repeats for eight more shifts as described above. The final value in the register, after all the bytes in the message have been applied, is the CRC value.

When CRC is added in a message, high-order bytes follow low-order bytes. The CRC simple function is as follows:

```
unsigned int crc_chk_value(unsigned char *data_value,unsigned char length)
{
unsigned int crc_value=0xFFFF;
int i;
while（length--）
{
crc_value^=*data_value++;
for（i=0;i<8;i++）
{
if（crc_value&0x0001）
{
crc_value=（crc_value>>1）^0xa001;
}
else
{
crc_value=crc_value>>1;
}
}
```

}

Return (crc_value);

}

12.3.6 Parameter Setting

Baud rate: FD-00 is used to set transmission speed between host computer and the drive. Note: The baud rate of the host controller must be the same as that of the drive. Otherwise, the host controller and AC drive cannot communicate with each other. The larger the baud rate, the quicker the communication speed.

Parameter	Name	Default	Value Range
FD-00	Modbus baud rate selection	5	3: 2400bps 4: 4800bps 5: 9600bps 6: 19200bps 7: 38400bps 8: 57600bps 9: 115200bps

Data format: The data format on the host controller must be the same as that on the drive. Otherwise, the host controller and AC drive cannot communicate with each other.

Parameter	Name	Default	Value Range
FD-01	Modbus data format	0	0: No check (8-N-2) 1: Even parity 2: Odd parity 3: No check (8-N-1)

Local address of the host controller command: When it is set to 0 (Broadcast address), the broadcasting function of the host computer is activated. This address is unique (except the broadcast address), which is the basis for point-to-point communication between the host controller and the drive.

Parameter	Name	Default	Value Range
FD-02	Modbus local host address	1	1 to 247

Response delay refers to the interval between the end of data-receiving by the drive to the start of data transmission to the host controller. If the response delay is shorter than the system processing time, the system processing time will prevail. If the response delay is longer than the system processing time, the AC drive will not send data to the host computer until the response delay elapsed.

Parameter	Name	Default	Value Range
FD-03	Modbus response delay	2ms	0 ms–20 ms

Communication timeout: When FD-04 is set to 0.0s, system does not detect communication timeout.

When Fd-04 is set to a non-zero value, If the interval between two consecutive communications exceeds the value defined by Fd-04, Err16 (Communication error) will be reported. FD-04 is

generally set to 0.0s. In a continuous communication system, you can monitor the communication status by setting Fd-04.

Parameter	Name	Default	Value Range
FD-04	Modbus communication timeout time	0.0s	0.0s to 60.0s

Parameter	Name	Default	Value Range
FD-06	Communication software version	-	0.00 to 655.35
FD-07	Temporary version of communication software	-	0.00 to 655.35

12.4 PROFINET Communication

12.4.1 Communication

To use PROFINET communication, you must configure a PROFINET communication card (MD500-PN1). After the drive communicates properly with the card, set related communication configurations to enable communication between the card and PROFINET master, achieving the networking function of the drive.

12.4.2 Hardware Interface and Specification Parameters

Hardware interface

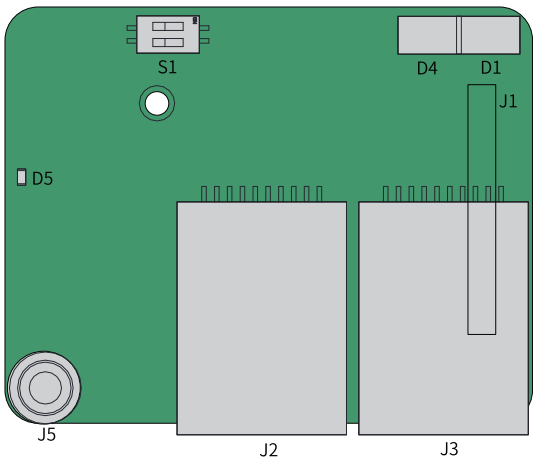


Figure 12-4 Terminal layout of MD500-PN1 card

Table 12–7 Functions of MD500-PN1 card terminals

Terminal Mark	Name	Function
J1	Pin header	Used to connect to the AC drive.
J2	Network port	Used for communication between PN card and PN card (PLC), which is direction-insensitive.
J3		

Terminal Mark	Name	Function
J5	EMC ground terminal	Used to connect the EMC grounding terminal in ES680.

Specifications

Item	Item
Communication protocol	PROFINET
Communication mode	RT mode
IRT	Not supported
Physical layer	100BASE-TX
Baud rate	100 bps (100Base-TX)
Duplex mode	Full duplex
Topology	Ring, linear, star
Transmission medium	Shielded cables of Cat 5e or higher
Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
Number of slaves	Up to 65535 (dependent on the performance of the PLC)
Communication code error rate	Ethernet standard
I&M data	I&M0 to I&M3
Configuration version	TIA Portal V13 SP1 or higher
	STEP7 V5.5 SP4 or higher
PROFINET version	V2.3
PROFINET interface	Number of ports: 2
Function	Switch: supported
	PROFINET IO devices, support for medium redundancy
Alarm/diagnosis information	Supported
MRP (ring-type network)	Supported
MRPD (Quick reset ring-type network)	Not supported
Profinet system redundancy	Not supported
Start priority	Supported
Port disabling	Supported (The two ports are not allowed to be disabled at the same time.)
No configuration is required when you change the configuration.	Supported

12.4.3 Network Topology

Communication networking

After the drive communicates properly with MD500-PN1 card, set related communication configurations to enable communication between MD500-PN1 card and PROFINET master, achieving the networking function of the drive.

PROFINET supports multiple types of topologies including the bus type, star type, and tree type. Multiple types of networking can be achieved through the switch.

You only need to connect one interface on either end of the circuit.

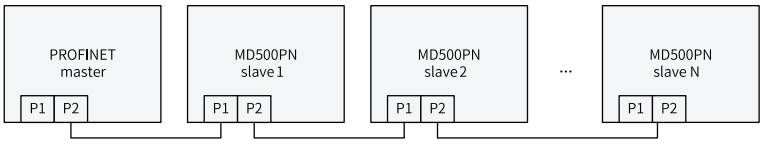


Figure 12-5 Bus-type topology

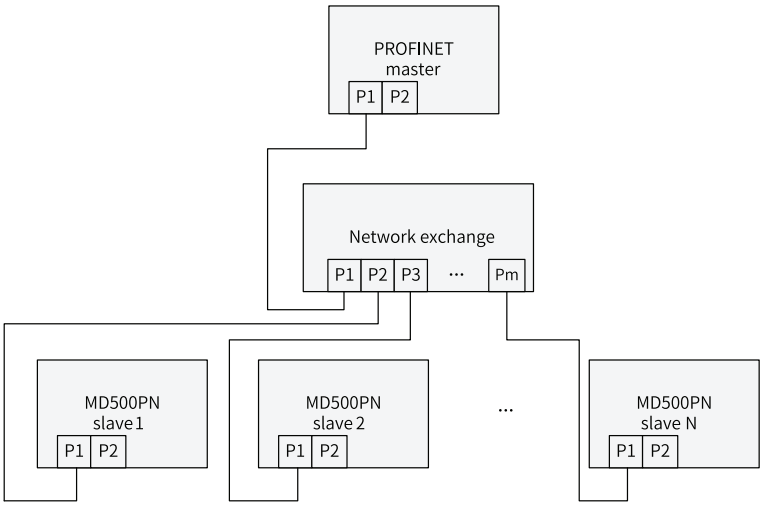


Figure 12-6 Star-type topology

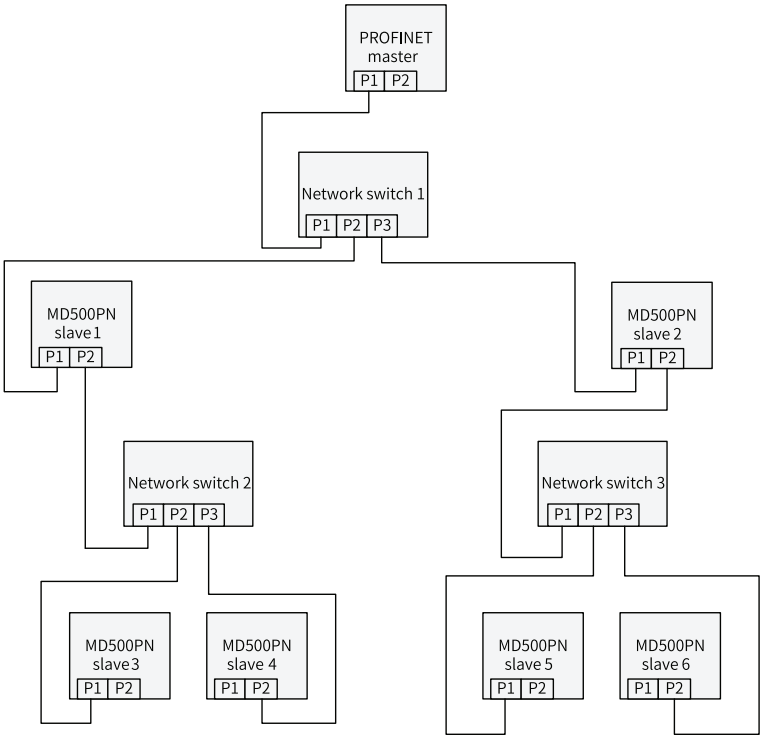


Figure 12-7 Tree-type topology

Transmission distance

The maximum length of the PROFINET bus is 100 m.

12.4.4 Data Transmission Format

The MD500PN card transmits data using PZD formats with different lengths as required. You can set the PZD functions during configuration.

The following table lists the functions supported by each data format.

Data type	Data Length	Supported Function
Standard telegram 1	PZD-2/2	Drive command and frequency settings Reading of drive state and speed
Standard telegram 2	PZD-4/4	Drive command and frequency settings Periodic writing of two function parameters Reading of drive state and speed Periodic reading of two function parameters
Standard telegram 3	PZD-6/6	Drive command and frequency settings Periodic writing of four function parameters Reading of drive state and speed Periodic reading of four function parameters
Standard telegram 4	PZD-8/8	Drive command and frequency settings Periodic writing of six function parameters Reading of drive state and speed Periodic reading of six function parameters
Standard telegram 5	PZD-10/10	Drive command and frequency settings Periodic writing of eight function parameters Reading of drive state and speed Periodic reading of eight function parameters
Standard telegram 6	PZD-12/12	Drive command and frequency settings Periodic writing of 10 function parameters Reading of drive state and speed Periodic reading of 10 function parameters
Supplementary telegram	PZD-2/6	Drive command and frequency settings Reading of drive state and speed Periodic reading of 4 function parameters

12.4.5 Data Description

PZD data description

The PZD data is used for the master station to modify and read drive data in real time and perform periodic data exchange. Data communication addresses are directly configured by the drive. The data mainly includes the following:

1. Real-time settings of the drive control command and target frequency
2. Real-time reading of the drive current state and speed
3. Real-time exchange of function parameter and monitoring data between the drive and PROFINET master station

The PZD is used for periodic data exchange between the master station and the drive, as described in the following table.

PZD Sent by the Master		
Drive command	Drive target frequency	Real-Time change of drive function parameter
PZD1	PZD2	PZD3 to PZD12
PZD Responded by the Drive		
Drive status	Drive speed	Real-Time read of drive function parameter
PZD1	PZD2	PZD3 to PZD12

Data sent by the master station

PZD Sent by the Master Station	
PZD1	Drive command word (command source set to "communication")
	01: Forward running 02: Reverse running 05: Coast to stop 06: Decelerate to stop 07: Reset upon fault
PZD2	Drive target frequency (frequency source set to "communication") The frequency reference ranges from -100.00% to +100.00%. When the frequency reference exceeds this range, the frequency reference is not written to the AC drive.
PZD3 to PZD12	The values of function parameters in groups F and A are modified in real time and are not written into EEPROM. FE-02 to FE-11 correspond to PZD3 to PZD12 respectively. For the configuration method, see PZD data configurations.

Drive response data

PZD Responded by the Drive	
PZD1	Drive running state 0: Unknown 1: Forward running 2: Reverse running 3: Stop 4: Auto-tuning 7/8: Fault

PZD2	Drive speed (in rpm) The current drive speed, which is the 16-bit signed data, is returned.
PZD3 to PZD12	Real-time reading of function parameters in groups F and A and monitoring parameters in group U FE-22 to FE-31 correspond to PZD3 to PZD12 respectively. For the configuration method, see PZD data configurations.

For details about the PZD definitions of other drives, see the corresponding AC drive user guides.

12.4.6 Parameter Setting

Set the parameters according to the following table.

Type	Parameter	Value	Description
General-purpose parameters	FD-00	9	Modbus baud rate selection
	FD-01	3	Modbus data format
	FD-04	0s/0.1s	Modbus communication timeout time
Speed control mode	A3-00	0	Set to speed mode
	F0-02	2	Set command source to communication
	F0-03	9	Set frequency source to digital setting
Oil pressure PN mode	A3-00	4	Set to oil pressure PN mode
	F0-02	1	When A3-00 is set to 4, the command source is automatically set to terminal setting. You can change it as needed.
	F0-03	9	When A3-00 is set to 4, the frequency source is automatically set to communication, and no other value can be set.



The communication timeout between the PN card and the drive cannot be detected when FD-04 is set to 0s. Setting FD-04 to a non-zero value triggers error 16.01, requiring a manual reset. You can select as needed.

In the oil pressure PN mode, you must configure the following parameters on the PLC.

PZD configuration for the master station	Object	Parameter Name
PZD3 sent by master	0x7302	Pressure (0.1 bar)
PZD4 sent by master	0x7303	Flow (0.01%)

12.5 CANopen Communication

12.5.1 Introduction

CANopen is a communication protocol and device profile specification for embedded systems used in automation. In terms of the OSI model, CANopen implements the layers above and including the

network layer. The CANopen standard consists of an addressing scheme, several small communication protocols and an application layer defined by a device profile. The communication protocols support network management, device monitoring and communication between nodes, including a simple transport layer for message segmentation/desegmentation. The lower level protocol implementing the data link and physical layers is usually Controller Area Network (CAN).

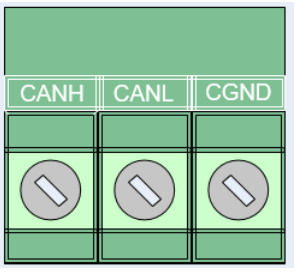
CANopen supports master/slave mode (master to multiple slaves). The address of master/slave node must be unique ranging from 1 to 63. The drive only supports the slave mode.

12.5.2 Hardware Interface and Specifications

Hardware interface

The drive supports CAN communication by default. The terminals are located on the drive enclosure, as shown in the following table.

Table 12–8 Pin connection between the drive and PLC communication cable

Signal name	Terminal Layout
CANH CANL CGND -	

Specifications

Item	Specifications
CAN-ID type	11bit-CAN2.0A
Baud rate	500 bps (default)
	1 bps, 250 bps, 125 bps
	50 bps, 20 bps
Maximum number of stations	63 in the speed mode, or 15 in the oil pressure mode
CAN frame length	0 bytes to 8 bytes
CAN frame type in application layer	Data frame, remote frame
Available profiles	CiA-301 V4.02: CANopen application layer and communication protocol
Services available	NMT: network management system
	SDO: service data object
	PDO: process data object
	Device monitoring: including node protection and heartbeat
	SYNC: including Sync generator and Sync receiver, which is used in PDO transmission
PDO transmission type	Time trigger, event trigger, Sync trigger
Number of supported PDOs	Four RPODs and four TPDOs (RPDO4 cannot be configured by user)
SDO transmission mode	Accelerated SDO transmission supported, segmented SDO transmission not supported

12.5.3 Network Topology

Communication networking

Use the daisy chain mode for CAN bus, as shown in the following figure.

- Shielded twisted pair cables are recommended for connecting the CAN bus. Twisted pairs are recommended for connecting CANH and CANL.
- Connect a 120 Ω termination resistor on each end of the bus to prevent signal reflection.
- Connect the reference grounds of CAN signals of all the nodes (up to 64 nodes) together. Ensure the distance of each node branch is lower than 0.3 m.

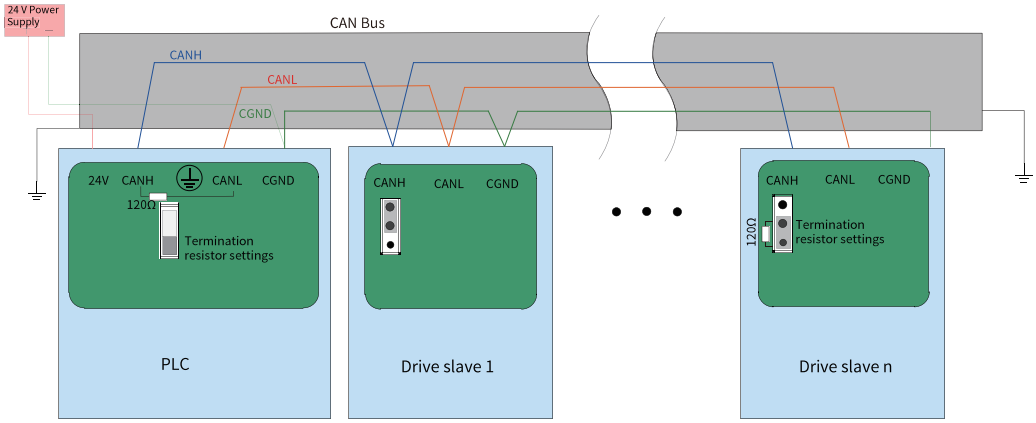


Figure 12-8 CAN bus topology

Transmission distance

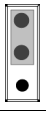
The transmission distance of the CAN bus is directly related to the baud rate and the communication cable. The following table describes the relationship between the maximum bus length and the baud rate.

Table 12–9 Transmission distance and baud rate

Transmission Distance (m)	Transmission Rate (kbps)	Number of Nodes	Cross Sectional Area (mm^2)
25	1024	64	0.205
95	500	64	0.34
560	100	64	0.5
1100	50	64	0.75

Termination resistor settings

Table 12–10 Termination resistor settings

Terminal Mark	Name	Function	Position of the Jumper/DIP Switch	Remarks
J2, J3	CAN termination resistor setting jumper	Matching the termination resistor		The states of J2 and J3 must be consistent.
		Not matching the termination resistor		

Note

The jumper setting is based on the top view with main terminal block at the bottom, which is subject to the jumpers silk-screened on the board.

12.5.4 Parameter Setting

Set the parameters according to the following table.

Parameter	Name	Value	Description
A2-00	CAN baud rate	4	500k
A2-01	CAN communication station no.	1 to 15	-
A3-00	Oil pressure control mode	6	CANopen communication setting
F0-02	Command source	2	Communication

12.5.5 Default RPDO Configuration

By default, the drive receives host controller commands with RPDO1. Mapping objects configure by RPDO1 are PQ control words, multi-pump control words, pressure commands and flow commands. For details, see the following table.

Table 12–11 Configuration of default mapping objects of RPDO1

RPDO1 0x20x x indicates node ID				
	Mapping Object 1	Mapping Object 2	Mapping Object 3	Mapping Object 4
Object Name	PQ control word	Multi-pump control word	Pressure (0.1 bar)	Flow (0.01%)
Object Index	0x2073-01	0x2073-02	0x2073-03	0x2073-04

- **PQ control word**

  The PQ control word contains information on the running modes and drive commands, as shown in the following table. You can set the lower three bits of the PQ control word. For other bits, you can only enter the specified values. You can disable the control word or reset the drive by adjusting the lower three bits.

Table 12–12 Description of PQ control word

Item	15 to 8	7	6	5	4	3	2	1	0
Description of bit	Reserved	1	1	Reserved	Reserved	Reserved	Control word 001: Forward running 010: Reverse running 101: Coast to stop 110: Decelerate to stop 111: Reset upon fault		
Forward running (H00C1)	H00	1	1	0	0	0	001		

Coast to stop (H00C5)	H00	1	1	0	0	0	101
Fault reset (H00C7)	H00	1	1	0	0	0	111

bit5 and bit4 indicate the PID selection. See the following table for details.

bit5	bit4	Corresponding PID selection
0	0	Oil pressure control 1 (A3-05 to A3-07)
0	1	Oil pressure control 2 (A3-11 to A3-13)
1	0	Oil pressure control 3 (A3-14 to A3-16)
1	1	Oil pressure control 4 (A3-17 to A3-19)

- **Multi-pump control word**

  The multi-pump control word is used to set whether the drive works in the master pump or slave pump mode. The control word is a 16-bit unsigned integer. The meaning of each bit is shown in the following table.

Table 12–13 Multi-pump control word

Example	Multi-pump control word															
H0-441	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	-	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1
	-	Master	Master	Master	Master	Slave	Master	Master	Master	Slave	Master	Master	Master	Master	Master	Slave

Note:

1 .Bit0 to bit14 correspond to the drives with NodeID ranging from 1 to 15. If corresponding bit of the multi-pump control word received by the drive is 0, the drive runs in the master pump mode. Otherwise, it runs in the slave pump mode.

2 .Only one master pump can be configured for each slave pump. Failure to comply will result in misoperation.

- **Pressure commands**

  The pressure command is a 16-bit unsigned integer. The minimum unit of the data is 0.1 bar. For details, see the following table.

Table 12–14 Example of pressure commands

Command Data	Description
H01F4 (500)	50.0bar
H03E8 (1000)	100.0bar
H07D0 (2000)	200.0bar

- **Flow commands**

Table 12–15 Example of flow commands

Command Data	Description
H07D0 (2000)	20.00%
H1388 (5000)	50.00%
H2710 (10000)	100.00%

12.5.6 Application example

- **Single master pump mode**
  In the application scenario where only one servo drive is used, the servo drive acts as an independent master pump. Assume that the node ID of the drive is 1, the drive runs forward according to the command of 70 bar and 50% flow, and the host controller uses the default RPDO1 configuration. The RPDO1 data sent by the host controller are as follows.

Table 12–16 Single master pump operation

COB-ID	PQ control word	Multi-pump control word	Pressure (0.1 bar)	Flow (0.01%)
201	H00C1	H0000	H02BC (700)	H1388 (5000)

- **Single-master and multi-slave operation**
  Assume that there are 3 drives whose Node Ids are 1, 2 and 3, and you want to set No. 1 as the master and No. 2 and 3 as the slaves which follow the master. The pressure and flow references are 70 bar and 50% respectively. The following table lists the RPDO1 messages sent by the host controller to each drive.

Table 12–17 Example of single-master and multi-slave mode

COB-ID	PQ control word	Multi-pump control word	Pressure (0.1 bar)	Flow (0.01%)
201	H00C1	H0006	H02BC (700)	H1388 (5000)
202	H00C1	H0006	H02BC (700)	H1388 (5000)
203	H00C1	H0006	H02BC (700)	H1388 (5000)

- **Multi-master and multi-slave operation**
  Assume that there are 4 drives whose Node Ids are 1, 2, 3 and 4, and you want to set No. 2 as a slave, which follows No. 1, and No. 3 as a slave, which follows No. 4. The pressure and flow references are 70 bar and 50% respectively. The following tables show the RPDO1 messages sent by the host controller to the 4 drives.

Table 12–18 RPDO1 messages received by No. 1 and 2

COB-ID	PQ control word	Multi-pump control word	Pressure (0.1 bar)	Flow (0.01%)
201	H00C1	H0002	H02BC (700)	H1388 (5000)
202	H00C1	H0002	H02BC (700)	H1388 (5000)

Table 12–19 RPDO1 messages received by No. 3 and 4

COB-ID	PQ control word	Multi-pump control word	Pressure (0.1 bar)	Flow (0.01%)
203	H00C1	H0004	H02BC (700)	H1388 (5000)
204	H00C1	H0004	H02BC (700)	H1388 (5000)

Note

The references of the same group of master/slave pumps are the same. When multiple groups of master/slave pumps exist in the network, the multi-pump control word of each group of master/slave pump is different.

Each slave pump can only be configured with one master pump. Failure to comply can lead to slave pump operation error.

12.5.7 PLC Parameter Configuration

TPDO1 and TPDO2 transmission time

TPDO1 trigger 0x1800/TPDO2 trigger 0x1801			
Sub-index	Description	Default value	Unit
3	Inhibit time	500 (50 ms)	100 us
5	Event time	150 (150 ms)	1 ms

Index of common monitoring data objects

Object index	Description	Min. unit	Description
0x2071-03	Hydraulic pressure feedback	0.1 kg/cm^2	-
0x2071-04	Motor speed	rpm	-
0x2070-05	Output current	0.1 A	-
0x2070-07	Output torque	0.1%	-
0x2070-06	Output power	0.1 kW	-
0x2070-0E	Output voltage	V	-
0x2073-0F	Fault code	-	The high 8 bits indicate the fault code, and the low 8 bits indicate the fault subcode.
0x2070-03	Bus voltage	0.1 V	-

Heartbeat protection

Heartbeat consumption time 0x1016		
Sub-index	Default value	Description
Sub1	0x007F012C	12C indicates 300 ms. If the drive does not receive the master heartbeat message within 300 ms, Error 42.11 is reported.

RPDO1 communication time setting

RPDO1 time setting 0x1400			
Sub-index	Description	Default value	Unit
3	Inhibit time	30 (3 ms)	100 us
5	Event time	10 (10 ms)	1 ms

EDS file

Contact Inovance technical support to get the EDS file.

Note

Improve the PDO transmission cycle to 2 ms to improve the responsiveness of the drive when the network load is not high.

To support the multi-pump function, RPDO4 in the PDO has been used. Do not use this PDO as it does not accept external configuration modification.

13 Routine Maintenance

13.1 Daily Maintenance

13.1.1 Daily Checklist

The ambient temperature, humidity, dust, and vibration will cause aging of components inside the drive, which leads to potential faults and shortens the service life of the drive. Therefore, routine maintenance on the device is required. The maintenance interval must be shortened when the drive is used in environments suffering from high ambient temperature, frequent startup and stop, violent fluctuation in the AC power supply and the load, strong vibration or shock, and intrusive and corrosive substances such as dust, metal dust, and hydrochloric acid.

Check the following items daily to ensure a proper operation of the product. It is recommended to make a copy of this checklist and sign the "Checked" column after each inspection.

Item	Description	Solution	Result
Motor	The motor encounters unusual vibration and noise.	• Ensure mechanical connections are normal. • Ensure no phase loss occurs on the motor. • Check whether motor screws are tightened.	□
Cooling fan	Check whether the fans of the drive and the motor work properly.	• Ensure the fan on the device side operates normally. • Ensure the fan on the device side operates normally. • Ensure the ventilation channel is not blocked. • Ensure that the ambient temperature is within the allowable range.	□
Installation Environment	The control cabinet and cable ducts are abnormal.	• Check that the insulation of the inlet/outlet cable is intact. • Check that the mounting bracket does not vibrate. • Check that the copper busbar and cable terminals are connected properly or are not corroded.	□
Load	The operating current of the drive exceeds the rated current of the drive and motor.	• Ensure motor parameters are set properly. • Ensure motor overload does not occur. • Ensure that the mechanical vibration is below 1 g.	□
Input voltage	The supply voltage between the main circuit and control circuit is abnormal.	• Ensure that the input voltage is within the allowable range. • Check that no heavy loads are starting nearby.	□

13.1.2 Daily Cleaning Items

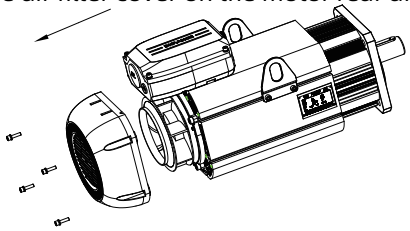
Perform routine cleaning according to the following table.

Table 13–1 Routine cleaning list

No.	Daily Cleaning Items	Tick
1	Clean the dust on the equipment surface, especially the metallic dust.	☐
2	Clean the air filter and the fan blades.	☐
3	Keep the front end of the servo drive and the connectors clean.	☐

The following takes the motor as an example to describe how to clean the air filter and fan blades.

- Remove the bolts used to fix the air filter cover on the motor rear and take off the cover.



- Use a piece of cloth dipped with alcohol to wipe the fan blades. Use an air gun to blow off the dust inside the air filter on the front cover side. After clean-up, re-install the air filter cover.

Note

- Cut off the power supply before cleaning. Clean the equipment with an air gun or a piece of dry cloth.
- Do not use the gasoline, diluent, alcohol, acidic or alkaline detergent during cleaning to prevent enclosure discoloration or damage.
- In application sites where cotton fibers and objects with high absorptivity can be easily attracted to the drive, such as shoe machineries and textile machineries, clean the air filter at least once every 31 days.

13.2 Periodic Maintenance

13.2.1 Periodic Checklist

Perform periodic inspection on items that are difficult to check during operation. Clear the dust especially metal powders on the surface of the drive to prevent the dust from entering the drive. Clear the greasy dirt from the cooling fan of the drive.

Caution

- To prevent electric shock, never perform inspection at power-on.
- Before inspection, disconnect all the power supplies and wait for at least 10 minutes to avoid risks caused by the residual voltage in the capacitor of the drive.

Item	Description	Precautions	Checked
Drive	There are waste, dirt, or dust on the surface.	• Ensure the controller cabinet is powered off. • Use a vacuum cleaner to suck up waste and dust to prevent direct contact with the parts. • For stubborn surface dirt, wipe up the dirt with a piece of soft cloth immersed in alcohol.	☐
Cable	• Power cables and connections are discolored. • The insulation is aged or cracked.	• Replace the cracked cables. • Replace the damaged terminal.	☐
Peripheral components of the electromagnetic contactor	• The contactor cannot be closed tightly or generates unexpected noise during operation. • Short circuit, water stain, expansion or cracking occurs on any peripheral device.	Replace such defective components.	☐
Air duct	• The air duct and heatsink are clogged. • The fan is damaged.	• Clean the air duct. • Replace the fan.	☐
Control circuit	• Control components are in poor contact. • Terminal screws are loose. • The insulation of the control cable is cracked.	• Clean the surface of control circuit cables and terminals. • Replace control circuit cables that are damaged or corroded.	☐

13.2.2 Regular Maintenance

The electrical and electronic parts inside the drive may be mechanically worn out and degraded. To keep the drive and servo motor in good condition, perform parts replacement based on the following table. Contact Inovance or Inovance agent before replacement to double check whether the part needs to be replaced.

Target	Category	Standard replacement interval	Remarks
Drive	Bus filter capacitor	About five years	The standard replacement cycle is for reference only. If any device/component works improperly before the replacement cycle expires, replace it immediately.
	Cooling fan	2 to 3 years (10,000 h to 30,000 h)	
	Aluminum electrolytic capacitor on the PCB	About five years	
	Pre-charge relay	100,000 operations (depending on the operating conditions)	
	Pre-charge resistor	20,000 operations (depending on the operating conditions)	
Motor	Bearing	3 to 5 years (20,000 h to 30,000 h)	
	Cooling fan	30000 h	
	Oil seal	5000 h	
	Encoder	3 to 5 years (20,000 h to 30,000 h)	

13.3 Components Replacement

13.3.1 Replacing the Cooling Fan

Number of fans

- The fan may be damaged due to worn-out bearing or aging blades.
- How to determine whether the fan needs to be replaced: (1) Check for signs of cracks on the blade. (2) Check for unexpected noise upon start. (3) Check whether the blade works properly.
- How to replace the fan: Press down the snap-fit joint of the fan cover and pull the fan outward. After replacing the fan, ensure the fan blows the air upward.

Table 13–2 Number of fans (three-phase 380 V to 480 V)

Category	Model	Cooling fan
Drive	T3 and T4	2
	T5 and T6	1
	T7-55 kW	1
	T7-75 kW	2
	T8	2
Motor	MEG20 and MEG23	1

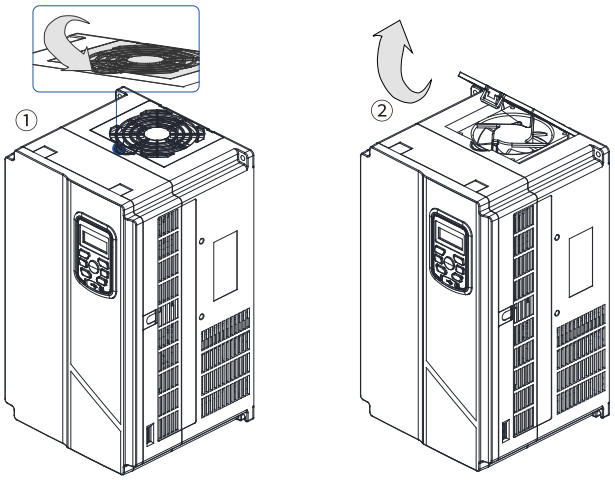
Note

The number and location of cooling fans vary with product models, but the fans are removed and installed in the same way.

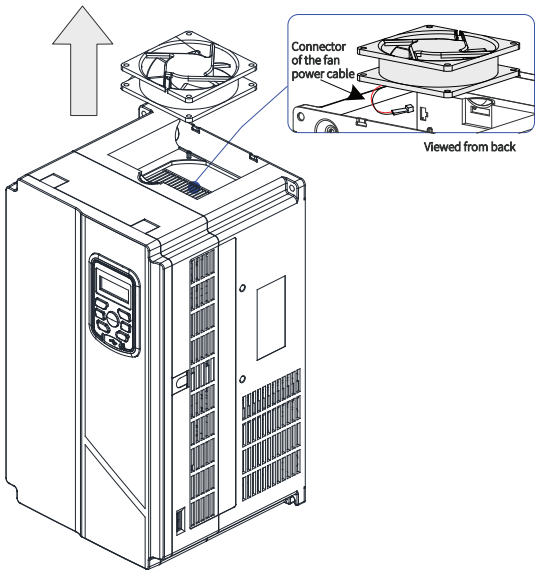
Removing and installing the fan of T3 to T6 models

Removing the fan (T6 as an example)

Step 1. Press the snap-fit joint on the fan cover and remove the cover.



Step 2. Pull the fan upwards and unplug the power cable connector from the socket.

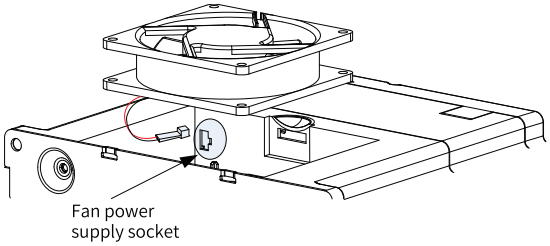


Installing the fan (T6 as an example)

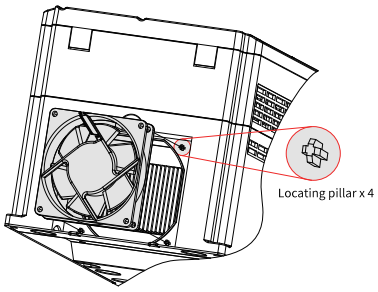
Note

- Install the fan in the reverse order of removal and ensure the correct direction of the fan.
- The fan should rotate clockwise to blow air into the motor air duct when viewed from the rear cover of the fan.

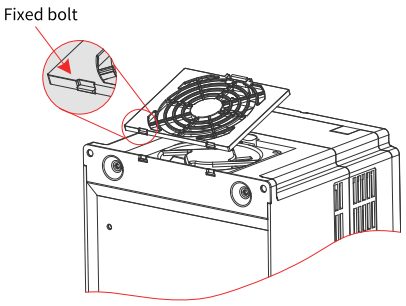
Step 1. Plug in the fan power cable plug into the socket.



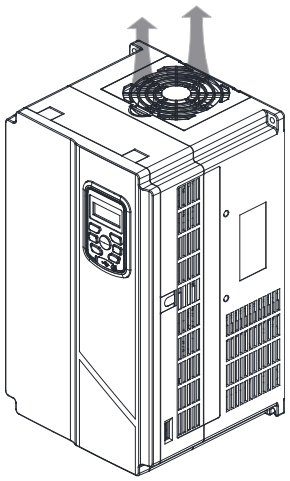
Step 2. Place the fan into the drive, with the four fixing holes at the bottom of the fan aligned to the positioning pins on the drive.



Step 3. Insert the two small snap-fit joints on the fan cover into the slot and then press down to fix the snap-fit joints.



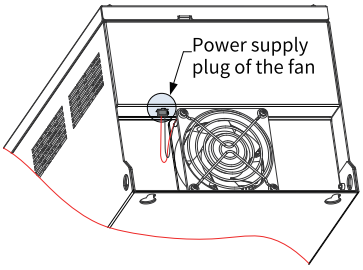
Step 4. After replacing the fan, ensure the fan blows the air upward.



Removing and installing the fan of T7 to T8 models

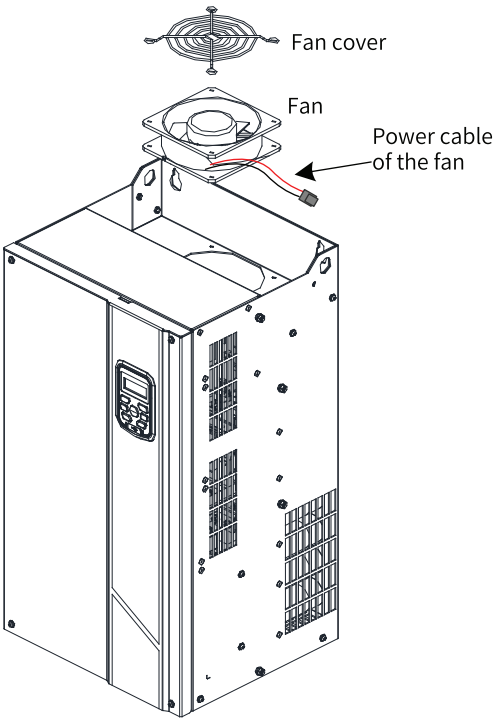
Removing the fan (T7 as an example)

Step 1. Unplug the fan power cable plug from the socket (top view).



Step 2. Remove the four fixing screws from the fan cover with a screwdriver.

Step 3. Remove the fan and fan cover from the drive.



Installing the fan (T7 as an example)

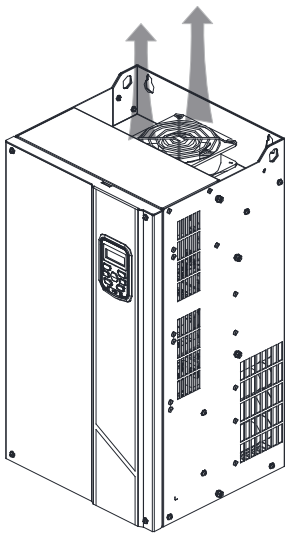
Note

- Install the fan in the reverse order of removal and ensure the correct direction of the fan.
- The fan should rotate clockwise to blow air into the motor air duct when viewed from the rear cover of the fan.

Step 1. Install the fan and fan cover into the AC drive. Align the mounting holes of the cooling fan with the mounting holes of the AC drive.

Step 2. Plug in the fan power cable plug into the socket.

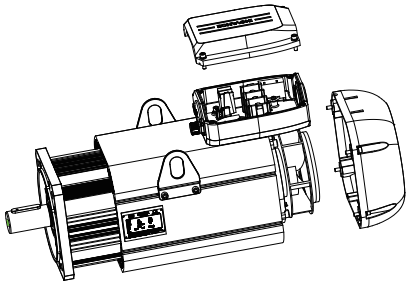
Step 3. After replacing the fan, ensure the fan blows the air upward.



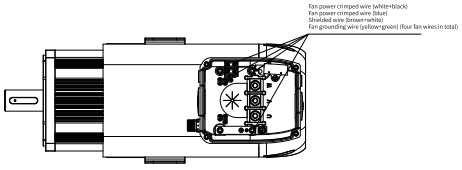
Removing and installing the motor fan

Removing the fan

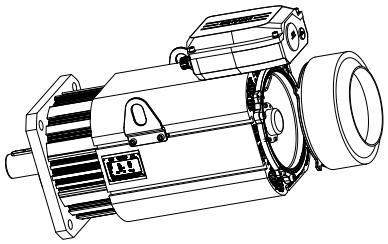
Step 1. Remove the cover of the junction box and the rear cover of the fan with a hexagon wrench.



Step 2. Remove the power crimping cables (white+black/blue), shielded cable (brown+white), and grounding cable (yellow-green) of the fan.



Step 3. Remove the cover of the fan with a hexagon wrench.



Step 4. Remove the fan with a hexagon wrench and pull the fan cable out through the cable outlet hole.

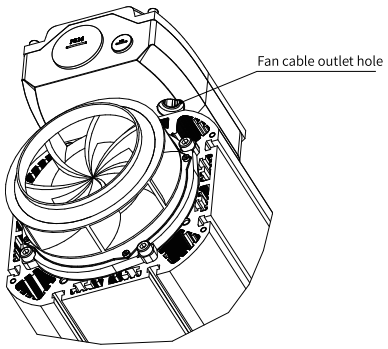
Installing the fan

Note

- Install the fan in the reverse order of removal and ensure the correct direction of the fan.
- The fan should rotate clockwise to blow air into the motor air duct when viewed from the rear cover of the fan.

Step 1. Install the fan to the fan cover.

Step 2. Pass the fan cable through the fan cable outlet hole of the junction box, and then install the fan cover to the rear end cover.



Step 3. Lock the power crimping cables (white+black/blue) to the power terminals of the fan. Crimp the shielded cable (brown+white) and lock the shielded cable and the grounding cable (yellow-green) of the fan to the grounding plate.

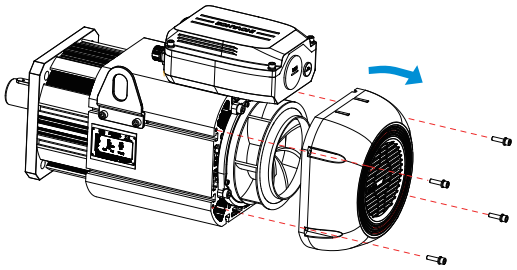
Step 4. Finally, lock the junction box cover and the rear cover of the fan.

Cleaning the fan

The estimated lifetime of the fan is 40,000 hours (operating at full speed under rated voltage and ambient temperature of 40℃). During operation, dusts or similar can be attracted to the fan,

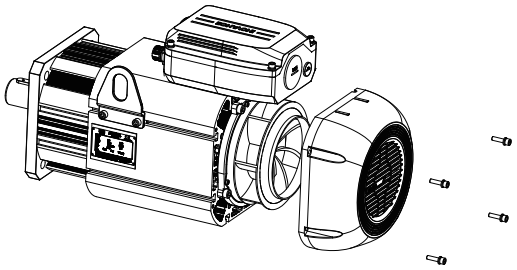
affecting the cooling effect. Err45 will be reported when the temperature of the motor winding exceeds the overtemperature protection threshold.

Step 1. Remove the four M6 bolts with equal height (GB/T 5281-85) on the rear part of the motor. These bolts are used to fix the rear cover of the fan.



Step 2. After taking off the rear cover of the fan, clean the unwanted objects on the surface of the fan with a small straight screwdriver and use an air gun to blow the fan surface finally.

Step 3. Install the rear cover of the fan in place after cleaning and fix the cover with original screws.



13.3.2 Replacing the Electrolytic Capacitor

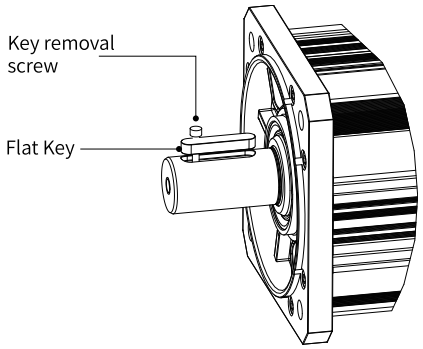
- The possible causes for capacitor damage include unstable input power supply, high ambient temperature, frequent load jump, and aging electrolyte.
- To determine whether the capacitor needs to be replaced, check whether there is liquid leakage or whether the safety valve has protruded. You must also measure the static capacitance and the insulation resistance.
- As the filter capacitor involves the internal parts, do not replace the capacitor by yourself. Contact Inovance for replacement.

13.3.3 Removing the Motor Flat Key

The motor flat key is equipped with the disassembly hole. See the following table for specifications of the disassembly bolt.

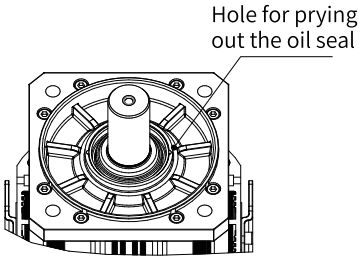
Motor specifications	Dimensions of the flat key	Specifications of the disassembly bolt (Inner hexagon bolt)
MEG20	Type-A flat key - 8 x 12 x 56	M5 x 10 and above
MEG23	Type-A flat key - 9 x 14 x 90	M5 x 10 and above

Screw down the disassembly bolt into the disassembly hole to push the flat key out.



13.3.4 Removing the Motor Oil Seal

1. When removing the oil seal, put a piece of cloth near the hole where the oil sealing is pried out. This is to prevent the end cover from being scratched.
2. Secure the motor properly and hold the outer lip of the oil seal with either end of the needle-nose pliers. Then pry out either or both holes for removing the oil seal, as shown below.



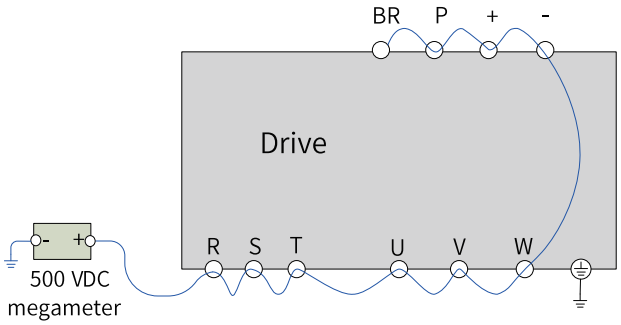
3. Pry out the oil seal slowly.

13.4 Main Circuit Insulation Test

Danger

Do not perform high voltage test (> 500 V) again because it has been done before delivery.

- Remove the voltage dependent resistor screw before test and disconnect the voltage dependent resistor.
- Before measuring the insulation resistance with a megameter (500 VDC megameter recommended), disconnect the main circuit from the drive. Do not test the main circuit insulation with the insulation resistance meter, as shown in the following figure.



- The measured insulation resistance must be higher than 5 MΩ.

13.5 Storage and Repair

Storage

For temporary and long-term storage of the drive, observe the following precautions:

- Try to store the system with the original packing carton of the company.
- Do not expose the drive to environments with moisture, high temperatures, or direct sunlight for a long time.
- The electrolytic capacitor will deteriorate after long-term storage. Therefore, switch on the drive once for at least 5 hours every 6 months. Increase the input voltage slowly to the rated value by using a voltage regulator. Contact Inovance for technical support if necessary.

Warranty

The warranty covers the drive only.

Inovance provides an 18-month warranty to the equipment from the date of shipment (subject to the barcode on the AC drive or contract if there is any) for failure or damage that occurs under normal use. When the warranty period expires, reasonable maintenance fee will be charged.

Within the warranty period, maintenance will be charged in the following cases:

- Damage caused by operations not following the instructions in the user guide
- Damage caused by fire, flood, abnormal voltage, or other disasters
- Damage caused by unintended use of the equipment
- Damage caused by use outside the specifications
- Damage caused by force majeure (natural disaster, earthquake, and lightning strike) and second damage caused thereof

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

For details, see *Product Warranty Card*.

14 Solutions to Common EMC Problems

14.1 Leakage Current Suppression

The drive outputs high-speed pulse voltage, which may easily incur high-frequency leakage current. The leakage current generated by the drive can exceed 100 mA. Therefore, the rated action current of the residual current device must be above 100 mA. Use a B-type (delay-time) RCD because the drive may generate DC leakage current in the protective conductor.

If multiple drives are required, each drive must be installed with a residual current device. The factors that affect the leakage current are as follows:

- Capacity of the drive
- Carrier frequency
- Type and length of motor cable
- EMI filter

When the leakage current causes the residual current device to act, you must:

- Increase rated action current of the residual current device.
- Replace the residual current device with a new one that carries high-frequency suppression function and is B-type (delay-time).
- Reduce the carrier frequency.
- Shorten the length of the drive output cable.
- Install a leakage current suppression device.
- Recommended ELCB manufacturers are Siemens and Schneider.

14.2 Residual Current Device (RCD)

When the earth leakage circuit breaker (ELCB) malfunctions, perform troubleshooting according to the following table.

Table 14–1 Solution for leakage current

Trip	Possible cause	Solution
Tripped upon power-on	The anti-interference performance of the ELCB is poor.	1. Use a RCD of a recommended brand. 2. Use a RCD with a higher action current. 3. Move the unbalanced load to the front end of the ELCB. 4. Remove the EMC screw or disconnect the grounding terminal of the external EMC filter to reduce the capacitance of the input end to the ground.
	The action current of the ELCB is too low.	
	Unbalanced load is connected to the back end of the ELCB.	
	The capacitance of the front end of the servo drive is too high.	
Tripped during operation.	The anti-interference performance of the ELCB is weak.	1. Use a RCD of a recommended brand. 2. For an individual drive, ensure the EMC screw has been screwed down. For multiple drives, disconnect the selective EMC grounding screw, as shown in *"Figure 14-1" on page 215* . 3. Install a simple filter on the input side of the drive, and wind the LN/RST cables through a magnetic ring near the RCD, as shown in *"Figure 14-2" on page 216* . 4. Use a RCD with a higher rated tripping current. 5. Reduce the carrier frequency while ensuring performance. 6. Use shorter motor cables.
	The action current of the ELCB is too low.	
	Unbalanced load is connected to the back end of the ELCB.	
	For motor cables and the motor, the distributed capacitance to ground is too high.	

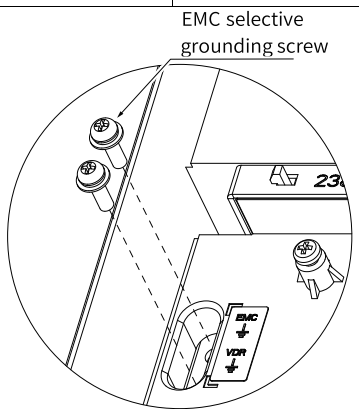


Figure 14-1 Disconnecting the selective EMC grounding screw

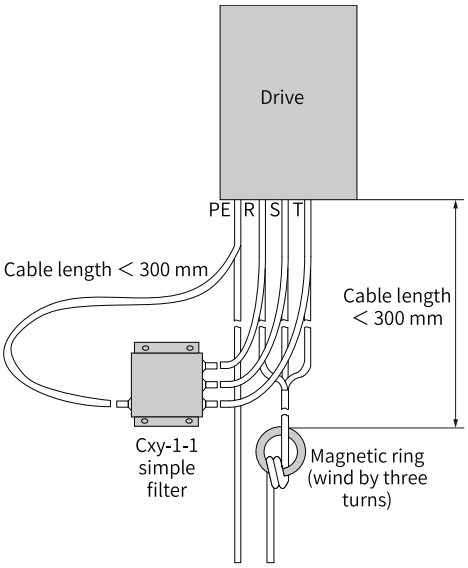


Figure 14-2 Installing a simple filter and magnetic ring on the input side

14.3 Harmonic Suppression

To suppress high-order harmonics of the drive and improve the power factor, install an AC input reactor on the input side of the drive to meet standard requirements.

14.4 Control Circuit Interference

14.4.1 High-Speed Pulse Interference

In the case of interference, take the following rectification measures.

Step	Solution
1	Use shielded twisted pair cables and ground the cables at both ends.
2	Connect the motor enclosure to the PE terminal of the drive.
3	Connect the PE terminal of the drive to the PE terminal of the power grid.
4	Add an equipotential bonding grounding cable between the host controller and the drive.
5	Separate signal cables from power cables with a distance of at least 30 cm.
6	Add a ferrite clamp to the signal cable, or add a magnetic ring and wind the signal cable through the magnetic ring for one to two turns.
7	Wind the magnetic ring around UVW cables of the drive by two to four turns.
8	Use a shielded power cable and properly ground its shield.

The drive generates strong interference during operation, which may interfere with other devices due to improper cabling or grounding. When the drive disturbs or is disturbed by other devices, adopt the following measures.

Step	Solution
1	Use shielded I/O signal cables with the shield connected to the PE terminal.
2	Connect the PE terminal of the motor to the PE terminal of the drive, and connect the PE terminal of the drive to the PE terminal of the power grid.
3	Add an equipotential bonding grounding cable between the host controller and the drive.
4	Wind the magnetic ring around UVW cables of the drive by two to four turns.
5	Increase the capacitor filtering of the low-speed DI, with a recommended maximum value of 0.1 μF.
6	Increase the filtering capacitance of the AI. The recommended maximum value is 0.22 uF.
7	Wind the signal cable around a ferrite clamp or magnetic ring by one or two turns.
8	Use shielded power cables with the shield grounded properly.

14.5 Communication Interference

14.5.1 RS485 and CAN Communication Interference

In the case of interference, take the following rectification measures.

Step	Solution
1	Install a 120 Ω termination resistor at both ends of the bus.
2	Use multi-conductor shielded twisted pair cables and ground the shield at both ends.
3	Separate communication cables from power cables with a distance of at least 30 cm.
4	Adopt the daisy chain mode for multi-node communication.
5	For multi-node communication, add an equipotential bonding grounding cable between nodes.
6	Add a ferrite clamp at both ends of the communication cable or add a magnetic ring at both ends of the communication cable and wind the communication cable through the magnetic ring for one to two turns.
7	Wind the magnetic ring around UVW cables of the drive by two to four turns.
8	Use a shielded power cable and properly ground its shield.

14.5.2 PROFINET Communication Interference

In the case of interference, take the following rectification measures.

No.	Step
1	Check that the communication network cables meet the specification requirements for shielded Cat 5e cables.
2	Check that the communication port is secure and in good contact.
3	Separate communication cables from power cables with a distance of at least 30 cm.
4	For multi-node communication, add an equipotential bonding grounding cable between nodes.
5	Check that the cable between two nodes is no longer than 100 m in length.

No.	Step
6	Install the ferrite clamp on both sides of the communication cable and wind the cable around the ferrite clamp by one or two turns.
7	Wind the magnetic ring around UVW cables of the drive by two to four turns.
8	Use a shielded power cable and properly ground its shield.

14.6 Encoder Feedback Signal Error

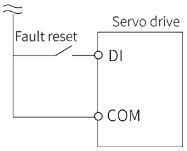
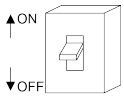
In the case of interference, take the following rectification measures.

No.	Step
1	Route encoder cables and power cables through different routes.
2	When the drive is routed far away from the motor (motor cable of 10 m), disconnect the selective grounding screw of the control board.
3	Install the magnetic ring or ferrite clamp near the encoder signal cable.
4	Wind the magnetic ring around UVW cables of the drive by two to four turns.
5	Use a shielded power cable and properly ground its shield.

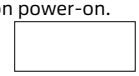
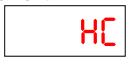
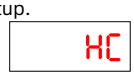
15 Troubleshooting

15.1 Drive Restart upon Faults

Table 15–1 Restart methods upon occurrence of faults

Stage	Corrective Action	Remarks
In fault status	Check the keypad for detailed information of the five latest faults, such as the fault time, fault type, speed, current, bus voltage, and DI/DO state upon occurrence of the fault.	Check these information through F8-36 to F8-57 and F9-18 to F9-50.
Before reset	View the fault cause and rectify the fault according to the fault type displayed on the operating panel.	Troubleshoot the fault according to section *"15.3 List of Fault Codes" on page 221*.
Fault reset methods	1) Assign function 9 (Fault reset) to a DI by setting any of F4-00...F4-09 to 9.	
	2) Confirm F7-02 is set to 2 (Default value), indicating the fault can be reset by pressing  in any operation mode.	Press the stop/reset key.
	3) Reset the fault by restarting the drive. Disconnect the main circuit power supply. Wait until the fault code disappears, and then connect the power supply again.	
	4) Reset the drive through communication. Write "7" (Fault reset) to the communication address 2000H through the host controller.	

15.2 Solutions to Common Faults

No.	Fault symptom	Possible cause	Solution
1	There is no display upon power-on. 	The drive is not connected to the grid or the grid voltage is too low.	Check the input power supply.
		The switched-mode power supply (SMPS) on the driver board of the drive is faulty.	Check the bus voltage.
		The cable connecting the control board and the drive board and the operating panel is broken.	Re-connect the 8-pin wire and 40-pin wire.
		The pre-charge resistor of the drive is damaged.	Contact Inovance for technical support.
		The control board or the operating panel is faulty.	
		The rectifier bridge is damaged.	
2	"HC" is displayed upon power-on. 	The cable connecting the drive board and the control board is in poor contact.	Re-connect the 8-pin wire and 40-pin wire.
		Related components on the control board are damaged.	Contact Inovance for technical support.
		The motor or the motor cable is short-circuited to ground.	
		Hall sensor fault	
		The grid voltage is excessively low.	
3	The display is normal upon power-on, but "HC" is displayed and the drive stops immediately after startup. 	The cooling fan is damaged or does not rotate.	Replace the fan.
		The peripheral control terminal is short-circuited.	Eliminate the external short-circuit fault.
4	The motor does not rotate when the servo drive is running.	The motor is improperly connected.	Confirm that the drive and motor are properly connected.
		Motor parameters of the drive are set incorrectly.	Restore to factory settings and reset related parameters correctly. Check whether encoder parameters and rated motor specifications (such as rated motor frequency and rated motor speed) are set properly. Check that F0-02 (operation mode) is set properly.
		The cable connecting the drive board and control board is in poor contact.	Re-connect the cable to ensure it is connected securely.
		The driver board is faulty.	Contact Inovance for technical support.

No.	Fault symptom	Possible cause	Solution
5	DI terminals are deactivated.	Parameters are set improperly.	Check and set the parameters in group F4 again.
		The external signal is incorrect.	Re-connect the external signal cable.
		The J1 jumper is incorrect.	Check that the J1 jumper is set in accordance with the actual wiring.
		The control board is faulty.	Contact Inovance for technical support.
6	The servo drive reports overcurrent and overvoltage frequently.	Settings of the motor parameters are incorrect.	Set the motor parameters again or perform motor parameter auto-tuning.
		The acceleration/deceleration time is improper.	Set a proper acceleration/deceleration time.
		The load fluctuates.	Contact Inovance for technical support.
7	The pre-charge resistor is burned out.	Check whether the lead wire of the braking resistor is bonded with the metal housing (short-circuited to PE).	Improve the insulation of the braking resistor outlet cable, for example, by wrapping electrical tape.
		The braking transistor is damaged.	Replace the braking transistor.
		The bus capacitor is burned out due to a short circuit.	Replace the bus capacitor.
		The negative bus is short-circuited to the ground.	Remove the fault.

15.3 List of Fault Codes

The following faults may occur during operation of the drive. Analyze the fault according to the following methods (subcodes that are not listed are not necessary).

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
2	Overcurrent	1	Phase W overcurrent fault	There are hardware overcurrent and software overcurrent faults. Hardware overcurrent: The instantaneous output current exceeds 2.5 x 1.414 x rated current of the drive. Phase W software overcurrent: The instantaneous output current of phase W exceeds the software overcurrent threshold.	Ground fault or short circuit exists in the output circuit.	1. Check whether the drive is grounded properly and whether disturbance exists. 2. Check whether the encoder speed feedback is normal. 3. Check the acceleration time (F0-17). 4. Check if the power ratings of the motor and drive are too low.	Rectify peripheral faults.
		2	Phase U overcurrent fault	The instantaneous output current of phase U exceeds the software overcurrent threshold.	Ground fault or short circuit exists in the output circuit.	Check whether the motor or contactor is short-circuited, check the value of F0-17 (acceleration time), and check whether the power ratings of the motor and drive are too low.	Rectify peripheral faults.
		3	Phase V overcurrent fault	The instantaneous output current of phase V exceeds the software overcurrent threshold.	Ground fault or short circuit exists in the output circuit.	Check whether the motor or contactor is short-circuited, check the value of F0-17 (acceleration time), and check whether the power ratings of the motor and drive are too low.	Rectify peripheral faults.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
2	Overcurrent	4	d-/q-axis current overflow	D/Q-axis current reaches the overcurrent threshold.	Abnormal current feedback causes overflow of the internal register in the drive.	Check whether the current upon the fault reaches the overcurrent threshold by viewing the fault log. If not, the fault is possibly caused by external interference. Find out the external interference source and rectify the fault. If there is no external interference, the cause may be damage of the driver board or Hall device. In this case, contact the manufacturer for replacement.	1. Set motor parameters in group F1 according to the motor nameplate and perform motor parameter auto-tuning. 2. Increase the acceleration/ deceleration time. 3. Start the motor after it stops. 4. View the fault records. If the current upon the fault is far lower than the overcurrent threshold, find out the interference source. If no interference exists, the driver board, Hall device, Hall cable, or control board may be faulty.
		5	Braking overcurrent	Braking transistor overcurrent	Resistance of braking resistor excessively low	Check whether the bus voltage before the fault is higher than the braking transistor voltage (760 V).	1. Power off and remove the braking resistor, and then power on again. 2. If the fault is cleared, the braking circuit is faulty, which is normally indicated by a low resistance (short circuit) of the braking resistor and the enclosure. In this case, replace the braking resistor. 3. If the fault persists, the braking transistor circuit is normal and the motor control loop is faulty. In this case, check the causes for other overcurrent faults.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
5	Bus overvoltage	0	Bus overvoltage	1. The motor runs and energy returns, causing the bus voltage to rise. 2. The input voltage is abnormal.	The input voltage is excessively high.	Measure the input voltage with a multimeter and check whether the value is greater than the overvoltage threshold.	Adjust the voltage to a value within the normal range.
					An external force drives the motor during operation.	Check whether the motor is driven by an external force.	Remove the external force or install a braking resistor.
					The acceleration time or deceleration time is too short.	Connect the software tool and check whether the acceleration time is excessively short.	Increase the acceleration time (F0-17) or deceleration time (F0-18).
					No braking unit or braking resistor is installed.	Check whether a braking unit and a braking resistor are installed.	Install a braking unit and a braking resistor.
					The motor is short-circuited to the ground.	Check whether the ground impedance is normal.	If the motor is short-circuited to ground, which forms a BOOST circuit, overvoltage may occur. In this case, check whether the output cables of the drive or the motor is short-circuited to ground.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
8	Pre-charge resistor fault	0	Pre-charge resistor fault	The counter is used to count the number of bus voltage fluctuations without thorough power-off within a period of time. An alarm is reported if the bus voltage is approaching and higher than the undervoltage threshold for five times. If the voltage resumes normal, the counter decreases by 1 for each minute until the value reaches 0. If the voltage fluctuates again, the counter starts counting again, and an alarm is reported when the number reaches 5.	The pre-charge resistor is opened and closed frequently within a short period of time.	1. Check whether the input grid voltage or power supply is between 342 VAC and 418 VAC. 2. Confirm that the input power supply does not power on or off repeatedly.	Contact Inovance for technical support.
9	Undervolt age fault	0	Undervolt age fault	1. The contactor is not closed due to faults. 2. The input voltage is abnormal, causing the bus voltage to fall below the undervoltage threshold.	The input voltage is excessively low.	Check whether the input power grid or power supply is within the normal range: three-phase 380 V to 480 V, -15% to +10%.	Adjust the voltage to a value within the normal range.
					The rectifier bridge, pre-charge resistor, driver board, or control board is abnormal.	1. Use a multimeter to check whether the DC bus voltage RMS value is approximately 1.414 x input voltage RMS value. 2. Check whether the bus voltage of the drive matches the bus voltage measured by the multimeter.	Contact Inovance for technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
10	Drive overload	0	Drive overload	The drive is considered to be overloaded when the overload time is reached based on the overload curve of the drive.	The load is too heavy.	1. Check whether the load (output current) is excessive during normal operation. 2. When an overload fault occurs, check whether the motor is stalled (the motor is not rotating).	Reduce the load and check the motor and mechanical conditions.
					The drive power rating is low.	The AC drive power is lower than the motor power.	Replace the drive with a drive of higher power rating.
12	Input phase loss	0	Hardware input phase loss	If the input phase loss signal is active, the input phase loss occurs.	Phase loss occurs to the input three-phase power supply.	Check the input RST wiring and whether the three-phase input voltage is normal.	Check and eliminate the problems in the peripheral circuits.
		1	Input phase loss occurs on the software.	To diagnose input phase loss, use the following methods: 1. Disconnect three-phase drive power supply. Then monitor the number of PL high-level states occurring within 30 ms in the main cycle. 2. Disconnect one phase at a time. Then use the FPGA to detect the VRS and VRT phase voltage.	The driver board, lightning protection board, main control board, or rectifier bridge is faulty.	Check whether the driver board, lightning protection board, main control board, and rectifier bridge is normal.	Contact Inovance for technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
13	Output phase loss	0	Output phase loss	The average value of three-phase output current is detected when the operating frequency is higher than 0.8 Hz. The ratio of the maximum phase output current to the minimum phase output current is larger than 10.	The motor is faulty.	Check whether motor phases U, V, and W are disconnected.	Check whether open circuit occurs on the motor.
					The lead wire connecting the drive and the motor is abnormal.	Check whether the lead wire from the output phase U, V, and W of the drive to the motor is normal.	Rectify peripheral faults.
					The three-phase outputs of the drive are unbalanced during operation of the motor.	Check whether the effective values of the three-phase output currents of the drive are consistent.	Check whether the motor three-phase winding is normal. If not, rectify the fault.
					The driver board or IGBT module is faulty.	If the fault persists after preceding causes are rectified, the driver board and IGBT module are abnormal.	Contact Inovance technical support.
14	Drive overtemperature	0	Drive overtemperature	The heatsink temperature exceeds the overtemperature threshold, leading to a drive overheat fault.	The ambient temperature is too high.	1. Check whether the ambient temperature exceeds 40℃. 2. Check whether derating is needed for temperatures between 40℃ and 50℃ (derate 1.5% for every additional 1℃).	Lower the ambient temperature.
					The air duct is blocked.	Check whether the air duct is blocked.	Clean the air duct.
					The fan is damaged.	Check whether the fan stops running.	Replace the fan.
					The thermistor of the module is damaged.	Stop the drive for more than 1 h and check whether the temperature increases or stays unchanged.	Replace the thermistor.
					The IGBT module is damaged.	Check whether the inverter is damaged.	Replacing the Inverter
		1	NTC signals disconnected	Check whether the AD sampling value is out of range.	NTC signals disconnected	Stop the drive for more than 1 h and check whether the temperature increases or stays unchanged.	Contact Inovance technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
15	External device fault	0	External Faults	This DI terminal should be normally closed (normally open), when it is detected to be open (closed), this fault is reported.	External fault signals are input through the multi-function DI terminal.	Check whether an external fault has occurred.	Eliminate external faults and reset.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
16	Communication Fault	1	Modbus communication timeout	A communication fault is reported if Modbus communication data exchange is interrupted for longer than the specified time.	The communication timeout period is set to an excessively low value or the data transmission cycle of the PLC is set to an excessively high value.	Check that RS485 communication cable is connected properly. Check that Fd-04 and PLC communication cycle are set properly.	Increase the communication timeout period FD-04 or reduce the data transmission cycle of PLC.
					The baud rate and data format are set incorrectly when the timeout period has been set.	Check whether Fd-00 and Fd-01 are set correctly.	If RS485 communication is used, check whether the baud rate of the drive is consistent with that of the host controller. If PN communication is used, check whether FD-00 is 9 and whether FD-01 is 3.
		41	Disconnection of PROFINET communication	A communication fault is reported if PROFINET communication data exchange is interrupted for longer than the specified time.	PN card communication disconnected	Check whether the communication wiring between the PN card and the PLC is normal.	1. Check that the communication wiring between the PN card and PLC is connected properly. 2. Check that the PLC operates properly. 3. Check whether the most significant bit (MSB) of the PZD1 sent by the master has a value. Ensure that the value of the high-order eight bits of the sent PZD1 must be 0. Check whether the master writes values to bits 8–15 of the sent PZD1. Ensure that the high-order eight bits of the sent PZD1 must be 0.
		46	Operation error on user side	A communication fault is reported if communication data exchange is interrupted for a period longer than the specified time.	Operation error on user side	Contact technical support for troubleshooting.	Contact Inovance technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
17	Contactor fault	0	Contactor fault	The pre-charge contactor is considered to be faulty when abnormal signals are detected for 1s continuously based on hardware contactor exception signal detection.	The driver board or the power supply board is abnormal.	Check whether the driver board or power supply board is damaged.	Replace the driver board or the power supply board.
					The contactor is abnormal.	Check whether the contactor is damaged.	Replace the contactor.
					The lightning protection board is abnormal.	Check whether the surge protection board is damaged.	Replace the surge protection board.
					The drive is subject to external interference.	Check whether the input grid voltage is normal. Ensure that the input voltage of the three-phase 380 V models is between 342 VAC and 418 VAC.	Remove external interference.
19	Motor parameter auto-tuning fault	1	Magnetic pole position angle parameter auto-tuning fault of synchronous motor	An error occurs during angle auto-tuning of the synchronous motor.	Initial angle auto-tuning error	Check whether motor parameters are set properly.	1. Check whether parameters in group F1 are set properly. 2. Replace with a motor of the same type and perform tests to check whether the motor is demagnetized.
		2	Back EMF auto-tuning error	An error during back EMF auto-tuning of the synchronous motor.	The back EMF detected via auto-tuning is too low.	Check whether the back EMF is too low.	Contact Inovance for technical support.
		3	Inductance auto-tuning error	An error occurs during d-/q-axis inductance auto-tuning using the voltage pulse injection method.	The encoder cable is disconnected.	Check whether the encoder is wired correctly.	Contact Inovance for technical support.
		4	Resistor auto-tuning error	An error occurs during resistance auto-tuning with 100% d-axis current.	The encoder cable is disconnected.	Check whether the encoder is wired correctly.	Contact Inovance for technical support.
		5	Phase sequence auto-tuning error	An error occurs during phase sequence auto-tuning.	The encoder cable is disconnected.	Check whether the encoder is wired correctly.	Contact Inovance for technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
21	Error in read/write operations on EEPROM	1	EEPROM parameter-write timeout	The time for a single-shot EEPROM write operation exceeds the threshold defined internally.	An error occurs during writing parameters.	Check whether parameters are read or written frequently.	1. Parameters in the EEPROM are written frequently. Prolong the parameter-write interval. 2. The board is faulty. Replace the board. 3. Reduce the number of parameters to be read or written.
		2	Timeout occurred when reading parameters from EEPROM	The time for a single-shot EEPROM read operation exceeds the threshold defined internally.	An error occurs during reading parameters.	Check whether parameters are read frequently.	1. Parameters in the EEPROM are written frequently. Prolong the parameter-write interval. 2. The board is faulty. Replace the board. 3. Reduce the number of parameters to be read or written.
		4	Number of write/read operations on the EEPROM exceeding the setpoint within 1s	The number of EEPROM reads and writes within 1s exceeds the set value.	Excessive parameters to be read or written	Check whether parameters are read or written frequently.	1. Parameters in the EEPROM are written frequently. Prolong the parameter-write interval. 2. The board is faulty. Replace the board. 3. Reduce the number of parameters to be read or written.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
21	Error in read/write operations on EEPROM	5	EEPROM write fault	The time for continuous EEPROM write operations exceeds the threshold defined internally.	The EEPROM or board is faulty.	Check whether parameters are read or written frequently.	1. Parameters in the EEPROM are written frequently. Prolong the parameter-write interval. 2. The board is faulty. Replace the board. 3. Reduce the number of parameters to be read or written.
		6	An error occurs during reading parameters upon power-on.	EEPROM read operation fails at power-on.	The EEPROM or board is faulty.	Check whether a single read/write operation is successful. If not, the EEPROM or board is faulty.	1. Parameters in the EEPROM are written frequently. Prolong the parameter-write interval. 2. The board is faulty. Replace the board. 3. Reduce the number of parameters to be read or written.
21	Error in read/write operations on EEPROM	8	Excessive parameters to be read or written upon power-on	The number of parameters to be read or written upon power-on is excessive.	The EEPROM or board is faulty.	Check whether the number of parameters to be read or written upon power-on is excessive.	1. Parameters in the EEPROM are written frequently. Prolong the parameter-write interval. 2. The board is faulty. Replace the board. 3. Reduce the number of parameters to be read or written.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
23	Output ground fault of the drive	1	Overcurrent occurs during output ground fault detection.	The drive output is short-circuited to ground when the current between the output phase and ground exceeds the designed threshold.	Output ground fault	Check whether each adapter connector is normal.	1. Check whether the motor is short-circuited to ground. If yes, replace the cable or motor. 2. If the fault persists after the preceding measures are taken, contact Inovance for technical support.
		2	Overvoltage occurs during detection on output short circuit to ground.	If the bus voltage fluctuation exceeds 65 V after power-on, E23.02 is reported.	Output ground fault	Check whether each adapter connector is normal.	1. Check whether the motor is short-circuited to ground. If yes, replace the cable or motor. 2. If the fault persists after the preceding measures are taken, contact Inovance for technical support.
26	Cumulative operating time arrival fault	0	Cumulative operating time arrival fault	This fault is reported if the cumulative operation time is reached.	The cumulative operation time reaches the set value.	Check whether the cumulative operating time reaches the set value.	When the following conditions are met, to continue operation, set F8-17 to a value higher than that of F7-09. If any one of the following conditions is not met, contact Inovance for technical support. 1. F8-17 is not set to 0. 2. F7-09 is set to a value higher than F8-17. 3. F8-23 is set to 1.
27	Commercial operating time reached	/	/	This fault is reported if the business time is reached.	The business time is reached.	Check whether the commercial time reaches the set value.	1. Check whether the value of FA-08 (cumulative business operating time) is higher than any one of FA-01, FA-03, FA-05, or FA-07. 2. If you need to acquire the operating time protection password from the supplier (FA-00/FA-02/FA-04/FA-06), add FA-01/FA-03/FA-05/FA-07.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
28	Internal Faults	0	Internal Faults	Reserved	-	Reserved	Contact Inovance for technical support.
		1	System parameter error	System parameters or manufacturer parameters are abnormal.	Instantaneous power failure occurs during saving parameters.	Check whether instantaneous power failure occurs when saving parameters.	Contact Inovance for technical support.
					The number of write operations within a certain period of time exceeds the limit.	Check whether parameters are updated frequently through the host controller.	Contact Inovance for technical support.
					The software is updated.	Check whether the software is updated.	Contact Inovance for technical support.
					The drive is faulty.	If the fault persists though parameters are restored to default settings after repeated power cycling, the drive is faulty.	Contact Inovance for technical support.
28	Internal Faults	2	Programmable logic configuration fault	A logic configuration fault or dual-port RAM verification failure occurs.	Software versions of MCU and FPGA mismatch	Check the software versions of the FPGA and MCU (F7-10 to F7-14) through the operating panel or software tool.	Contact Inovance for technical support.
					The FPGA is faulty.	The fault persists after repeated power cycling.	Contact Inovance for technical support.
		3	Programmable logic interrupt	FPGA transmission is interrupted, FPGA operation times out, or MCU access to FPGA times out.	1. FPGA is faulty. 2. The handshaking between FPGA and MCU is faulty. 3. Internal operation of the drive times out.	The fault persists after repeated power cycling.	Contact Inovance for technical support.
		4	Internal program error	System parameters cannot be reset.	EEPROM fault	Check the causes according to the check method for 28 and 01.	Contact Inovance for technical support.
					The drive is faulty.	The fault persists after repeated power cycling.	Contact Inovance for technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
28	Internal Faults	5	Product matching fault	No corresponding motor or drive	1. The product (motor or servo drive) code is unknown. 2. Power ratings of the motor and drive do not match.	1. Check the drive nameplate and motor nameplate to ensure that Inovance ES680 series drive and servo motor are used. View the motor model (F1-00) and drive model (FF-01).	Contact Inovance for technical support.
		6	Product matching fault in absolute position mode	The motor model is incorrect.	In the absolute position mode, the motor does not match or the motor code is set incorrectly.	1. Check whether the motor with a multi-turn absolute encoder is indicated on the nameplate. 2. Check whether the motor model (F1-00) is correct.	Contact Inovance for technical support.
28	Internal Faults	7	FPGA system sampling operation timeout	The torque reference operation time of channel 41 in the software tool is greater than the set value of A0-47.	MCU communication times out.	If F9-96 is 1208 and F9-97 is 0208, check whether the internal chip is damaged.	Contact Inovance for technical support.
					Current sampling timeout	If F9-96 is 3208 and F9-97 is 0208, check whether there are large equipment generating interference on-site, check whether there are multiple interference sources such as power variable frequency equipment in the cabinet, and check whether the internal current sampling chip is damaged.	Contact Inovance for technical support.
30	Motor fan speed regulation fault	0	Motor fan speed regulation fault	Reserved	The motor fan is faulty.	Reserved	Check whether the motor fan operates properly.
		1	Drive fan fault	Reserved	Drive fan fault	Reserved	Check whether the fan of the drive operates properly.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
31	DI function assignment fault	/	/	The DI is assigned a function that is already used by another terminal or is assigned a non-existent function.	DI function assignment conflict	Check whether parameters for DI function assignment are set to the same value.	Check whether DI terminals are assigned with correct functions (F4-00 to F4-15).
32	STO data check error	0	STO RAM check error	Reserved	Program version incorrect	Reserved	Contact Inovance for technical support.
		1	STOP Flash check error	Reserved	Program version incorrect	Reserved	Contact Inovance for technical support.
41	Slave pump stuck fault	0	Slave pump stuck fault	Compare the slave pump current and the drive current such as master pump current. If the deviation between the slave pump current and the master pump current is greater than A5-11 (default: 20%) for five consecutive times within 50 ms, an alarm is triggered.	The slave pump is faulty.	Check whether the slave pump load is excessive.	Check whether the slave is stuck or damaged.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
42	CAN communication fault	1	Disconnection after a certain period of operation	A disconnection occurs during operation.	Communication disconnected	Check whether the CAN wiring is proper.	1. Check whether the communication cable is in good contact.
		2	Severe interference	Severe interference exists on the bus.	Severe interference exists (reception error).	Check whether the drive is grounded properly.	1. Check whether the cable shield is connected properly and whether the communication cable is excessively long. 2. Check the load rate of the CAN bus.
		3	PDO data has never been received or sent successfully after power-on.	CAN communication has not been established since power-on.	Communication is not established after power-on.	Check whether the CAN wiring is proper.	1. Check whether CANH/CANL is connected reversely. 2. Check whether parameters (A2-00, A2-01) are set improperly or whether the communication cable is faulty.
		11	CANopen communication timeout	CANopen bus offline	CANopen communication times out.	Check whether the CAN wiring is proper.	1. Check whether the heartbeat or node guarding configurations are proper. 2. Check whether the CAN network has been disturbed. 3. Contact Inovance for technical support.
		12	The length of the transmission PDO does not match the mapping.	The CANopen bus is closed or interfered.	The length of the transmission PDO does not match the mapping.	Check whether the CAN wiring is proper.	Contact Inovance for technical support.
		15	PDO mapping configuration error	PDO mappings are incorrect.	The configured PDO mapping object is incorrect.	Check whether the configured PDO mapping objects are correct.	Check whether the parameter mapped by PDO is correct.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
44	Speed deviation excessively high	0	Speed deviation excessively high	In non-torque mode, E44.00 is reported when all the following conditions are met: (1) The motor is running. (2) F9-15 ≠ 0. (3) DI function 52 = 0. (4) DI function 57 = 0 or CAN is not enabled in speed mode. (5) The speed deviation exceeds F9-14 for longer than F9-15. (6) F2-10 ≥ 120.	Excessive speed deviation	Check whether the wiring and load are normal.	1. Check whether the motor power cable is disconnected. 2. Check whether the load is excessive.
		1	Torque upper limit excessively low	In non-torque mode, E44.01 is reported when all the following conditions are met: (1) The motor is running. (2) F9-15 ≠ 0. (3) DI function 52 = 0. (4) DI function 57 = 0 or CAN is not enabled in speed mode. (5) The speed deviation exceeds F9-14 for longer than F9-15. (6) F2-10 < 120.	Drive parameter setting error	Check whether the torque upper limit is set properly.	Increase the torque upper limit (F2-10).
		2	The motor speed exceeds the maximum speed.	The positive/ negative speed feedback exceeds 1.2 x maximum speed (F1-17) for five consecutive times.	Speed reference beyond overspeed threshold	Check whether the input speed reference is proper.	Check whether the input speed reference is within the overspeed threshold.
					The motor speed overshoots.	Check whether the speed loop parameters are normal.	Adjust the speed loop gain or mechanical operating conditions.
					The drive is faulty.	Check whether the drive is faulty.	Replace the drive if the fault persists after restart.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
44	Speed deviation excessively high	3	Runaway	If the motor is running, F9-87 is not 0, the drive is not in parameter auto-tuning mode, and the control mode is closed-loop, then: (1) When the set torque is greater than the rated torque, the set frequency is positive, the feedback frequency is negative, the absolute feedback frequency is less than 3 Hz, and acceleration is negative, time is accumulated. (2) When the set torque is greater than the rated torque, the set frequency is negative, and the feedback frequency is higher than 3 Hz, and acceleration is positive, time is accumulated. If the cumulated time is greater than F9-87 and the speed deviation is greater than F1-04, E44.03 is reported.	Motor runaway occurs.	Check whether motor parameters in group F1 are set correctly.	Check whether the phase sequence of the drive is correct.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
45	Motor temperature fault	3	Overtemperature Fault	The motor temperature is higher than the set motor temperature alarm threshold.	The motor overtemperature protection is triggered.	Check whether the motor operates for a long time under excessive load.	1. Check whether the alarm threshold (F9-59) is set properly. If not, adjust it. 2. If the alarm threshold is proper, contact Inovance for technical support.
		4	Short circuit fault	The temperature sensor is short-circuited.	PT1000 short-circuited or connected reversely	Check whether the motor temperature changes with the ambient temperature.	1. Check whether the motor temperature sensor is short-circuited. 2. Check whether PTCP/ PTCN terminal on the interface board is wired reversely.
		5	Open circuit fault	The temperature sensor is disconnected.	PT1000 disconnected	Check whether the motor temperature changes with the ambient temperature.	Check whether the temperature sensor is disconnected.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
46	The pressure sensor is faulty.	0	The pressure sensor is faulty.	This fault is reported if the current is higher than the set current percentage, the feedback pressure is lower than 2.5 kg, the drive is working in hydraulic pressure control mode, the actual motor frequency is less than or equal to 50% of the rated frequency, and the drive remains in this state for the set time.	The pressure sensor is faulty.	Check whether the pressure sensor pressure matches the machine pressure.	Check whether the pressure sensor is connected loosely, whether the power supply is normal, and whether the pressure sensor output is normal.
		1	The load is excessive.	Reserved	The load is excessive.	Check whether the load is excessive.	1. Stop and check whether the motor shaft can be rotated manually. 2. Check whether F2-10 is set properly. 3. Check whether dynamic auto-tuning of the motor is normal.
		2	Zero drift auto-tuning fault	This fault is reported if the auto-tuned zero drift is too large and the deviation is less than 2 V.	Zero drift auto-tuning of the pressure sensor is faulty.	Check whether the pressure sensor wiring is normal.	1. Ensure the measuring part of the pressure sensor is free from any pressure. 2. Ensure the pressure sensor is connected properly (measure the voltage of AI3 with a multimeter to see whether the readout is consistent with the value displayed in U0-32). 3. Ensure F4-28...F4-31 are set properly.
		3	Range exceeds upper/lower limits	The AI3 voltage feedback keeps exceeding the range for a certain period of time.	The range of the pressure sensor exceeds the limit.	Check whether the pressure sensor is normal.	The range of the pressure sensor is lower than A3-55 or higher than A3-56. Check the pressure sensor.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
47	Multi-pump confluence fault	1	Slave fault in multi-pump confluence	When the slave pump disconnects or fails and the main pump fails, the main fault code is E47 and the subcode is the slave pump station number.	Slave fault in multi-pump confluence	Check whether the drive whose station number displayed in A2-01 matches the fault subcode is faulty.	See details in the appendix in the user guide.
48	Station number conflict	0	Station number conflict	This fault is reported if an address conflict occurs.	A conflict of station No. exists.	In CAN communication mode, check whether A2-01 is set improperly.	See details in the appendix in the user guide.
49	The encoder is faulty.	1	Absolute encoder fault	The encoder wiring is incorrect.	Encoder wiring is incorrect.	Check whether the encoder is wired correctly.	Connect the encoder cable according to the correct wiring diagram.
		2	Absolute encoder single-turn decoding error	Single-turn position feedback of the encoder is abnormal.	Connection of the encoder cable becomes loose.	Check whether the encoder is wired correctly.	Check whether vibration is excessive, which loosens the encoder cable. Re-connect the encoder cable properly.
		3	Absolute encoder counting increment error	Encoder count increment is abnormal.	The encoder signal has been disturbed.	Check whether the driver board is grounded properly.	1. It is recommended to use the cables provided by Inovance. 2. If a custom cable is used, check whether this cable is a shielded twisted pair cable that complies with the specifications. 3. Route the motor cables and encoder cables through different routes. Ensure the motor and drive are grounded properly. 4. Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts.
		4	Encoder EEPROM parameter read delay too long	Encoder parameter read timeout	The encoder is faulty.	Check whether the encoder is wired correctly.	Replace the servo motor.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
49	The encoder is faulty.	5	Encoder parameter error	An error is detected during encoder parameter read check.	The serial encoder cable is disconnected or loose.	Check whether the encoder is wired correctly.	Check for incorrect connection, open circuit, and poor contact of the encoder cable. Route the motor cable and encoder cable through different routes.
		6	Encoder algorithm error	Encoder parameter read/write operations are abnormal.	An error occurs when reading/ writing serial encoder parameters.	Check whether the motor is normal.	If the fault persists after repeated restart, the encoder is faulty. In this case, replace the motor.
		7	Encoder multi-turn counter overflow	The encoder multi-turn count value is out of range.	An encoder algorithm error occurs.	Check whether the motor is normal.	If the fault persists after repeated restart, the encoder is faulty. In this case, replace the motor.
50	Encoder fault 2	1	Encoder battery failure	Encoder battery failure detection	Battery fault	Replace the servo motor and check whether it operates normally.	Contact Inovance for technical support.
		2	Encoder multi-turn counting error	E50.02 is reported when an error is detected in the encoder multi-turn position feedback.	Interference	Check whether the drive is grounded properly.	Contact Inovance for technical support.
		3	Encoder battery alarm	Encoder battery alarm position 1	Battery fault	Replace the servo motor and check whether it operates normally.	Contact Inovance for technical support.
		4	Encoder overtemperature	The encoder temperature exceeds the threshold.	Encoder overtemperature	Stop for one hour and check whether it operates normally.	1. Reduce the ambient temperature and clean the air duct. 2. The motor fan or encoder is damaged, contact Inovance for technical support.
52	Multi-master fault in multi-pump confluence	0	Multi-master fault in multi-pump confluence	This fault is reported if master/slave switchover occurs 150 times within 1 second.	Multiple masters exist in the multi-pump mode.	Check whether the master is switched frequently.	See details in the appendix in the user guide.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
58	User parameter recovery fault	0	User parameter recovery fault	E58.00 is reported when an error occurs during the execution of the user parameter recovery program.	Parameters are not saved before restoring user parameters.	Check whether user parameters are saved before recovery.	Save user parameters after setting parameters (enter the password in FP-04 and save user parameters by setting FP-05 to 1).
61	Braking time of the braking transistor excessively long	0	Braking time of the braking transistor excessively long	When the braking transistor of the drive is turned on, the performance flag bit is set to 1 and the function software starts counting. This fault is reported if the reset time of the performance flag bit exceeds the allowable braking transistor ON time.	The braking transistor has been in the braking protection state for a long time.	Check whether the bus voltage keeps exceeding the braking transistor switch-on voltage.	Check whether the bus voltage keeps higher than the braking voltage and whether the braking protection time setpoint is too small.
63	Reverse operating time arrival fault	0	Reverse operating time arrival fault	The motor running speed is monitored in oil pressure mode. This fault is reported if the motor running speed is less than 0 and lasts longer than the set time.	The accumulative time of reverse operation in the hydraulic pressure mode exceeds the value of A4-09.	Check whether the motor is running reversely for a long time in hydraulic pressure mode.	Check whether the flow drop time setpoint and oil-cooling command drop time setpoint are too low.
64	The EEPROM of the driver board is faulty.	0	The EEPROM of the driver board is faulty.	E64.00 is reported when the parameter index is outside the upper and lower limits.	The EEPROM of the driver board is faulty.	Check whether the EEPROM of the driver board is faulty.	Power off and contact Inovance for technical support.
67	Parameter initializa tion error	0	Parameter initialization error	Parameter initialization abnormal	An error occurs on parameter initialization upon power-on.	Check whether parameter initialization upon power-on is normal.	Power off and contact Inovance for technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
69	Motor stall fault	0	Motor stall fault	E69.00 is reported when the actual speed is below 0.5 Hz, the set torque is greater than F2-10, and the output current is larger than 1.6 times the rated drive current.	The motor is stalled.	Check whether the motor speed is low.	1. Check whether the oil pump is stuck. 2. Check whether the internal leakage of the oil pump is too small. If yes, set the protection time longer. 3. Ensure that the UVW wiring of the drive and motor is consistent. If not, power off and adjust the motor wires. 4. Check whether the load is excessive. 5. Check whether a stall fault is reported after a stopped motor is enabled. If yes, check whether output phase loss occurs.
69	Motor stall fault	1	Stall fault in pressure mode	The master pump reports E69.01 if the current exceeds A3-51, the torque upper limit is non-zero, the feedback hydraulic pressure is less than 2.5 kg, the speed is less than A3-52, and such condition persists for longer than A3-21.	The oil pump is seized or the internal leakage in the oil pump is too small, leading to a motor stall fault.	Check whether the motor speed is low.	1. Check whether the oil pump is stuck. 2. Check whether the internal leakage of the oil pump is too small. If yes, set the protection time longer. 3. Ensure that the UVW wiring of the drive and motor is consistent. If not, power off and adjust the motor wires. 4. Check whether the load is excessive. 5. Check whether a stall fault is reported after a stopped motor is enabled. If yes, check whether output phase loss occurs.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
69	Motor stall fault	2	Fast protection for stall and large current	If the speed is below 0.5 Hz, the output current exceeds the drive maximum current, and such condition persists for longer than F9-94, E69.02 is reported.	Incorrect UVW wiring causes motor stall and triggers alarms.	Check whether the motor speed is low.	1. Check whether the oil pump is stuck. 2. Check whether the internal leakage of the oil pump is too small. If yes, set the protection time longer. 3. Ensure that the UVW wiring of the drive and motor is consistent. If not, power off and adjust the motor wires. 4. Check whether the load is excessive. 5. Check whether a stall fault is reported after a stopped motor is enabled. If yes, check whether output phase loss occurs.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
70	Motor ROM data error	1	Data check error or no parameter saved in the motor ROM	Upon power-on, motor parameters must be read from the absolute encoder to configure the FPGA. The first two parameters saved in the motor ROM are checksum words. If the read parameters differ from those in Flash, an error is reported and motor parameters must be rewritten.	Drive and motor type not match	Check whether the motor matches the drive.	Replace with mutually-matching drive and motor. Then restart the drive.
		2	Data check error or no parameter saved in the motor ROM	Communication error at the RX end of the absolute encoder	A parameter check error occurs or no parameter is saved in the serial encoder ROM.	Check whether the encoder wiring is normal.	1. Use the encoder cable provided by Inovance. Ensure motor terminals and drive screws are connected securely. Use a new encoder cable if necessary. 2. Route encoder cables and power cables (UVW) through different routes.
		3	Torque fluctuation compensation parameter read error in the motor ROM	The fault is reported when H06-22 (Read/Write switch for saving torque fluctuation compensation to the encoder) is set to a non-zero value and the attempt to read compensation data fails.	The drive is faulty.	Contact Inovance technical support.	Replace the drive.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
72	CANopen displacement sensor fault	1	CANopen communication disconnected	CANopen communication disconnection detection	Communication disconnected	Check whether the transducer CAN wiring is normal.	Check the wiring of the transducer.
		2	CANopen communication timeout	The CANopen receiving time exceeds the threshold.	Communication timeout	Check whether the drive and position sensor are properly grounded.	The communication is disconnected due to interference. Check the grounding condition of the position sensor.
		3	CANopen position sensor failure	The position sensor cannot be detected.	There is no position sensor.	Check whether the position sensor is normal.	The magnet of the position sensor does not work. It is recommended to replace the position sensor.
73	The output wiring is improper.	0	The output wiring is improper.	U/V/W cables are connected incorrectly.	Phase sequence incorrect or output phase loss	Check whether the U/V/W cables are connected correctly.	1. Check whether U/V/W phases of the motor are connected properly. 2. Check whether output phase loss occurs. 3. Contact technical support engineers.
95	Pressure beyond the limit during mold opening	0	Pressure beyond the limit during mold opening	When the pressure during mold opening exceeds the system oil pressure, E95.00 is reported.	The feedback pressure during mold opening exceeds the maximum pressure of the system.	Check whether the feedback pressure during mold opening exceeds the maximum pressure of the system.	Contact Inovance technical support.
97	Motor parameter modification fault	0	Motor parameter modification fault	An error occurs during modification of motor parameters, triggering A97.00.	Parameters in group F1 have been modified.	Check whether parameters in group F1 have been modified.	1. Check that parameters in group F1 are modified properly. 2. Contact Inovance for technical support.

Fault code	Fault code name	Subcode	Fault Subcode Name	Fault description	Possible cause	Verification method	Solution
98	Restart error after parameter modification	0	Restart error after parameter modification	If parameters that require a power cycle to take effect are modified, E98.00 is reported.	The modified parameters become effective only after a power cycling or software reset.	Check whether parameters have been modified without a subsequent power cycle.	Restart the controller.
99	Number of software-defined parameters incorrect	0	Number of software-defined parameters incorrect	Software-defined parameter out of limit	Number of software-defined parameters incorrect	Contact technical support engineers.	Contact Inovance technical support.

16 Certification and Standard

16.1 Certifications, Directives, and Standards

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

Certification	Directive		Standard
CE	EMC directive	2014/30/EU	EN IEC 61800-3
	LVD directive	2014/35/EU	EN 61800-5-1
	RoHS directive	2011/65/EU&2015/863/EU	-
UL certification	-		UL61800-5-1 CSA C22.2 No.274

Note

The drive complies with the latest version of directives and standards for CE/UL/cUL certifications.

16.2 CE Certification

16.2.1 Introduction to CE Certification



Figure 16-1 CE mark

- The "CE mark" indicates compliance with the Low Voltage Directive (LVD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives for commercial trades (production, import, and sales) in the EU.
- The CE mark is mandatory for engaging in commercial business (production, importation, and distribution) in the EU.
- The drive complies with LVD, EMC, and RoHS directives and carries the CE mark.
- Machines and devices integrated with this drive must also comply with CE requirements for distribution in EU.
- The integrator who integrates this drive into other products and attaches CE mark to the final assembly has the responsibility of ensuring compliance with CE certification.

16.2.2 Requirements for Compliance with EMC

- The drive is applicable to the first environment and second environment and complies with EMC directive 2014/30/EU and standard EN IEC 61800-3.

Caution

If the product is used in the first environment, radio interference may be generated. In addition to CE compliance requirements, measures should be taken to prevent interference when necessary.

- To enable the drive to comply with the EMC directive and standards, install an EMC filter on the input side and use shielded cables on the output side. Ground the filter properly. Ground the shield of the output cable in 360 degrees.

Caution

The manufacturer of the system with the product installed must ensure that the system meets the requirements of the European EMC Directive, and ensure that the system meets the requirements of the standard EN IEC 61800-3 according to the application environment of the system.

EMC specifications

The drive complies with EN IEC 61800-3. The maximum length of the motor cable allowed by the conducted and radiated emission is shown in the following table.

Table 16–1 Maximum motor cable length allowed by conducted and radiated emission

Product model	Maximum cable length allowed by conducted emission				Maximum cable length allowed by radiated emission			
	Category C2		Category C3		Category C2		Category C3	
	Built-in filter	External EMC filter	Built-in filter	External EMC filter	Built-in filter	External EMC filter	Built-in filter	External EMC filter
T3 to T4	/	1 m	1 m	/	/	1 m	1 m	/
T5 to T8	/	3 m	/	/	/	3 m	/	/

Introduction to EMC standards

Electromagnetic compatibility (EMC) describes the ability of electronic and electrical devices or systems to work properly in the electromagnetic environment and not to generate electromagnetic interference that influences other local devices or systems. EMC includes the following requirements:

- The electromagnetic interference generated by a device during normal operation must be restricted within a certain limit.
- The device must have sufficient immunity to electromagnetic interference in the environment and can work properly in the environment with electromagnetic interference, which is described as electromagnetic sensitivity.

EN IEC 61800-3 defines the following two environments:

- First environment: It includes domestic premises. It also includes establishments directly connected without intermediate transformer to a low-voltage power supply network which supplies buildings used for domestic purposes.

- Second environment: It includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

Devices are divided into the following four categories based on the intended application environment.

- C1 equipment: power drive system (PDS) with the rated voltage lower than 1000 V, which is intended for use in the first environment
- C2 equipment: PDS with the rated voltage lower than 1000 V, which is neither a plug-in device nor a movable device and is intended to be installed and commissioned only by professionals when used in the first environment.
- C3 equipment: PDS with the rated voltage lower than 1000 V, which is intended for use in the second environment and not intended for use in the first environment
- C4 equipment: PDS with the rated voltage equal to or higher than 1000 V or rated current equal to or higher than 400 A, or intended for use in complex systems in the second environment

16.2.3 Requirements for Compliance with LVD

The drive has been tested in accordance with EN 61800-5-1 and has complied with the LVD. Observe the following requirements to enable machines and devices integrated with this drive to comply with the LVD.

Installation location

Install the product in a place with overvoltage category III and pollution degree 2 or below as specified by IEC 60664-1.

Installation environment

For requirements of the installation requirements, see section "Installation Environment" in ES680 Series Servo Drive Installation Guide.

Installation protection requirements

- The drive serves as a part of a final system. Install the drive as the system component in a fireproof cabinet that provides effective electrical and mechanical protection, and install it in accordance with local laws and regulations and relevant IEC standards.
- For IP20-certified products, install them in structures where foreign objects cannot enter from the top or front sides.

Wiring requirements of main circuit terminals

For details about main circuit terminal wiring requirements, see *"7.3.4 Wiring Requirements of Main Circuit" on page 93*.

Selection of main circuit cables

For details about main circuit cable selection requirements, see *"Table 7-2" on page 88*.

Requirements for protective devices

To comply with EN 61800-5-1 standards, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit. See *"8.1.1 Fuse, Contactor, and Circuit Breaker" on page 121* for recommended fuse/circuit breaker models.

16.3 UL/cUL Certification



Figure 16-2 UL/cUL mark

- The UL/cUL mark commonly applies to products sold in the United States and Canada. Products with UL/cUL mark have been inspected and assessed by the UL organization. To pass UL/cUL certification, main built-in components of electrical products must also be UL certified.
- The drive has been tested in accordance with UL 61800-5-1 and CSA C22.2 No. 274 standard to determine compliance with UL/cUL standards. Observe the following requirements to enable machines and devices integrated with this drive to comply with UL/cUL standards.

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by UL61800-5-1.

Ambient temperature

According to the protection level, the ambient temperature must be maintained within the following range:

Ambient temperature range for T3-T8 models (open type): -10°C to +50°C

Installation requirements

- Drives of T3 to T7 models are open-type, which must be installed inside a cabinet according to the following requirements:
  The drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations and relevant NEC standards.
- Solid state motor overload protection: 115% of rated operating current of the motor
- The integrated solid state short circuit protection does not cover the branch circuit. The branch circuit must be protected based on national and regional electrical standards.
- Motor overtemperature protection is not available.
- The rated value of short circuit current is 100,000 Arms (maximum).

Wiring requirements of main circuit

Caution

Field installation is not allowed for output terminals BR, (-), and (+).

- Terminals BR, (-), and (+) are used to connect optional parts. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- The control circuit is the internal safety extra-low voltage (SELV) circuit, which must be insulated and isolated from other circuits. Make sure that the control circuit is connected to the external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder the twisted conductors.
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws with an angle not higher than 5°. Failure to comply may damage the terminal screws.

Requirements for control circuit wiring

Observe the requirements in UL508 during wiring.

Main circuit cable selection requirement

For the selection of cable dimensions, follow the requirements of US National Electrical Code (NEC) and Part 1 of Canadian Electrical Code (CEC) and relevant local regulations.

- Use cables with copper conductors.
- The recommended cables for the main circuit are 600 V Class 2 heat-resistant indoor PVC cables that can work under temperature of 75°C (167°F) continuously. The following conditions are used as premises:

  1. Ambient temperature: Below 40°C (104°F)
  2. Normal operating ratings

If the recommended cables for peripheral equipment or options are not suitable for the product, contact Inovance.

Main circuit cable selection

For details about main circuit cable selection requirements, see *"Table 7-3" on page 89*.

Requirements for protective devices

- To meet the requirements of UL standards, a fuse/circuit breaker must be connected on the input side to prevent accidents caused by internal short circuits.
- Install sufficient protective devices against short circuit in branch circuits according to applicable regulations and this guide. The drive is applicable to circuits with the rated breaking capacity lower than 100000 A and the maximum voltage of 480 VAC (class 400 V). See *"8.1.1 Fuse, Contactor, and Circuit Breaker" on page 121* for recommended fuse/circuit breaker models.

17 Appendix A: Multi-pump Mode of Injection Molding Machine

17.1 Parallel Servo Oil Pump Control

Parallel servo oil pump control includes two methods: multi-pump convergent flow and multi-pump divergent flow.

- Multi-pump convergent flow: A servo drive is used as the master drive, and the other servo drives are used as slave drives in parallel. The system computer outputs a set of flow and pressure analog signals.
  - In the flow control state (the feedback pressure is less than the pressure reference), the speeds of the master and slave drives can be the same.
  - In the pressure control state (the feedback pressure is greater tan or equal to the pressure reference), the slave pumps stop automatically and are controlled by the master drive.
- Multi-pump divergent flow: Multiple servo drives can work in multi-pump convergent and and divergent flow modes (oil pressure loop PID control applied separately). The system computer outputs multiple sets of flow and pressure analog signals.

Multi-pump convergent flow

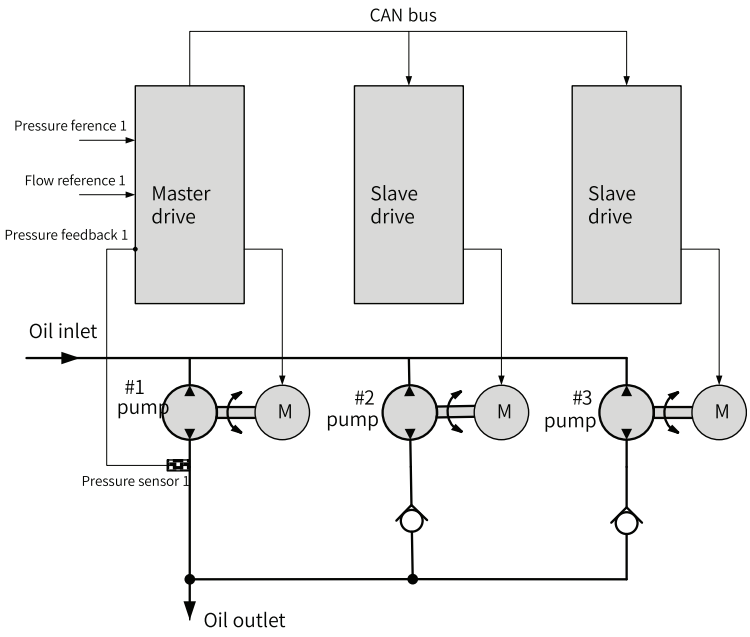


Figure 17-1 Structure of multi-pump convergent flow

Note: For details on the wiring and CAN communication wiring, see *"17.2.2 Wiring" on page 258*.

The motor speeds can be the same through communication.

Multi-pump divergent flow

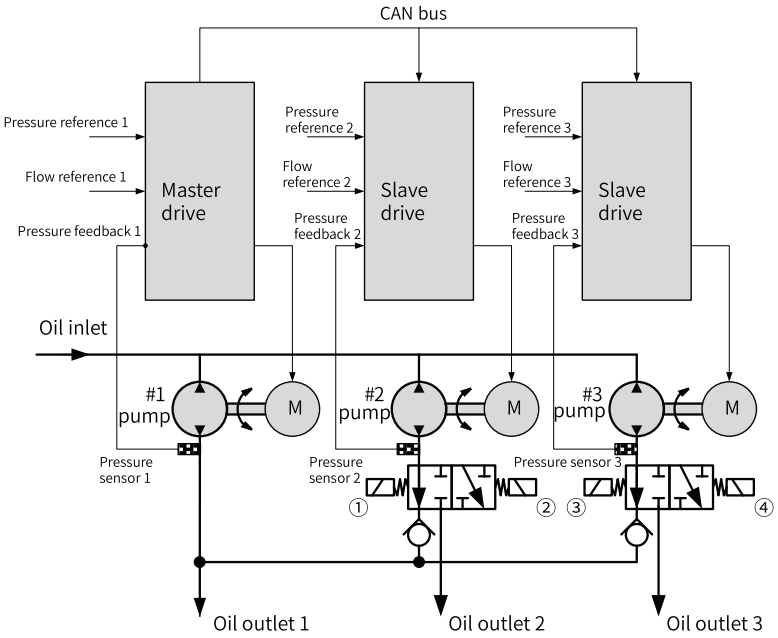


Figure 17-2 Structure of multi-pump divergent flow

Note: For details on the wiring and CAN communication wiring, see *"17.2.2 Wiring" on page 258*.

The motor speeds can be the same through communication.

The convergent and divergent control of pumps 2 and 3 can be achieved through the energization state of solenoid valves 1, 2, 3 and 4.

In convergent flow control, the pressure and flow commands received from the drive and the pressure feedback signal are ineffective.

In divergent flow control, the CAN communication command received from the drive is ineffective.

17.2 Multi-Pump Control Mode

17.2.1 Description

Parameter	Name	Value	Description
A2-03	CAN multi-pump mode	0	Multi-pump mode 1 (broadcast mode)
		1	Multi-pump mode 2 (multi-master mode)
A3-00	Oil pressure mode selection	2	Drive oil pressure control mode 2 (analog setting)

The drive supports two multi-pump modes:

- Multi-pump mode 1 (broadcast mode): It is suitable for simple multi-pump control. The slave pump cannot be controlled when it is switched to the master pump. The No. 50 terminal is in

multi-pump mode. If you disconnect the No. 50 terminal of the slave pump, the slave pump switches to the master pump.

- Multi-pump mode 2 (multi-master mode) supports 4 types of wiring and applications. See the following for details.

17.2.2 Wiring

Multi-pump convergent flow

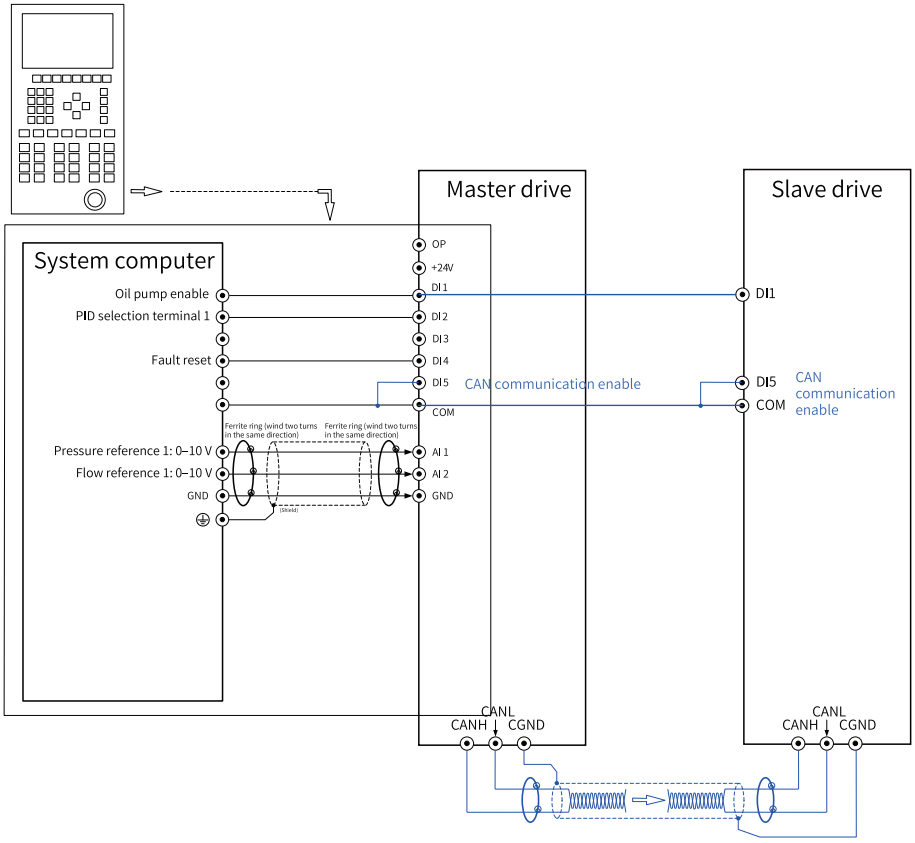


Figure 17-3 Wiring of multi-pump convergent flow mode 1

Note

In multi-pump mode 1, No. 50 DI terminals of the master and slave drives must be closed to enable the multi-pump convergent flow control mode.

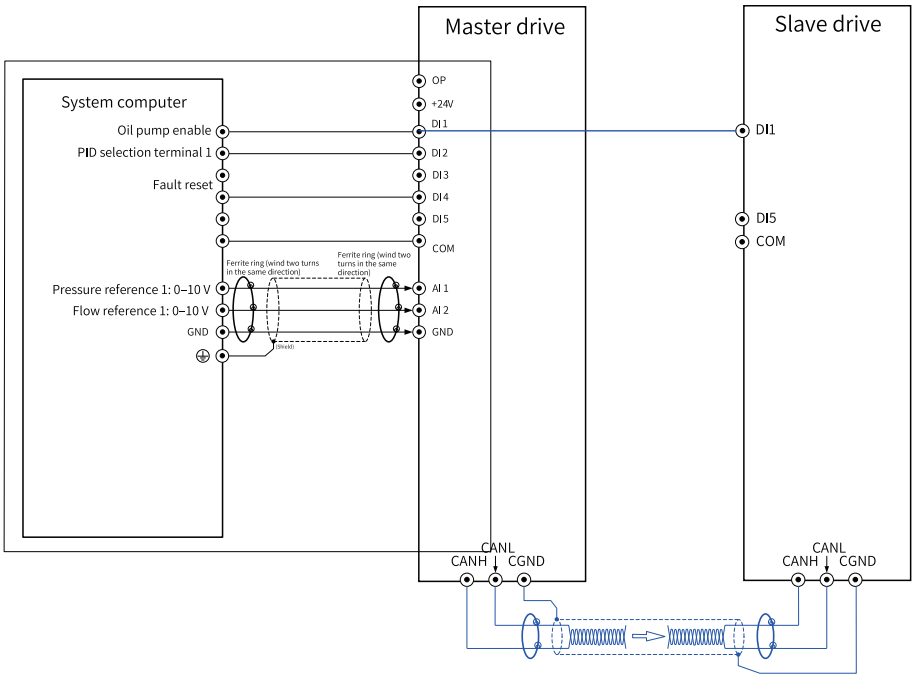


Figure 17-4 Wiring of multi-pump convergent flow mode 2

Note

After the CAN bus is connected properly in multi-pump convergent flow mode 2, set the slave pump address responding to the master pump flow references. The following *"17.3 Setting of Master Drive" on page 263* describes related parameter settings.

During multi-pump convergent flow, set the slave alarm output (F5-02) to 25 to connect the slave alarm output signal to the system computer for alarm display.

Note

In the pressure control state, unexpected high pressure may occur on the oil circuit of slave pump when the check valve leakage is high but the internal leakage of the slave pump is low. In this case, do the following to relieve the high pressure.

- Reduce the pumpage of the slave pump properly through H14.47.
- Reduce the upper limit of the drive torque properly through 200734 in the host controller.
- Set the slave speed response curve based on the maximum leakage speed of the master pump to enable the slave drive to automatically relief pressure under low-speed pressure holding. For details on parameter settings, see *"17.2.3 Parameter Settings for Slave Pump Response to Master Pump Commands" on page 262*.

Multi-pump distributed flow

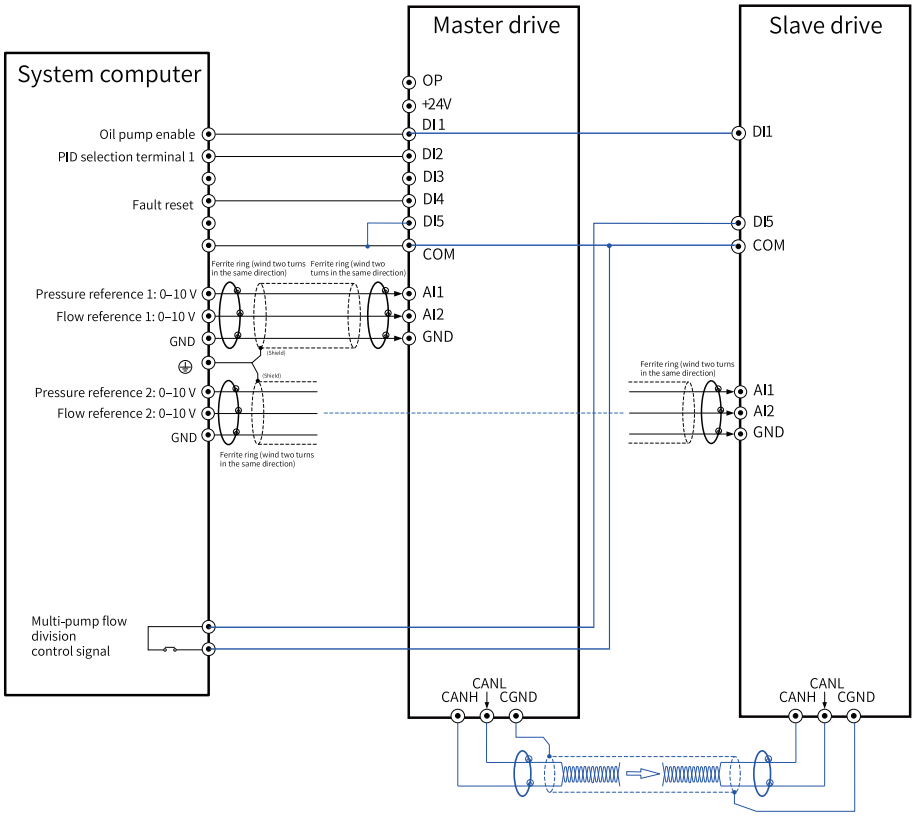


Figure 17-5 Wiring of multi-pump distributed flow mode 1

Note

Use the flow-dividing signal delivered by the host controller to disconnect No. 50 DI terminal of the slave. After receiving the pressure, flow reference 2 and pressure feedback 2 from the controller, the master drive (switched from the slave drive) enters the oil pressure loop PID control state.

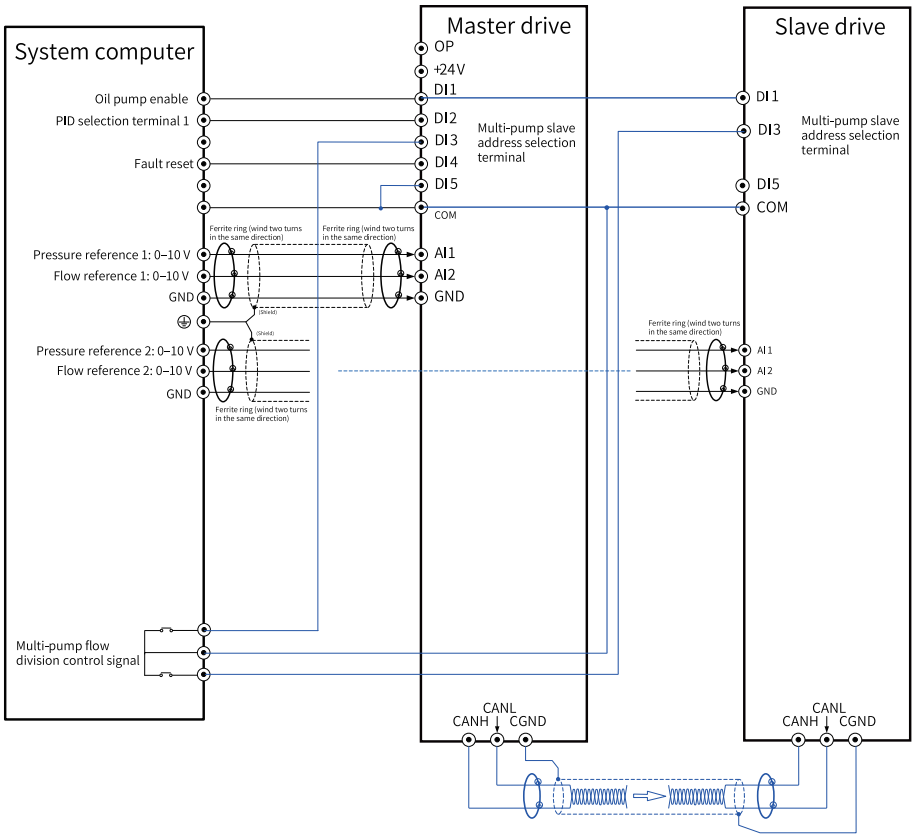


Figure 17-6 Wiring of multi-pump distributed flow mode 2

Note

Set F5-02 to 25 to connect the slave alarm output signal to the controller for alarm display.

In the pressure control mode, the slave drive receives pressure feedback 2 independently from the pressure sensor on the slave drive oil circuit. Therefore, unexpected high pressure will not occur on the oil circuit of slave drive in this mode.

Communication Wiring

The following figure describes the CAN bus connections of all pumps.

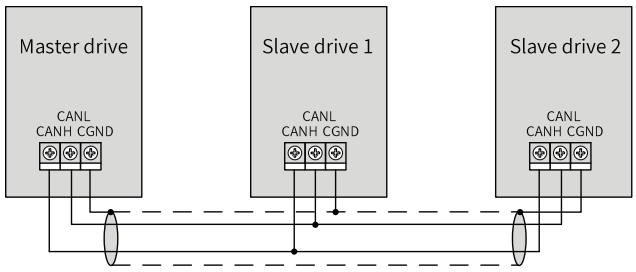


Figure 17-7 CAN bus connection

Note

Connect CANH and CANL signal terminals on the drive control board with shielded twisted pairs. Connect the grounding terminal CGND through the shield. Connect a CAN communication termination resistor to the drives at the head and end of the bus respectively (through jumper J4).

17.2.3 Parameter Settings for Slave Pump Response to Master Pump Commands

Table 17–1 Slave pump drive setting

Parameter	Name	Default
A3-32	Minimum input of slave speed reference	0.0%
A3-33	Corresponding setting of slave speed reference minimum input	0.0%
A3-34	2nd point input of slave speed reference	0.0%
A3-35	Corresponding value of the 2nd point input of slave speed reference	0.0%
A3-36	Max. input of slave speed reference	100.0%
A3-37	Corresponding value of slave speed reference maximum input	100.0%

Setting A3-32 to A3-37 enables the slave pump to relieve pressure automatically when the master pump is running at pressure holding low speed, to avoid high pressure of the slave pump and ensure the linearity of the whole flow.

For example:

- Condition 1: Assume that the maximum pressure holding speed of the master is 50 RPM, the maximum speed is 2000 RPM, and the maximum speed of the slave is 2000 RPM.
- Condition 2: During pressure holding, only the master pump is involved, and the slave pumps stop completely.
- Condition 3: To ensure the flow linearity, the speed of the slave pump is the same as that of the master pump when the speed of the master pump is above 100 RPM.

That means, when the master pump runs below 50 RPM, the slave pumps stop. When the master pump runs above 100 RPM, the slave pumps run at the same speed as the master pump. The speed reference of the slave pump is 0% to 100%. See the following for details.

(A3-32, A3-33) = (Slave pump input reference: 50 RPM, slave pump response reference: 0 RPM) = (25.5%, 0.0%)

(A3-34, A3-35) = (Slave pump input reference: 100 RPM, slave pump response reference: 100 RPM) = (5.0%, 5.0%)

(A3-36, A3-37) = (Slave pump input reference: 2000 RPM, slave pump response reference: 2000 RPM) = (100%, 100%)

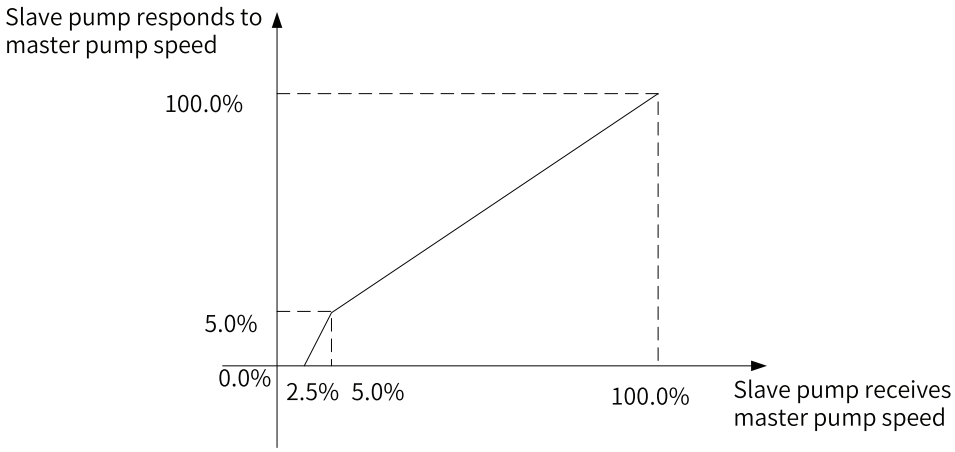


Figure 17-8 Slave pump response to master pump speed

Note

The slave drive responses to the speed reference of the master pump are set in the same way for the two multi-pump modes.

17.3 Setting of Master Drive

Multi-pump mode 1 (A2-03 = 0)

The setting is simple. All drives must enable the No. 50 multi-pump control enable DI terminal.

Parameter	Name	Value	Description
A2-01	Comm. Add.	1 to 15	The station number cannot exceed 15. At least one station number is set to 1.
A2-03	CAN multi-pump mode	0	Multi-pump mode 1 (broadcast mode)
F4-**	Multi-pump control enable	50	DI5 is shorted to COM
F5-02	D02 output selection	25	Slave pump alarm output

Multi-pump mode 2 (A2-03 = 1)

Parameter setting: Ensure that the No. 1 drive exists. The No. 1 drive is an absolute master pump and cannot be used as a slave pump. Up to four combinations of divergent flow control are available as follows:

Parameter	Name	Value	Description
F4-**	Slave pump address selection terminal 1	53	It is used to determine which slave pumps are used for convergence in multi-pump divergent flow control.
F4-**	Slave pump address selection terminal 2	54	
F5-02	D02 output selection	25	Slave pump alarm output
A2-01	Comm. Add.	1 to 15	The station number cannot exceed 15. At least one station number is set to 1.
A2-03	CAN multi-pump mode	1	Multi-pump mode 2 (multi-master mode)

Parameter	Name	Value	Description
A2-04	CAN slave pump address 1	0	Used with No. 53 an 54 input terminals to achieve four slave pump combinations.
A2-05	CAN slave pump address 2	0	
A2-06	CAN slave pump address 3	0	
A2-07	CAN slave pump address 4	0	

Slave pump address DI selection

N0. 54 terminal input	N0. 53 terminal input	CAN slave address selection
0	0	A2-04: CAN slave pump address 1
0	1	A2-05: CAN slave pump address 2
1	0	A2-06: CAN slave pump address 3
1	1	A2-07: CAN slave pump address 4

Slave pump address setting

The LED for setting the slave pump address is as follows:

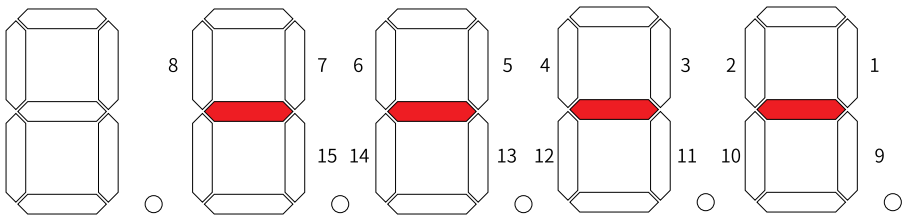


Figure 17-9 Slave address setting LED

- The digits next to the LED segments are station numbers.
- When a segment is lit, the slave pump with the corresponding station No. is enabled for flow control.
- You can set up to 15 slave pump addresses.

In the following setting, No. 1 is the master pump, and No. 2, 3 and 4 slave pumps are enabled.

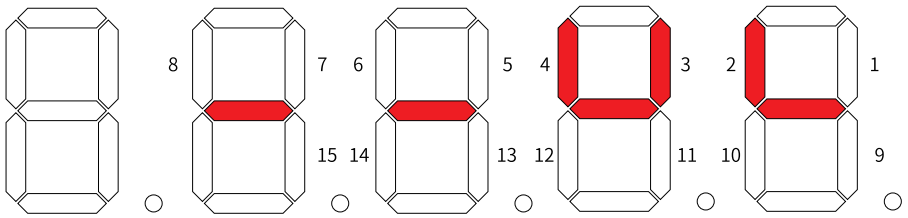


Figure 17-10 Slave pump address setting

Key operation:

You can use  and  to set the addresses of No. 1 to 2 pumps.

You can use  and  to set the addresses of No. 9 to 15 pumps.

17.4 Setting of Slave Drive

Multi-pump mode 1 (A2-03 = 0)

The following table shows the drive parameter setting. Other parameters are set according to the general method of the servo drive pump.

Parameter	Name	Value	Description
A2-01	PROFIBUS-CAN communication address	2 to 15	The slave drive station number must be at least 2 and not exceed 15.
F4-**	Multi-pump control enable	50	Slave pump or switch to master pump control

To switch from a slave pump to the main pump, just disconnect the No. 50 DI terminal of the slave pump.

Multi-pump mode 2 (A2-03 = 1)

The following table shows the drive parameter setting. Other parameters are set according to the general method of the servo drive pump.

Parameter	Name	Value	Description
A2-01	PROFIBUS-CAN communication address	2 to 15	The slave drive station number must be at least 2 and not exceed 15.
F4-**	Slave pump address selection terminal 1	53	Turning the slave pump to the master pump must be triggered by a terminal. For slave pump address setting, see "Setting of the Master Pump Drive".
F4-**	Slave pump address selection terminal 2	54	

17.5 Multi-Pump Convergent and Shunt Flow Control

Multi-pump mode 1 (A2-03 = 0)

Example: The oil pump system of the injection molding machine carries three pumps in total. As slave pump is not available in multi-pump mode 1, the following two combinations can be used.

- Combination 1: 3-pump convergent flow
- Combining 2: 2+1 divergent flow, No. 2 slave pump follows No. 1 master pump and No. 3 pump switches to the master pump.

The following describes the wiring of the preceding two combinations.

- **Combination 1: 3-pump convergent flow**

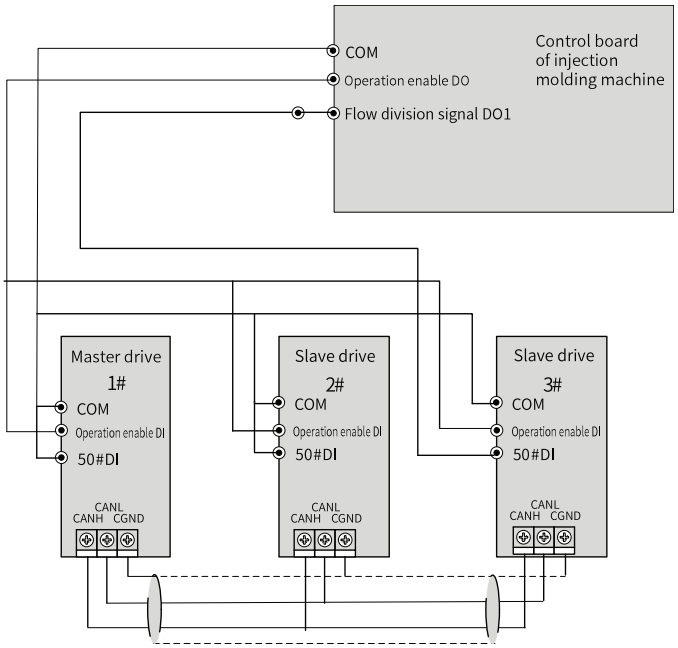


Figure 17-11 Wiring

Description:

As master pump 1 keeps being the master pump and master pump 2 keeps being the slave pump, the No. 50 DI terminal is shorted directly.

In combination 3, the No. 3 slave pump is switched to the master pump through an external signal. Therefore, the computer board of the host controller sends a closing signal to close the No. 50 DI terminal of the No. 3 slave pump for multi-pump convergent flow control.

- **Combining 2: 2+1 divergent flow, No. 2 slave pump follows No. 1 master pump and No. 3 pump switches to the master pump.**

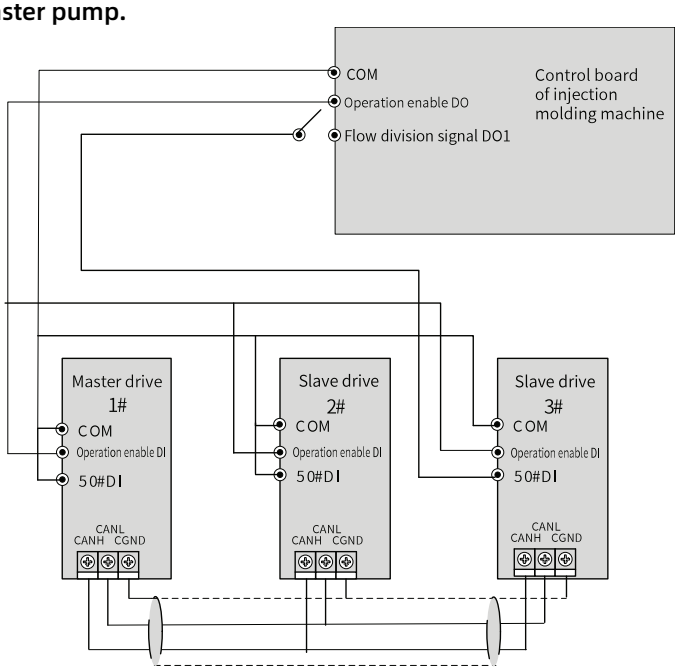


Figure 17-12 2+1 divergent flow control

The master pump 1 drives the slave pump 2 and pump 3 switches to the master pump. You can switch pump 3 to the master pump by disconnecting No. 50 DI terminal of slave pump 3. The same applies to other cases.

Multi-pump mode 2 (A2-03 = 1)

Example: The oil pump drive system of the injection molding machine carries four oil pumps in total, with addresses being #1, #2, #3, and #4 respectively. Then the following four combinations are available.

- Combination 1: 4-pump convergent flow
- Combination 2: 2+2 divergent flow control, pump 1 used as master pump to drive slave pump 2, and pump 3 used as the master pump to drive slave pump 4.
- Combination 3: 3+1 divergent flow control. No. 2 and 3 slave pumps follow No. 1 master pump and No. 4 pump switches to the master pump.

The following describes the wiring and setting for preceding three combinations.

The CAN communication addresses A2-01 of the four pumps are set to 1#, 2#, 3#, and 4# respectively. In the three combinations, the master pump address is set to 1#.

- **Combination 1: 4-pump convergent flow control**

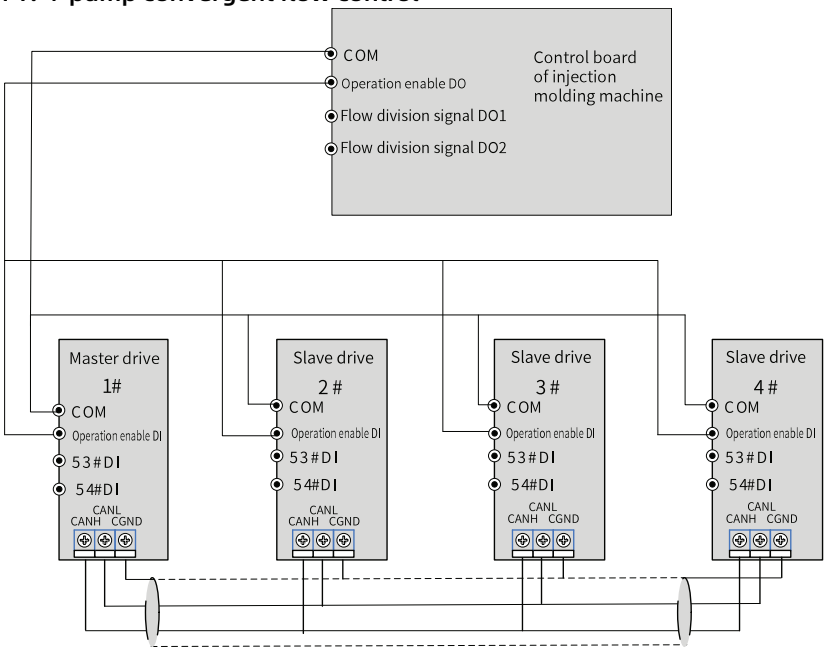


Figure 17-13 Pump convergent flow control

Wiring description: In case of flow integration only, connect all the CAN cables properly, including the operation enable DI terminal.

Parameter setting: Pump 1 acts as the master pump, pumps 2, 3, and 4 are available. The corresponding slave pump address parameter is A2-04. The parameter setpoint is as follows.

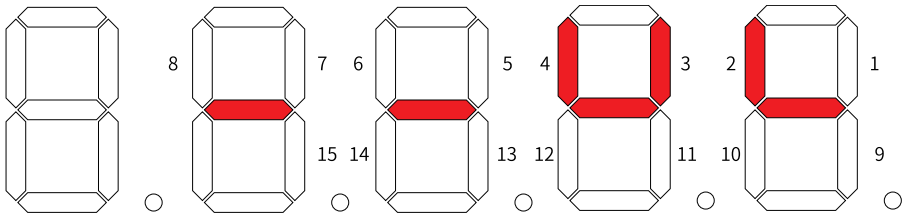


Figure 17-14 Slave pump address parameter setting

- **Combination 2: 2+2 divergent flow control, pump 1 used as master pump to drive slave pump 2, and pump 3 used as the master pump to drive slave pump 4.**

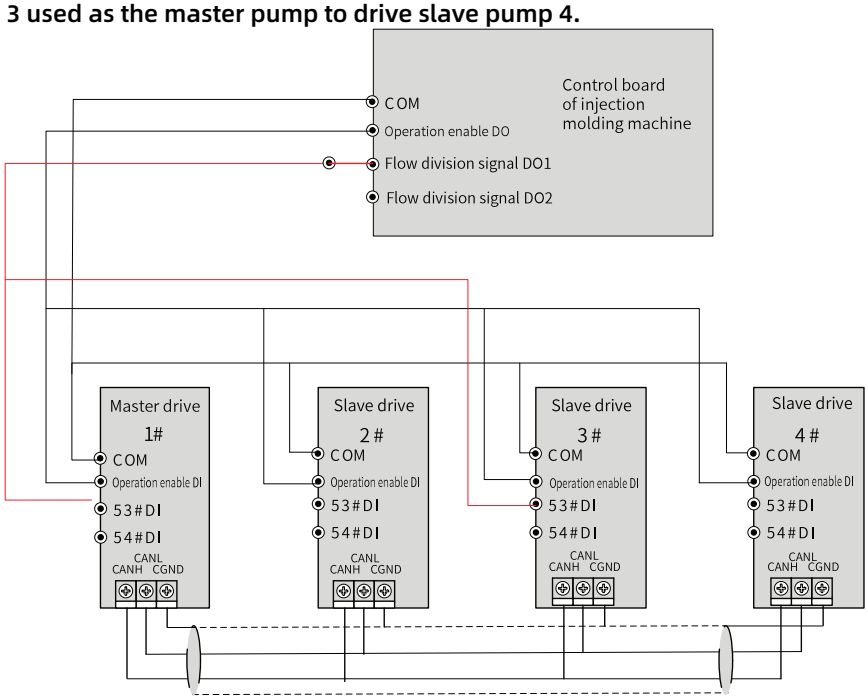


Figure 17-15 2+2 for flow-dividing control

Wiring description: The host controller provides flow-dividing signal to be connected to No. 53 DI terminal of the drive that used as the master pump. The master pump uses the No. 53 signal to identify the slave address, while the slave pump uses the No. 53 signal to switch to the master pump to identify the slave pump address.

Parameter setting: In this combination mode, master pumps 1 and 3 are available, with the slave pump changed accordingly. The slave pump address needs to be set. The slave pump of master pump 1 is pump 2. The slave pump address (A2-05) is set as follows.

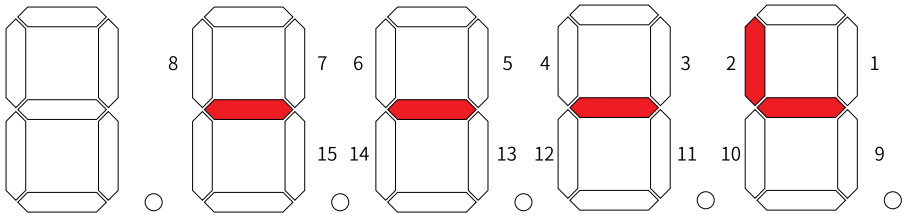


Figure 17-16 Slave pump address setting (A2-05)

The slave pump of master pump 3 is pump 4. The slave pump address (A2-05) is set as follows.

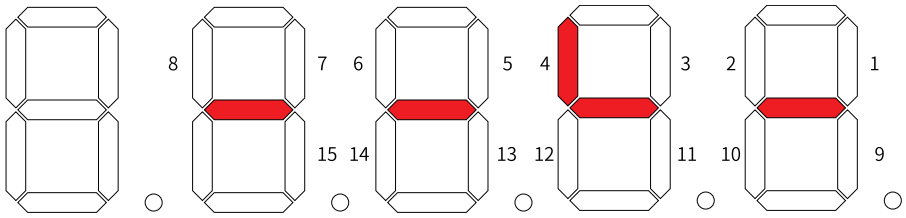


Figure 17-17 Slave pump address setting (A2-05)

- **Combination 3: 3+1 divergent flow control. No. 2 and 3 slave pumps follow No. 1 master pump and No. 4 pump switches to the master pump.**

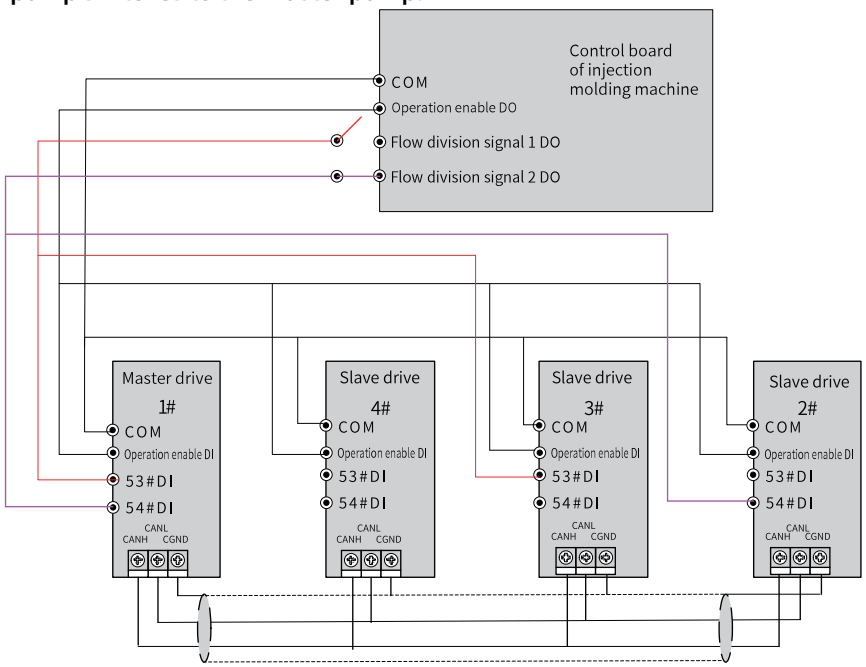


Figure 17-18 3+1 divergent flow control

Wiring instructions: The computer board of the host controller sends a divergent flow signal to the No. 54 DI terminal of the master pump. The master pump use this signal to identify the slave pump address, while the slave pump uses this signal to switch to the master pump to identify the slave pump address. In the second combination, the No. 53 DI terminal is disconnected.

Parameter setting: In this combination mode, master pumps 1 and 4 are available, with the slave pump changed accordingly. The slave pump address needs to be set. The slave pumps of master pump 1 is pump 2 and pump 3. The slave pump address (A2-06) is set as follows.

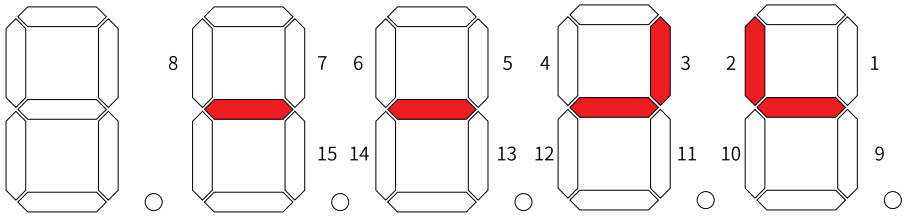


Figure 17-19 Slave pump address setting (A2-06)

After switching to the master pump, the pump 4 does not carry any slave pump, so A2-06 needs no setting.

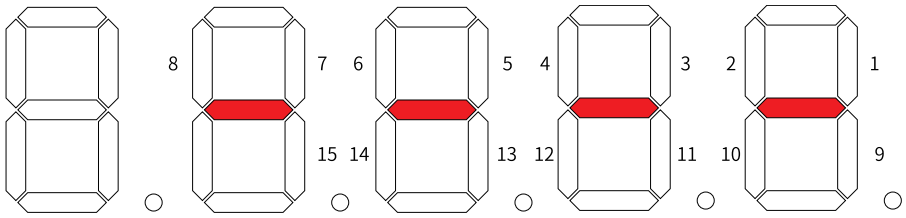


Figure 17-20 Slave pump address setting (A2-06)

17.6 Faults

The following describes the faults that are specific to multi-pump control.

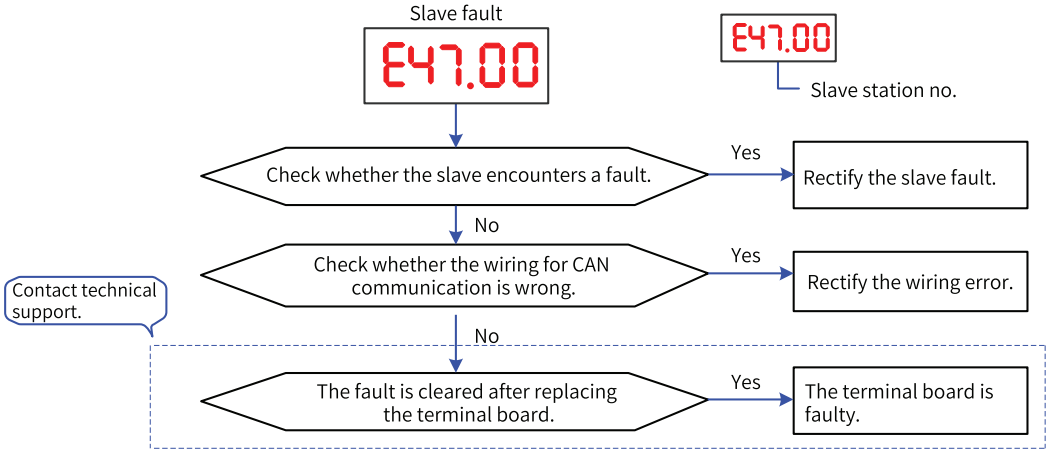


Figure 17-21 Slave fault pre-warning (E47.00)

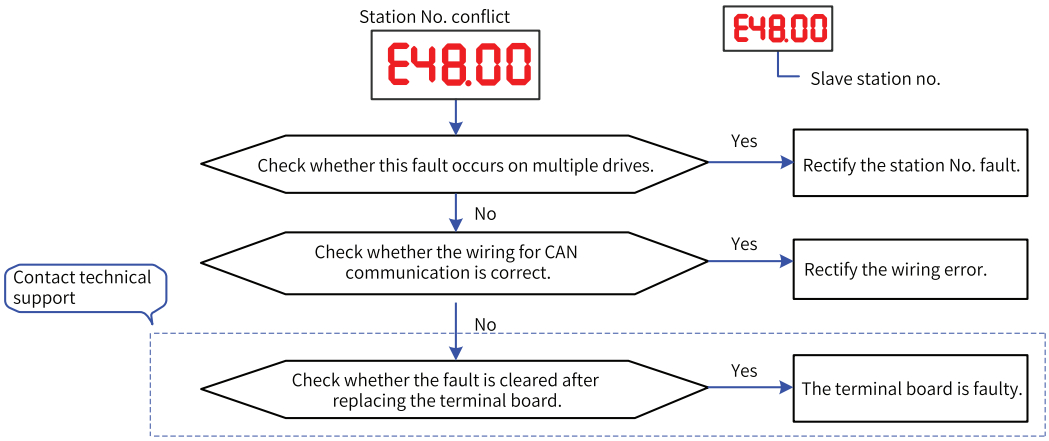


Figure 17-22 CAN address conflict (E48.00)

18 Appendix B: Motor Codes and Models

Motor series	Motor model	Remarks
MEG20-A3A1F	MEG20-85C22CD-A3A1F MEG20-80C20CD-A3A1F MEG20-71C17CD-A3A1F	Standard: Tuning-free
	MEG20-13D22CD-A3A1F MEG20-13D20CD-A3A1F MEG20-11D17CD-A3A1F	
	MEG20-20D22CD-A3A1F MEG20-18D20CD-A3A1F MEG20-17D17CD-A3A1F	
	MEG20-23D22CD-A3A1F MEG20-22D20CD-A3A1F MEG20-23D22CD-A3A1F	
	MEG20-27D22CD-A3A1F MEG20-25D20CD-A3A1F MEG20-23D17CD-A3A1F	
	MEG20-31D22CD-A3A1F MEG20-30D20CD-A3A1F MEG20-27D17CD-A3A1F	
	MEG20-33D22CD-A3A1F MEG20-32D20CD-A3A1F MEG20-29D17CD-A3A1F	
	MEG20-39D22CD-A3A1F MEG20-35D20CD-A3A1F MEG20-32D17CD-A3A1F	
MEG23-A3A1F	MEG23-51D22CD-A3A1F MEG23-48D20CD-A3A1F MEG23-41D17CD-A3A1F	Standard: Tuning-free
	MEG23-55D22CD-A3A1F MEG23-52D20CD-A3A1F MEG23-48D17CD-A3A1F	
	MEG23-63D22CD-A3A1F MEG23-59D20CD-A3A1F MEG23-55D17CD-A3A1F	
	MEG23-75D22CD-A3A1F MEG23-67D20CD-A3A1F MEG23-59D17CD-A3A1F	

19 Appendix C: Motor Parameters and Parameter Auto-tuning

19.1 Overview

This drive allows use of the motor without auto-tuning. You can also perform auto-tuning according to the instructions in this section.

19.2 Motor Parameters

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode
F1-01	0xF101	Motor rated power	0.00 kW–650.00 kW	0.75	kW	At stop
F1-02	0xF102	Motor rated voltage	0 V to 800 V	380	V	At stop
F1-03	0xF103	Motor rated current	0.00 A–650.00 A	4.70	A	At stop
F1-04	0xF104	Motor rated frequency	0.00 Hz–300.00 Hz	133.00	Hz	Un-changeable
F1-05	0xF105	Motor rated rotation speed	0 rpm to 3000 rpm	1500	rpm	At stop
F1-06	0xF106	Rated motor torque	0.00N·m to 650.00N·m	2.39	N·m	At stop
F1-07	0xF107	Max. motor torque	0.00N·m to 650.00N·m	7.16	N·m	At stop
F1-08	0xF108	Motor inertia	0.00 to 650.00	1.30	-	At stop
F1-09	0xF109	Number of motor pole pairs	0 to 10	4	-	At stop
F1-10	0xF10A	Torque coefficient Kt	0.00 to 650.00	0.51	-	Real-time
F1-11	0xF10B	Synchronous motor D-axis inductance	0.00 to 655.35	3.87	-	At stop
F1-12	0xF10C	Synchronous motor Q-axis inductance	0.00 to 655.35	3.27	-	At stop
F1-13	0xF10D	Synchronous motor stator resistance	0.000Ω to 65.535Ω	0.500	Ω	At stop
F1-14	0xF10E	Electrical constant Te	0.00 to 655.35	6.54	-	At stop
F1-15	0xF10F	Synchronous motor back EMF	0 V to 65535 V	300	V	Un-changeable

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode
F1-16	0xF110	Parameter auto-tuning selection	0: No action 1: No-load static auto-tuning 2: No-load dynamic auto-tuning 3: No-load initial angle auto-tuning 4: No-load resistor inductance auto-tuning 5: No-load back EMF auto-tuning	0	-	At stop
F1-17	0xF111	Maximum speed	0 RPM to 65535 RPM	6000	rpm	At stop

19.3 Parameter Auto-tuning

Internal electrical parameters of the controlled motor can be obtained through auto-tuning, as shown in the following table.

Param.	Function	Value range	Default value	Change mode
F1-16	Parameter auto-tuning selection	0: No action 1: No-load static auto-tuning 2: No-load dynamic auto-tuning 3: No-load initial angle auto-tuning 4: No-load resistor inductance auto-tuning 5: No-load back EMF auto-tuning	0	At stop

Note

The ES680 series servo drive supports the tuning-free function when working with an Inovance motor equipped with A3 series high performance encoder. It also supports motor auto-tuning function.

Auto-tuning mode	Applicable scenario
No-load static auto-tuning F1-16 = 1	Applies to scenarios where the motor back EMF is known. The motor operates at low speed during auto-tuning, so the overflow valve can be closed during auto-tuning.
No-load dynamic parameter auto-tuning F1-16 = 2	Applies to scenarios where the motor back EMF is unknown. When the motor operates at high speed during auto-tuning, the relief valve must be opened during auto-tuning. With-load auto-tuning can affect motor auto-tuning precision and system control.

Note

- In addition to the preceding motor auto-tuning methods, you can also input motor parameters manually.
- After auto-tuning is done, set A1-10 to 1 to write parameters to the encoder. Otherwise, the parameters will return to the values before auto-tuned after software reset or restart.
- The operating commands for motor auto-tuning can only be set through local operating panel.
- After re-installing and re-wiring the synchronous motor on the field, perform motor parameter auto-tuning to prevent abnormal motor operation.

Static parameter auto-tuning

Perform motor auto-tuning as follows:

- If the motor can be disconnected from the load, disconnect the power supply, and then disconnect the load from the motor to let the motor rotate without load.

Step	Process
Step 1	After power-on, set F0-02 to 0 to define LED keypad as the command source.
Step 2	Input motor nameplate parameters (F1-00 to F1-05) and the number of motor pole pairs (F1-09) correctly.
Step 3	Set F1-16 to 1 (Static auto-tuning) and press the ENTER key. The operating panel displays "TUNE", as shown below: 
Step 4	Press RUN on the LED operating panel to enable operation. The drive will drive the motor to accelerate/decelerate and run in the forward/reverse direction, and the RUN indicator lights up. The auto-tuning process lasts for about two minutes. When the preceding information disappears and the operating panel returns to the normal parameter display status, auto-tuning is completed.

The motor resistance, inductance, and initial angle are auto-tuned.

Dynamic parameter auto-tuning

If the motor features constant output or high accuracy is required, perform dynamic complete auto-tuning after disconnecting the motor from the load for optimal auto-tuning effect.

Step	Process
Step 1	After power-on, set F0-02 to 0 to define the keypad as the command source.
Step 2	Input motor nameplate parameters (F1-00 to F1-05) and the number of motor pole pairs (F1-09) correctly.
Step 3	Set F1-16 to 2 (No-load dynamic auto-tuning) and press ENTER. The operating panel displays as follows: 
Step 4	Press RUN on the LED operating panel to enable operation. The drive will drive the motor to accelerate/decelerate and run in the forward/reverse direction, and the RUN indicator lights up. The auto-tuning process lasts for a while. If the preceding display disappears and the keypad returns to the normal parameter display state, auto-tuning is done.

The motor resistance, inductance, initial angle, and back EMF are auto-tuned.

Single auto-tuning

Single auto-tuning mode applies when the motor can be disconnected from the load and only single motor parameter needs to be auto-tuned.

Step	Process
Step 1	After power-on, set F0-02 to 0 to define the keypad as the command source.
Step 2	Input motor nameplate parameters (F1-00 to F1-05) and the number of motor pole pairs (F1-09) correctly.
Step 3	Set F1-16 based on the single auto-tuning function needed and press ENTER. The keypad displays the following information. 
Step 4	Press RUN on the LED operating panel to enable operation. The drive will drive the motor to accelerate/decelerate and run in the forward/reverse direction, and the RUN indicator lights up. The auto-tuning process lasts for a while. If the preceding display disappears and the keypad returns to the normal parameter display state, auto-tuning is done.

19.4 Running Status Observation

1. After motor auto-tuning is done, set F0-08 to 5.00 Hz for low-speed trial running.
2. Check whether the operating current of the drive is low and stable.
   If the operating current is large, check whether the motor parameters (group F1) are set properly.
   If you change the motor parameters, perform auto-tuning and low-speed operation again.
3. Check whether the motor operates properly.

- If oscillation or humming sound occurs during operation of the motor, weaken the responsiveness of the speed loop and current loop. You can reduce the values of F2-00, F2-03, F1-23, F1-24, F1-25, F1-26, F1-29, F1-30, F1-31, and F1-32, and increase the values of F2-01 and F2-04.
- If the motor speed is unstable during operation, increase the speed loop gain and current loop gain. You can increase the values of F2-00, F2-03, F2-13, F2-14, F2-15, and F2-16 and reduce the values of F2-01 and F2-04.

Warning

Fully open the overflow valve to ensure a no-load operation.

Note

- Speed loop and current loop parameters are listed in groups F1 and F2.
- The responsiveness of the speed loop and current loop affect the pressure stability directly. Set the responsiveness of the speed loop and current loop to high values if allowed.

20 Appendix D Parameter List

For more detailed parameter descriptions, download the My Inovance app (follow the guidance in *" " on page*) and view parameters in the app.

20.1 Group F0 Basic Control Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F0-00	0xF000	Model selection	1: G type 2: P type	1	-	Read-only
F0-01	0xF001	Control mode	1: Feedback vector control (FVC)	1	-	At stop
F0-02	0xF002	Reference source	0: Operating panel 1: Terminal 2: Communication	0	-	Real time
F0-03	0xF003	Main frequency source	0: Numeric value; adjusted by UP/DOWN key; non-retentive 1: Numeric value; adjusted by UP/DOWN key; retentive 2: AI1 3: AI2 4: AI3 5: Reserved 6: Multi-reference 7: Reserved 8: Reserved 9: Communication	0	-	At stop
F0-04	0xF004	Auxiliary frequency source Y	0: Numeric value; adjusted by UP/DOWN key; non-retentive 1: Numeric value; adjusted by UP/DOWN key; retentive 2: AI1 3: AI2 4: AI3 5–8: Reserved 9: Communication	0	-	At stop
F0-05	0xF005	Range of auxiliary frequency source Y	0: Relative to the maximum frequency 1: Relative to the main frequency X	0	-	Real time
F0-06	0xF006	Range of auxiliary frequency source Y	0 to 100	100	%	Real time
F0-07	0xF007	Frequency source	0: Main frequency source X 1: Operation result of main frequency X and auxiliary frequency Y (based on tens) 2: Switchover between main frequency source X and auxiliary frequency source Y 3: Switchover between main frequency X and the operation result of main and auxiliary frequencies	0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F0-08	0xF008	Preset frequency	0.00 to 300.00	100.00	Hz	Real time
F0-09	0xF009	Rotation direction	0: Same as the default direction 1: Reverse to the default direction	0	-	At stop
F0-10	0xF00A	Maximum frequency	50.00 to 300.00	200.00	Hz	At stop
F0-11	0xF00B	Frequency upper limit source	0: F0-12 1: AI1 2: AI2 3: AI3 4: Reserved 5: Communication	0	-	At stop
F0-12	0xF00C	Frequency upper limit	F0-14 to F0-10	200.00	Hz	Real time
F0-13	0xF00D	Frequency upper limit offset	0.00 to F0-10	0.00	Hz	Real time
F0-14	0xF00E	Frequency lower limit	0.00 to F0-12	0.00	Hz	Real time
F0-15	0xF00F	Carrier frequency	2.0 to 8.0	5.0	kHz	At stop
F0-17	0xF011	Acceleration time	0 to 65000	20000	ms	Real time
F0-18	0xF012	Deceleration time	0 to 65000	20000	ms	Real time

20.2 Group F1 Motor Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F1-00	0xF100	Motor type selection	0 to 65535	14101	-	At stop
F1-01	0xF101	Rated motor power	0.00 to 650.00	0.75	kW	At stop
F1-02	0xF102	Rated motor voltage	0 to 800	380	V	At stop
F1-03	0xF103	Rated motor current	0.00 to 650.00	4.70	A	At stop
F1-04	0xF104	Rated motor frequency	0.00 to 300.00	133.00	Hz	Read-only
F1-05	0xF105	Rated motor speed	0 to 3000	1500	rpm	At stop
F1-06	0xF106	Motor rated torque	0.00 to 650.00	2.39	N·m	At stop
F1-07	0xF107	Max. motor torque	0.00 to 650.00	7.16	N·m	At stop
F1-08	0xF108	Motor moment of inertia	0.00 to 650.00	1.30	-	At stop
F1-09	0xF109	Number of motor pole pairs	0 to 10	4	-	At stop
F1-10	0xF10A	Torque coefficient Kt	0.00 to 650.00	0.51	-	Real time
F1-11	0xF10B	D-axis inductance of synchronous motor	0.00 to 655.35	3.87	-	At stop
F1-12	0xF10C	Q-axis inductance of synchronous motor	0.00 to 655.35	3.27	-	At stop
F1-13	0xF10D	Stator resistance of synchronous motor	0.000 to 65.535	0.500	Ω	At stop
F1-14	0xF10E	Motor electrical constant Te	0.00 to 655.35	6.54	-	At stop

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F1-15	0xF10F	Back EMF of synchronous motor	0 to 65535	300	V	Read-only
F1-16	0xF110	Test auto-tuning selection	0: No action 1: No-load static auto-tuning 2: No-load dynamic auto-tuning 3: No-load initial angle auto-tuning 4: No-load resistor inductance auto-tuning 5: No-load back EMF auto-tuning	0	-	At stop
F1-17	0xF111	Maximum speed	0 to 65535	6000	rpm	At stop
F1-18	0xF112	Back EMF coefficient	0.00 to 655.35	33.30	-	At stop
F1-19	0xF113	Absolute encoder position offset L	0 to 65535	8192	-	At stop
F1-20	0xF114	Absolute encoder position offset H	0 to 65535	0	-	At stop
F1-21	0xF115	D-axis back EMF compensation coefficient	0.0 to 6553.5	60.0	-	Real time
F1-22	0xF116	q-axis back EMF compensation coefficient	0.0 to 6553.5	100.0	-	Real time
F1-23	0xF117	D-axis current loop proportional gain	0 to 65535	1000	-	Real time
F1-24	0xF118	d-axis current loop integral compensation factor	0.00 to 655.35	2.00	-	Real time
F1-25	0xF119	Q-axis current loop proportional gain	0 to 65535	1000	-	Real time
F1-26	0xF11A	q-axis current loop integral compensation factor	0.00 to 655.35	1.00	-	Real time
F1-27	0xF11B	Duty ratio set directly upon voltage injection auto-tuning electrical angle	0 to 65535	0	-	At stop
F1-28	0xF11C	Carrier frequency obtained upon voltage injection auto-tuning electrical angle	200 to 20000	8000	-	Real time
F1-29	0xF11D	d-axis proportional gain in performance priority mode	0 to 65535	2000	-	Real time
F1-30	0xF11E	D-axis integral compensation factor in performance priority mode	0.00 to 655.35	2.00	-	Real time
F1-31	0xF11F	q-axis proportional gain in performance priority mode	0 to 65535	2000	-	Real time
F1-32	0xF120	Q-axis integral compensation factor in performance priority mode	0.00 to 655.35	1.00	-	Real time
F1-33	0xF121	Mechanical constant Tm	0.00 to 655.35	0.24	-	At stop

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F1-34	0xF122	Serial encoder motor model	0 to 65535	0	-	At stop
F1-35	0xF123	Absolute encoder function setting bit	0 to 65535	0	-	At stop
F1-36	0xF124	Maximum motor current	0.00 to 655.35	16.95	A	At stop
F1-37	0xF125	Low 16 bits of motor SN	0 to 65535	0	-	At stop
F1-38	0xF126	High 16 bits of motor SN	0 to 65535	0	-	At stop
F1-39	0xF127	Encoder software version	0.0 to 6553.5	0.0	-	Read-only
F1-40	0xF128	Absolute encoder type	0 to 65535	0	-	At stop
F1-41	0xF129	Search for duty cycle upon voltage injection auto-tuning	0 to 1	1	-	At stop
F1-42	0xF12A	Q-axis current integral gain varying with carrier frequency	0 to 1	1	-	At stop

20.3 Group F2 Vector Control Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F2-00	0xF200	Speed loop proportional gain 1	0.1 to 2000.0	25.0	-	Real time
F2-01	0xF201	Speed loop integral time 1	0.15 to 512.00	31.83	-	Real time
F2-02	0xF202	Speed loop switchover speed 1	0 to F2-05	75	rpm	Real time
F2-03	0xF203	Speed loop proportional gain 2	0.1 to 2000.0	14.0	-	Real time
F2-04	0xF204	Speed loop integral time 2	0.15 to 512.00	26.53	-	Real time
F2-05	0xF205	Speed loop switchover speed 2	F2-02 to 20000	150	rpm	Real time
F2-06	0xF206	Real-time inertia ratio display value	0.00 to 120.00	2.00	-	Read-only
F2-07	0xF207	Speed feedback filter time	0.1 to 100.0	2.0	ms	Real time
F2-08	0xF208	Servo performance mode	0: Normal mode 1: Performance enhanced mode 2: High-performance mode	0	-	Real time
F2-09	0xF209	Torque upper limit source in speed control	0: F2-10 1: AI1 2: AI2 3: AI3 5: Communication	0	-	Real time
F2-10	0xF20A	Torque upper limit	0.0 to 250.0	200.0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F2-11	0xF20B	Auto-tuning mode selection	0 to 1 When this parameter changes from 0 to 1, the first and second rigidity levels are modified once (rigidity level: speed loop PI regulator parameter group).	1	-	Real time
F2-12	0xF20C	Rigidity level selection	0 to 31	12	-	Real time
F2-13	0xF20D	Load moment of inertia ratio	0.00 to 120.00	1.00	-	At stop
F2-14	0xF20E	Second stiffness level Kp	0 to 31	10	-	Real time
F2-15	0xF20F	Second stiffness level Ki	0 to 31	13	-	Real time
F2-16	0xF210	Time constant of speed feedforward filter	0.00 to 64.00	0.50	-	Real time
F2-17	0xF211	Speed feedforward gain	0.0 to 100.0	0.0	-	Real time
F2-18	0xF212	FPGA speed moving average filter selection	0 to 4	4	-	At stop
F2-19	0xF213	Cutoff frequency of speed feedback low-pass filter	100 to 4000	4000	-	Real time
F2-20	0xF214	Torque feedforward selection	0: No torque feedforward 1: Internal torque feedforward	1	-	Real time
F2-21	0xF215	Cogging torque compensation fluctuation component	0 to 200	100	-	Real time
F2-22	0xF216	Cogging torque fluctuation learning selection	0 to 1	0	-	Real time
F2-23	0xF217	Average of friction torque fluctuation	0 to 100	0	-	Real time
F2-24	0xF218	Cogging torque compensation enable	0 to 1	1	-	Real time
F2-25	0xF219	Time constant of torque feedforward filter	0.00 to 64.00	0.50	-	Real time
F2-26	0xF21A	Torque feedforward gain	0.0 to 200.0	0.0	-	Real time
F2-27	0xF21B	PDFF control coefficient	0.0 to 1000.0	100.0	-	Real time
F2-28	0xF21C	Speed feedback selection	0 to 1	0	-	Real time
F2-29	0xF21D	Speed observer control coefficient	0.0 to 100.0	0.0	-	Real time
F2-30	0xF21E	Cutoff frequency of speed observer	10 to 2000	170	Hz	Real time
F2-31	0xF21F	Inertia correction coefficient of speed observer	10 to 10000	100	%	Real time
F2-32	0xF220	Filter time of speed observer	0.02 to 20.00	0.80	ms	Real time
F2-33	0xF221	Disturbance compensation time	0.00 to 100.00	0.20	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F2-34	0xF222	Disturbance compensation gain	10 to 1700	600	%	Real time
F2-35	0xF223	Disturbance compensation coefficient	0 to 100	0	-	Real time
F2-36	0xF224	Inertia correction for 1% disturbance compensation gain	1 to 10000	100	%	Real time
F2-37	0xF225	Constant ratio for disturbance observer vibration suppression APF (Tapf/Tbpf x 100)	0 to 1600	0	-	Real time
F2-38	0xF226	Vibration suppression frequency	0 to 1000	0	-	Real time
F2-39	0xF227	Vibration suppression coefficient of disturbance observation	0 to 200	0	-	Real time
F2-40	0xF228	APF2	0 to 1600	0	-	Real time
F2-41	0xF229	Vibration suppression frequency 2	0 to 800	0	-	Real time
F2-42	0xF22A	Vibration suppression coefficient 2 of disturbance observation	0 to 1500	0	-	Real time
F2-43	0xF22B	Speed observation selection	0 to 1	0	-	Real time
F2-44	0xF22C	Disturbance observer torque switch	0 to 2	0	-	Real time
F2-45	0xF22D	Model control enable	0 to 1	0	-	Real time
F2-46	0xF22E	Model gain	0.0 to 6553.5	40.0	-	Real time
F2-47	0xF22F	Gain adjustment coefficient	51.2 to 204.8	102.4	-	Real time
F2-48	0xF230	Feedforward position selection	0 to 1	0	-	Real time
F2-49	0xF231	Feedforward value	0.0 to 102.4	95.0	-	Real time
F2-50	0xF232	Integral of gain adjustment coefficient 2	0.15 to 512.00	512.00	-	Real time
F2-51	0xF233	Model torque forward correction coefficient	0.0 to 204.8	102.4	-	Real time
F2-52	0xF234	Model torque negative correction coefficient	0.0 to 204.8	102.4	-	Real time
F2-53	0xF235	Filter time	0.00 to 655.35	0.00	-	Real time
F2-54	0xF236	Derivative constant	0.00 to 655.35	0.00	-	Real time
F2-55	0xF237	Fully closed-loop vibration suppression selection	0 to 2	0	-	Real time
F2-56	0xF238	Vibration frequency	0.0 to 600.0	0.0	-	Real time
F2-57	0xF239	Compensation gain	0 to 200	0	-	Real time
F2-58	0xF23A	Speed reference filter time	0.00 to 655.35	0.00	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F2-59	0xF23B	Vibration suppression phase	0 to 1600	100	-	Real time
F2-60	0xF23C	Rotor vibration detection selection	0 to 1	0	-	Real time
F2-61	0xF23D	Excessive vibration reporting switch	0 to 2	0	-	Real time
F2-62	0xF23E	Vibration frequency 2	0.0 to 600.0	0.0	-	Real time
F2-63	0xF23F	Compensation gain 2	0 to 200	0	-	Real time
F2-64	0xF240	Vibration suppression phase 2	0 to 1600	100	-	Real time
F2-65	0xF241	Speed observation feedback source	0 to 1	0	-	Real time

20.4 Group F3 Torque Control Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
F3-00	0xF300	Torque control mode	0: Non-torque mode 1: Torque mode	0	-	At stop
F3-01	0xF301	Torque reference source	0: Operating panel (F3-02) 1: AI1 2: AI2 3: AI3 5: Communication	0	-	At stop
F3-02	0xF302	Torque reference set through operation panel	-400.0 to 400.0	0.0	%	Real time
F3-03	0xF303	Torque reference filter time 1	0.00 to 30.00	0.80	ms	Real time
F3-04	0xF304	Torque reference filter time 2	0.00 to 30.00	2.65	ms	Real time
F3-05	0xF305	Speed limit in torque control	0 to 6000	3000	rpm	Real time
F3-43	0xF32B	Tooling mode selection	0: Disable 1: Enable	0	-	At stop
F3-44	0xF32C	Tooling frequency reference	0 to 50	50	Hz	At stop
F3-45	0xF32D	Tooling current reference	10.0 to 100.0	30.0	%	At stop

20.5 Group F4 Input Terminal Parameters

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
F4-00	0xF400	DI1 function selection	0: Not assigned 1: Forward run 2: Reverse run 3-7: Reserved 8: Coast to stop 9: Fault reset 10: Reserved 11: External fault NO input 12: Multi-reference terminal 1 13: Multi-reference terminal 2 14: Multi-reference terminal 3 15: Multi-reference terminal 4 16 to 31: Reserved 32: Mold-opening signal flag 33: External fault normally closed (NC) input 34 to 47: Reserved 48: Servo oil pump PID selection terminal 1 49: Servo oil pump PID selection terminal 2 50: CAN communication 51: Slave used as master 52: Switching from pressure mode to speed mode 53: Slave pump address selection terminal 1 54: Slave pump address selection terminal 2 55: Switching from injection mode to pressure holding mode 56: Fault reset terminal 2 (overcurrent fault cannot be reset) 57: Switching from pressure mode to speed mode (torque upper limit = F2-10) 58 to 61: Reserved	1	-	Change at stop
F4-01	0xF401	DI2 function	Same as F4-00	48	-	Change at stop
F4-02	0xF402	DI3 function	Same as F4-00	53	-	Change at stop
F4-03	0xF403	DI4 function	Same as F4-00	9	-	Change at stop
F4-04	0xF404	DI5 function	Same as F4-00	50	-	Change at stop
F4-05	0xF405	DI6 terminal function selection	Same as F4-00	0	-	Change at stop
F4-06	0xF406	DI7 function selection	Same as F4-00	0	-	Change at stop

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
F4-07	0xF407	DI8 terminal function selection	Same as F4-00	0	-	Change at stop
F4-08	0xF408	DI9 function selection	Same as F4-00	0	-	Change at stop
F4-09	0xF409	DI10 terminal function selection	Same as F4-00	0	-	Change at stop
F4-10	0xF40A	DI11 terminal function selection	Same as F4-00	0	-	Change at stop
F4-11	0xF40B	DI12 terminal function selection	Same as F4-00	0	-	Change at stop
F4-12	0xF40C	DI13 terminal function selection	Same as F4-00	0	-	Change at stop
F4-13	0xF40D	DI14 terminal function selection	Same as F4-00	0	-	Change at stop
F4-14	0xF40E	DI15 terminal function selection	Same as F4-00	0	-	Change at stop
F4-15	0xF40F	DI filter time	0.00 to 500.00	0.50	ms	Real time
F4-16	0xF410	Active state of DI	0x0 to 0x3FF	0x0	-	Change at stop
F4-17	0xF411	AI filter time	0.000 to 5.000	0.010	s	Real time
F4-18	0xF412	AI1 minimum input	-11.00 to +11.00	0.02	V	Real time
F4-19	0xF413	Corresponding setting of AI1 minimum input	-100.0 to +100.0	0.0	%	Real time
F4-20	0xF414	Maximum input of AI1	-11.00 to +11.00	10.00	V	Real time
F4-21	0xF415	Corresponding setting of AI1 maximum input	-100.0 to +100.0	100.0	%	Real time
F4-22	0xF416	AI1 filter time	0.000 to 10.000	0.040	s	Real time
F4-23	0xF417	Minimum input of AI2	-11.00 to +11.00	0.02	V	Real time
F4-24	0xF418	Corresponding setting of AI2 minimum input	-100.0 to +100.0	0.0	%	Real time
F4-25	0xF419	Maximum input of AI2	-11.00 to +11.00	10.00	V	Real time
F4-26	0xF41A	Settings corresponding to AI2 maximum input	-100.0 to +100.0	100.0	%	Real time
F4-27	0xF41B	AI2 filter time	0.000 to 10.000	0.020	s	Real time
F4-28	0xF41C	Minimum input of AI3	0.00 to 11.00	0.02	V	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
F4-29	0xF41D	Corresponding setting of AI3 minimum input	-100.0 to +100.0	0.0	%	Real time
F4-30	0xF41E	Maximum input of AI3	0.00 to 11.00	10.00	V	Real time
F4-31	0xF41F	Settings corresponding to AI3 maximum input	-100.0 to +100.0	100.0	%	Real time
F4-32	0xF420	AI3 filter time	0.000 to 10.000	0.000	s	Real time
F4-33	0xF421	AI4 minimum input	0.00 to 11.00	0.02	V	Real time
F4-34	0xF422	Corresponding setting of AI4 minimum input	-100.0 to +100.0	0.0	%	Real time
F4-35	0xF423	AI4 maximum input	0.00 to 11.00	10.00	V	Real time
F4-36	0xF424	Corresponding setting of AI4 maximum input	-100.0 to +100.0	100.0	%	Real time
F4-37	0xF425	AI4 filter time	0.000 to 10.000	0.000	s	Real time
F4-38	0xF426	Displayed voltage 1 of motor temperature sampling	0.000 to 5.000	1.500	V	Real time
F4-39	0xF427	Measured voltage 1 of motor temperature sampling	0.000 to 5.000	1.500	V	Real time
F4-40	0xF428	Displayed voltage 2 of motor temperature sampling	0.000 to 5.000	2.200	V	Real time
F4-41	0xF429	Measured voltage 2 of motor temperature sampling	0.000 to 5.000	2.200	V	Real time
F4-43	0xF42B	AI1 displayed voltage 1	-9.999 to 9.999	2.000	V	Real time
F4-44	0xF42C	Measured voltage 1 of AI1	-9.999 to 9.999	2.000	V	Real time
F4-45	0xF42D	Displayed voltage 2 of AI1	-9.999 to 9.999	8.000	V	Real time
F4-46	0xF42E	AI1 measured voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-47	0xF42F	AI2 displayed voltage 1	-9.999 to 9.999	2.000	V	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
F4-48	0xF430	AI2 measured voltage 1	-9.999 to 9.999	2.000	V	Real time
F4-49	0xF431	AI2 displayed voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-50	0xF432	AI2 measured voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-51	0xF433	AI3 displayed voltage 1	-9.999 to 9.999	2.000	V	Real time
F4-52	0xF434	AI3 measured voltage 1	-9.999 to 9.999	2.000	V	Real time
F4-53	0xF435	AI3 displayed voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-54	0xF436	AI3 measured voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-55	0xF437	AI4 displayed voltage 1	-9.999 to 9.999	2.000	V	Real time
F4-56	0xF438	AI4 measured voltage 1	-9.999 to 9.999	2.000	V	Real time
F4-57	0xF439	AI4 displayed voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-58	0xF43A	AI4 measured voltage 2	-9.999 to 9.999	8.000	V	Real time
F4-59	0xF43B	VDI reference (bit0 to 7 correspond to eight VDIs)	0 to 255	0	-	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
F4-60	0xF43C	VDI1 function	0: Not assigned 1: Forward run 2: Reverse run 3-7: Reserved 8: Coast to stop 9: Fault reset 10: Reserved 11: External fault NO input 12: Multi-reference terminal 1 13: Multi-reference terminal 2 14: Multi-reference terminal 3 15: Multi-reference terminal 4 16 to 31: Reserved 32: Mold-opening signal flag 33: External fault normally closed (NC) input 34 to 47: Reserved 48: Servo oil pump PID selection terminal 1 49: Servo oil pump PID selection terminal 2 50: CAN communication 51: Slave used as master 52: Switching from pressure mode to speed mode 53: Slave pump address selection terminal 1 54: Slave pump address selection terminal 2 55: Switching from injection mode to pressure holding mode 56: Fault reset terminal 2 (overcurrent fault cannot be reset) 57: Switching from pressure mode to speed mode (torque upper limit = F2-10) 58 to 61: Reserved	0	-	Change at stop
F4-61	0xF43D	VDI2 function	Same as F4-60	0	-	Change at stop
F4-62	0xF43E	VDI3 function	Same as F4-60	0	-	Change at stop
F4-63	0xF43F	VDI4 function	Same as F4-60	0	-	Change at stop
F4-64	0xF440	VDI5 function	Same as F4-60	0	-	Change at stop
F4-65	0xF441	VDI6 function	Same as F4-60	0	-	Change at stop
F4-66	0xF442	VDI7 function	Same as F4-60	0	-	Change at stop
F4-67	0xF443	VDI8 function	Same as F4-60	0	-	Change at stop

20.6 Group F5 Output Terminal Parameter List

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F5-01	0xF501	DO1 function selection	0: No output 1: Drive in operation 2: Fault output 3 to 6: Reserved 7: Drive overload pre-alarm 8 to 11: Reserved 12: Operating time arrival 13: Reserved 14: Reserved 15: Ready to run 16: AI1 absolute value higher than AI2 absolute value after calibration 17 to 19: Reserved 20: Communication 21: Reserved 22: Reserved 23: Swashplate switchover 1 of double-discharge piston pump 24: Pressure control state output 25: Slave pump alarm output 26: Swashplate switchover 2 of double-discharge piston pump 27: Bus voltage established 28: Commercial operating time arrival 29: Commercial operating time lower than 24 hours 30: Maximum negative speed DO 31: Alarm output 32: Motor temperature reached 33: Reserved 34: Back pressure valve open during mold opening 35: Reserved	2	-	Real time
F5-02	0xF502	DO2 output	Same as F5-01	23	-	Real time
F5-03	0xF503	DO3 output (expansion card)	Same as F5-01	24	-	Real time
F5-04	0xF504	DO4 output selection (expansion card)	Same as F5-01	0	-	Real time
F5-05	0xF505	Communication-controlled DO output (DO written through communication, represented by 4 bits)	0 to 15	0	-	Real time
F5-06	0xF506	VDO output 1 (No. 0 to 15 functions, low bit indicates No. 0 function)	0 to 65535	0	-	Read-only

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F5-07	0xF507	VDO 2 (No. 16 to 31 functions, low bit indicating No. 16 function)	0 to 65535	0	-	Read-only
F5-08	0xF508	VDO 3 (No. 32 to 47 functions, low bit indicating No. 32 function)	0 to 65535	0	-	Read-only
F5-09	0xF509	VDO output 4 (No. 48 to 63 functions, low bit indicates No. 46 function)	0 to 65535	0	-	Read-only
F5-10	0xF50A	AO1 output	0: Operating frequency 1: Frequency reference 2: Output current 3: Output torque 4: Output power 5: Output voltage 6: Reserved 7: AI1 voltage 8: AI2 voltage 9: AI3 voltage 10: Feedback speed 11: Feedback pressure 12: Reserved 13: Reserved 14: Communication control 15: AI3 setting 16: Communication 17: 10 V output	10	-	Real time
F5-11	0xF50B	AO2 output	0: Operating frequency 1: Frequency reference 2: Output current 3: Output torque 4: Output power 5: Output voltage 6: Reserved 7: AI1 voltage 8: AI2 voltage 9: AI3 voltage 10: Feedback speed 11: Feedback pressure 12: Reserved 13: Reserved 14: Communication control 15: AI3 setting 16: Communication setting 17: 10 V output	11	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F5-14	0xF50E	AO1 zero offset coefficient	-100.0 to +100.0	0.0	%	Real time
F5-15	0xF50F	AO1 gain	-10.00 to +10.00	1.00	-	Real time
F5-16	0xF510	AO2 zero offset coefficient	-100.0 to +100.0	0.0	%	Real time
F5-17	0xF511	AO2 gain	-10.00 to +10.00	1.00	-	Real time
F5-20	0xF514	DO active mode selection	0x0 to 0x7FFF	0x0	-	Real time
F5-23	0xF517	AO1 measured value 1	-9.999 to 9.999	2.000	V	Real time
F5-24	0xF518	AO1 theoretical output value 1	-9.999 to 9.999	2.000	V	Real time
F5-25	0xF519	AO1 measured value 2	-9.999 to 9.999	8.000	V	Real time
F5-26	0xF51A	AO1 theoretical output value 2	-9.999 to 9.999	8.000	V	Real time
F5-27	0xF51B	AO2 measured value 1	-9.999 to 9.999	2.000	V	Real time
F5-28	0xF51C	AO2 theoretical output value 1	-9.999 to 9.999	2.000	V	Real time
F5-29	0xF51D	AO2 measured value 2	-9.999 to 9.999	8.000	V	Real time
F5-30	0xF51E	AO2 theoretical output value 2	-9.999 to 9.999	8.000	V	Real time

20.7 Group F6 Start/Stop Control Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F6-10	0xF60A	Stop mode	0: Decelerate to stop 1: Coast to stop	0	-	At stop
F6-15	0xF60F	Braking utilization rate	0 to 100	100	%	Real time

20.8 Group F7 Operating Panel and Display Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F7-00	0xF700	LED display check	0: Inactive 1: Active	0	-	Real time
F7-02	0xF702	STOP button function selection	0: The stop function is valid only in operating panel control mode. 1: The stop function is valid in any mode. 2: The reset function is valid in any mode. 3: Both the stop and reset functions are valid in any mode.	2	-	Real time
F7-04	0xF704	Parameters displayed during operation	0x0 to 0xFFFF	0x270	-	Real time
F7-05	0xF705	Parameter displayed on LED operating panel at stop	0x1 to 0xFFFF	0x1473	-	Real time
F7-07	0xF707	Inverter heatsink temperature	-1000 to +1000	0	℃	Read-only
F7-09	0xF709	Cumulative operating time	0 to 65000	0	h	Read-only
F7-10	0xF70A	Function software version	0.00 to 655.30	0.00	-	Read-only
F7-11	0xF70B	Performance software version	0.00 to 655.30	0.00	-	Read-only
F7-12	0xF70C	Function software temporary version	0.00 to 655.35	0.00	-	Read-only
F7-13	0xF70D	Temporary performance software version	0.00 to 655.35	0.00	-	Read-only
F7-14	0xF70E	Software version auto-tuned with phase sequence	0.00 to 655.35	0.00	-	Read-only
F7-15	0xF70F	Servo Err120 fault shielded by aging parameter	0 to 1	0	-	At stop
F7-16	0xF710	High 16 bits of motor power	0 to 65535	0	-	Read-only
F7-17	0xF711	Low 16 bits of motor power	0 to 65535	0	-	Read-only
F7-18	0xF712	Power clear	0 to 1	0	-	Real time
F7-19	0xF713	Drive power (high 16 bits)	0 to 65535	0	-	Read-only
F7-20	0xF714	Drive power (low 16 bits)	0 to 65535	0	-	Read-only

20.9 Group F8 Auxiliary Function Parameter List

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F8-14	0xF80E	Operation for frequency setpoints below lower limit	0: Operating at the frequency reference 1: Stop 2: Run at zero speed	0	-	Real time
F8-17	0xF811	Set operation time	0 to 65000	0	h	Real time
F8-22	0xF816	Ground fault detection protection enable	0: Inactive 1: Active	1	-	Real time
F8-23	0xF817	Action selection when accumulative operation time is reached	0: Continue running 1: Inhibited	0	-	Real time
F8-24	0xF818	Software undervoltage threshold	100.0 to 800.0	247.5	V	Real time
F8-25	0xF819	Allowable braking unit enable time	0.0 to 3600.0	5.0	s	Real time
F8-30	0xF81E	Drive fan detection	0: Inactive 1: Valid	0	-	Real time
F8-36	0xF824	Type of the 1st fault	0.00 to 655.35	0.00	-	Read-only
F8-37	0xF825	Type of the 2nd fault	0.00 to 655.35	0.00	-	Read-only
F8-38	0xF826	Speed upon the 2nd fault	-32768 to 32767	0	rpm	Read-only
F8-39	0xF827	Current upon the 2nd fault	0.00 to 655.35	0.00	A	Read-only
F8-40	0xF828	Bus voltage upon the 2nd fault	0.0 to 6553.5	0.0	V	Read-only
F8-41	0xF829	Input terminal state upon the 2nd fault	0 to 65535	0	-	Read-only
F8-42	0xF82A	Output terminal state upon the 2nd fault	0 to 65535	0	-	Read-only
F8-43	0xF82B	High bits of the occurrence time of the 2nd fault	0 to 65535	0	h	Read-only
F8-44	0xF82C	Low bits of the occurrence time of the 2nd fault	0 to 65535	0	s	Read-only
F8-45	0xF82D	Other information 1 upon occurrence of the 2nd fault	0 to 65535	0	-	Read-only
F8-46	0xF82E	Other information 2 upon occurrence of the 2nd fault	0 to 65535	0	-	Read-only
F8-47	0xF82F	Other information 3 upon occurrence of the 2nd fault	0 to 65535	0	-	Read-only
F8-48	0xF830	Speed upon occurrence of the 1st fault	-32768 to 32767	0	rpm	Read-only
F8-49	0xF831	Current upon the 1st fault	0.00 to 655.35	0.00	A	Read-only
F8-50	0xF832	Bus voltage upon the 1st fault	0.0 to 6553.5	0.0	V	Read-only
F8-51	0xF833	Input terminal status upon the 1st fault	0 to 65535	0	-	Read-only

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F8-52	0xF834	Output terminal status upon the 1st fault	0 to 65535	0	-	Read-only
F8-53	0xF835	High bits of the occurrence time of the 1st fault	0 to 65535	0	h	Read-only
F8-54	0xF836	Low bits of the occurrence time of the 1st fault	0 to 65535	0	s	Read-only
F8-55	0xF837	Other information 1 upon occurrence of the 1st fault	0 to 65535	0	-	Read-only
F8-56	0xF838	Other information 2 upon occurrence of the 1st fault	0 to 65535	0	-	Read-only
F8-57	0xF839	Other information 3 upon occurrence of the 1st fault	0 to 65535	0	-	Read-only

20.10 Group F9 Protection and Fault Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-08	0xF908	Braking transistor switch-on voltage	340.0 to 2500.0	760.0	V	Real time
F9-12	0xF90C	Input phase loss protection	0: Inactive 1: Valid	1	-	Real time
F9-13	0xF90D	Output phase loss protection	0: Inactive 1: Valid	1	-	Real time
F9-14	0xF90E	Threshold value of excessive speed deviation protection	0.50 to 50.00	10.00	Hz	Real time
F9-15	0xF90F	Detection time of excessive speed deviation protection	0.0 to 40.0	10.0	s	Real time
F9-16	0xF910	Motor temperature protection	0: Inactive 1: PT1000 2: KTY	1	-	Real time
F9-17	0xF911	Motor stall time threshold	0.000 to 65.535	0.500	s	Real time
F9-18	0xF912	Type of the 3rd fault	0.00 to 655.35	0.00	-	Read-only
F9-19	0xF913	Type of the 4th fault	0.00 to 655.35	0.00	-	Read-only
F9-20	0xF914	Type of the 5th fault (latest)	0.00 to 655.35	0.00	-	Read-only
F9-21	0xF915	Speed upon occurrence of the 5th fault	-32768 to 32767	0	rpm	Read-only
F9-22	0xF916	Current upon 5th fault	0.00 to 655.35	0.00	A	Read-only
F9-23	0xF917	Bus voltage upon occurrence of the 5th fault	0.0 to 6553.5	0.0	V	Read-only
F9-24	0xF918	Input terminal state upon 5th fault	0 to 65535	0	-	Read-only
F9-25	0xF919	Output terminal state upon occurrence of 5th fault	0 to 65535	0	-	Read-only

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-26	0xF91A	High bits of the occurrence time of the 5th fault	0 to 65535	0	h	Read-only
F9-27	0xF91B	Low bits of the occurrence time of the 5th fault	0 to 65535	0	s	Read-only
F9-28	0xF91C	Other information 1 upon occurrence of the 5th fault	0 to 65535	0	-	Read-only
F9-29	0xF91D	Other information 2 upon occurrence of the 5th fault	0 to 65535	0	-	Read-only
F9-30	0xF91E	Other information 3 upon occurrence of the 5th fault	0 to 65535	0	-	Read-only
F9-31	0xF91F	Speed upon occurrence of the 4th fault	-32768 to 32767	0	rpm	Read-only
F9-32	0xF920	Current upon occurrence of the 4th fault	0.00 to 655.35	0.00	A	Read-only
F9-33	0xF921	Bus voltage upon occurrence of the 4th fault	0.0 to 6553.5	0.0	V	Read-only
F9-34	0xF922	Input terminal state upon occurrence of 4th fault	0 to 65535	0	-	Read-only
F9-35	0xF923	Output terminal state upon occurrence of 4th fault	0 to 65535	0	-	Read-only
F9-36	0xF924	High bits of the occurrence time of the 4th fault	0 to 65535	0	h	Read-only
F9-37	0xF925	Low bits of the occurrence time of the 4th fault	0 to 65535	0	s	Read-only
F9-38	0xF926	Other information 1 upon occurrence of the 4th fault	0 to 65535	0	-	Read-only
F9-39	0xF927	Other information 2 upon occurrence of the 4th fault	0 to 65535	0	-	Read-only
F9-40	0xF928	Other information 3 upon occurrence of the 4th fault	0 to 65535	0	-	Read-only
F9-41	0xF929	Speed upon occurrence of the 3rd fault	-32768 to 32767	0	rpm	Read-only
F9-42	0xF92A	Current upon the 3rd fault	0.00 to 655.35	0.00	A	Read-only
F9-43	0xF92B	Bus voltage upon the 3rd fault	0.0 to 6553.5	0.0	V	Read-only
F9-44	0xF92C	Input terminal state upon the 3rd fault	0 to 65535	0	-	Read-only
F9-45	0xF92D	Output terminal state upon the 3rd fault	0 to 65535	0	-	Read-only
F9-46	0xF92E	High bits of the occurrence time of the 3rd fault	0 to 65535	0	h	Read-only
F9-47	0xF92F	Low bits of the occurrence time of the 3rd fault	0 to 65535	0	s	Read-only
F9-48	0xF930	Other information 1 upon occurrence of the 3rd fault	0 to 65535	0	-	Read-only

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-49	0xF931	Other information 2 upon occurrence of the 3rd fault	0 to 65535	0	-	Read-only
F9-50	0xF932	Other information 3 upon occurrence of the 3rd fault	0 to 65535	0	-	Read-only
F9-51	0xF933	Digital output when motor temperature reached	0.0 to 300.0	0.0	-	Real time
F9-58	0xF93A	Motor temperature	-49.0 to 300.0	0.0	℃	Read-only
F9-59	0xF93B	Motor fault temperature setting	-49.0 to 300.0	130.0	℃	Real time
F9-60	0xF93C	Protection action for faults 1 to 7	Tens: Fault 1 protection action 0: Coast to stop Hundreds: Faults 2 to 3 protection action 0: Coast to stop Thousands: Faults 5 to 7 protection action 0: Coast to stop	0	-	At stop
F9-61	0xF93D	Protection action for faults 8 to 11	Ones: Fault 8 protection action 0: Coast to stop Tens: Fault 9 protection action 0: Coast to stop Hundreds: Fault 10 protection action 0: Coast to stop 1: Decelerate to stop Thousands: Fault 11 protection action 0: Coast to stop 6: Cancel fault	6000	-	At stop
F9-62	0xF93E	Protection action for faults 12 to 15	Ones: Fault 12 protection action 0: Coast to stop 1: Decelerate to stop Tens: Fault 13 protection action 0: Coast to stop 1: Decelerate to stop Hundreds: Fault 14 protection action 0: Coast to stop 1: Decelerate to stop Thousands: Fault 15 protection action 0: Coast to stop 1: Decelerate to stop	0	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-63	0xF93F	Protection action for faults 16 to 19	Ones: Fault 16 protection action 0: Coast to stop 1: Decelerate to stop Tens: Fault 17 protection action 0: Coast to stop Hundreds: Fault 18 protection action 0: Coast to stop Thousands: Fault 19 protection action 0: Coast to stop	0	-	At stop
F9-64	0xF940	Protection action for faults 20 to 23	Ones: Fault 20 protection action 0: Coast to stop Tens: Fault 21 protection action 0: Coast to stop Hundreds: Fault 22 protection action 0: Coast to stop Thousands: Fault 23 protection action 0: Coast to stop	0	-	At stop
F9-65	0xF941	Protection action for faults 24 to 27	Ones: Fault 24 protection action 0: Coast to stop Tens: Fault 25 protection action 0: Coast to stop Hundreds: Fault 26 protection action 0: Coast to stop 1: Decelerate to stop Thousands: Fault 27 protection action 0: Coast to stop 1: Decelerate to stop	0	-	At stop
F9-66	0xF942	Protection action for faults 28 to 31	Ones: Fault 28 protection action 0: Coast to stop Tens: Fault 29 protection action 0: Coast to stop Hundreds: Fault 30 protection action 0: Coast to stop Thousands: Fault 31 protection action 0: Coast to stop	0	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-67	0xF943	Protection action for faults 32 to 35	Ones: Fault 32 protection action 0: Coast to stop Tens: Fault 33 protection action 0: Coast to stop Hundreds: Fault 34 protection action 0: Coast to stop Thousands: Fault 35 protection action 0: Coast to stop	0	-	At stop
F9-68	0xF944	Protection action for faults 36 to 39	Ones: Fault 36 protection action 0: Coast to stop Tens: Fault 37 protection action 0: Coast to stop Hundreds: Fault 38 protection action 0: Coast to stop Thousands: Fault 39 protection action 0: Coast to stop	0	-	At stop
F9-69	0xF945	Protection action for faults 40 to 43	Ones: Fault 40 protection action 0: Coast to stop Tens: Fault 41 protection action 0: Coast to stop Hundreds: Fault 42 protection action 0: Coast to stop 1: Decelerate to stop Thousands: Fault 43 protection action 0: Coast to stop	0	-	At stop
F9-70	0xF946	Protection action for faults 44 to 47	Ones: Fault 44 protection action 0: Coast to stop 1: Decelerate to stop Tens: Fault 45 protection action 0: Coast to stop 1: Decelerate to stop Hundreds: Fault 46 protection action 0: Coast to stop 1: Decelerate to stop Thousands: Fault 47 protection action 0: Coast to stop	0	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-71	0xF947	Protection action for faults 48 to 51	Ones: Fault 48 protection action 0: Coast to stop 1: Decelerate to stop Tens: Fault 49 protection action 0: Coast to stop Hundreds: Fault 50 protection action 0: Coast to stop Thousands: Fault 51 protection action 0: Coast to stop	0	-	At stop
F9-72	0xF948	Protection action for faults 52 to 55	Ones: Fault 52 protection action 0: Coast to stop 1: Decelerate to stop Tens: Fault 53 protection action 0: Coast to stop Hundreds: Fault 54 protection action 0: Coast to stop Thousands: Fault 55 protection action 0: Coast to stop	0	-	At stop
F9-73	0xF949	Protection action for faults 56 to 59	Ones: Fault 56 protection action 0: Coast to stop Tens: Fault 57 protection action 0: Coast to stop Hundreds: Fault 58 protection action 0: Coast to stop Thousands: Fault 59 protection action 0: Coast to stop	0	-	At stop
F9-74	0xF94A	Protection action for faults 60 to 63	Ones: Fault 60 protection action 0: Coast to stop Tens: Fault 61 protection action 0: Coast to stop Hundreds: Fault 62 protection action 0: Coast to stop Thousands: Fault 63 protection action 0: Coast to stop 1: Decelerate to stop	0	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-75	0xF94B	Protection action for faults 64 to 67	Ones: Fault 64 protection action 0: Coast to stop Tens: Fault 65 protection action 0: Coast to stop Hundreds: Fault 66 protection action 0: Coast to stop Thousands: Fault 67 protection action 0: Coast to stop	0	-	At stop
F9-76	0xF94C	Protection action for faults 68 to 71	Ones: Fault 68 protection action 0: Coast to stop Tens: Fault 69 protection action 0: Coast to stop Hundreds: Fault 70 protection action 0: Coast to stop Thousands: Fault 71 protection action 0: Coast to stop	0	-	At stop
F9-77	0xF94D	Protection action for faults 72 to 75	Ones: Fault 72 protection action 0: Coast to stop Tens: Fault 73 protection action 0: Coast to stop Hundreds: Fault 74 protection action 0: Coast to stop Thousands: Fault 75 protection action 0: Coast to stop	0	-	At stop
F9-78	0xF94E	Protection action for faults 76 to 79	Ones: Fault 76 protection action 0: Coast to stop Tens: Fault 77 protection action 0: Coast to stop Hundreds: Fault 78 protection action 0: Coast to stop Thousands: Fault 79 protection action 0: Coast to stop	0	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-79	0xF94F	Protection action for faults 80 to 83	Ones: Fault 80 protection action 0: Coast to stop Tens: Fault 81 protection action 0: Coast to stop Hundreds: Fault 82 protection action 0: Coast to stop Thousands: Fault 83 protection action 0: Coast to stop	0	-	At stop
F9-80	0xF950	Protection action for faults 84 to 87	Ones: Fault 84 protection action 0: Coast to stop Tens: Fault 85 protection action 0: Coast to stop Hundreds: Fault 86 protection action 0: Coast to stop Thousands: Fault 87 protection action 0: Coast to stop	0	-	At stop
F9-81	0xF951	Protection action for faults 88 to 91	Ones: Fault 88 protection action 0: Coast to stop Tens: Fault 89 protection action 0: Coast to stop Hundreds: Fault 90 protection action 0: Coast to stop Thousands: Fault 91 protection action 0: Coast to stop	0	-	At stop
F9-82	0xF952	Protection action for faults 92 to 95	Ones: Fault 92 protection action 0: Coast to stop Tens: Fault 93 protection action 0: Coast to stop Hundreds: Fault 94 protection action 0: Coast to stop Thousands: Fault 95 protection action 0: Coast to stop	0	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
F9-83	0xF953	Protection action for faults 96 to 99	Ones: Fault 96 protection action 0: Coast to stop 5: Alarm Tens: Fault 97 protection action 0: Coast to stop 5: Alarm Hundreds: Fault 98 protection action 0: Coast to stop Thousands: Fault 99 protection action 0: Coast to stop	55	-	At stop
F9-84	0xF954	Absolute encoder reset	0: Inactive 1: Reset encoder fault 2: Reset encoder fault and multi-turn data	0	-	At stop
F9-87	0xF957	Runaway protection detection time	0.000 to 5.000	0.030	s	Real time
F9-88	0xF958	Automatic reset of communication fault	0: Disable automatic reset 1: Enable automatic reset	0	-	Real time
F9-89	0xF959	Deceleration time for stop at fault	0 to 65535	0	ms	Real time
F9-90	0xF95A	STO fault reset mode	0: Manual reset for STO fault 1: Automatic reset for STO fault	0	-	Real time
F9-91	0xF95B	STO displayed on panel	0: Inactive 1: Enable	1	-	Real time
F9-92	0xF95C	High bit of internal fault	0x0 to 0xFFFF	0x0	-	Read-only
F9-93	0xF95D	Low bit of internal fault	0x0 to 0xFFFF	0x0	-	Real time
F9-94	0xF95E	Quick stall detection time	0.000 to 65.535	0.050	ms	Real time
F9-95	0xF95F	160% of rated load for 1 min enabled for the drive	0 to 1	0	-	At stop
F9-96	0xF960	Max. temperature for 160% of rated load for 1 min of the drive	45 to 65	65	-	Real time

20.11 Group FA Business Timed Operation Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
FA-00	0xFA00	1st operation time protection password	0 to 65535	0	-	Real time
FA-01	0xFA01	1st timed operation time	0 to FA-03	0	h	Real time
FA-02	0xFA02	2nd operation time protection password	0 to 65535	0	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
FA-03	0xFA03	2nd timed operation time	FA-01 to FA-05	0	h	Real time
FA-04	0xFA04	3rd operation time protection password	0 to 65535	0	-	Real time
FA-05	0xFA05	3rd timed operation time	FA-03 to FA-07	0	h	Real time
FA-06	0xFA06	4th operation time protection password	0 to 65535	0	-	Real time
FA-07	0xFA07	4th timed operation time	FA-05 to 65535	0	h	Real time
FA-08	0xFA08	Accumulative business operation time (h)	0 to 65535	0	h	Read-only
FA-09	0xFA09	Accumulative business operation time (s)	0 to 65535	0	s	Read-only
FA-10	0xFA0A	Accumulative power-on time (h)	0 to 65535	0	h	Read-only
FA-11	0xFA0B	Accumulative power-on time (s)	0 to 65535	0	s	Read-only

20.12 Group Fd Communication Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
Fd-00	0xFD00	Modbus baud rate	3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	5	-	At stop
Fd-01	0xFD01	Modbus data format	0: No parity, 2 stop bits (8-N-2) 1: Even parity, 1 stop bit (8-E-1) 2: Odd parity, 1 stop bit (8-O-1) 3: No parity, 1 stop bit (8-N-1)	0	-	At stop
Fd-02	0xFD02	Modbus local address	1 to 247	1	-	At stop
Fd-03	0xFD03	Modbus response delay time	0 to 20	2	ms	Real time
Fd-04	0xFD04	Modbus communication timeout period	0.0 to 60.0	0.0	s	Real time
Fd-06	0xFD06	Communication software version	0.00 to 655.35	0.00	-	Read-only
Fd-07	0xFD07	Temporary version of communication software	0.00 to 655.35	0.00	-	Read-only
Fd-22	0xFD16	Oscilloscope bit and channel bit variable selection bit 1	0 to 65535	0	-	Real time
Fd-23	0xFD17	Oscilloscope bit and channel bit variable selection bit 2	0 to 65535	0	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
Fd-24	0xFD18	Oscilloscope bit and channel bit variable selection bit 3	0 to 65535	0	-	Real time
Fd-25	0xFD19	Oscilloscope bit and channel bit variable selection bit 4	0 to 65535	0	-	Real time
Fd-26	0xFD1A	Oscilloscope bit and channel bit variable selection bit 5	0 to 65535	0	-	Real time
Fd-27	0xFD1B	Oscilloscope bit and channel bit variable selection bit 6	0 to 65535	0	-	Real time
Fd-28	0xFD1C	Oscilloscope bit and channel bit variable selection bit 7	0 to 65535	0	-	Real time
Fd-29	0xFD1D	Oscilloscope bit and channel bit variable selection bit 8	0 to 65535	0	-	Real time
Fd-30	0xFD1E	Oscilloscope sampling clock	0 to 65535	0	-	Real time
Fd-31	0xFD1F	Frequency-division coefficient of oscilloscope sampling clock	0 to 65535	0	-	Real time
Fd-32	0xFD20	Oscilloscope sampling state	0 to 65535	0	-	Real time
Fd-33	0xFD21	Oscilloscope trigger variable setting A	0 to 65535	0	-	Real time
Fd-34	0xFD22	Oscilloscope trigger edge setting A	0 to 65535	0	-	Real time
Fd-35	0xFD23	Oscilloscope trigger level A (low-order bit)	0 to 65535	0	-	Real time
Fd-36	0xFD24	Oscilloscope trigger level A (high-order bit)	0 to 65535	0	-	Real time
Fd-37	0xFD25	Oscilloscope trigger variable setting B	0 to 65535	0	-	Real time
Fd-38	0xFD26	Oscilloscope trigger edge setting B	0 to 65535	0	-	Real time
Fd-39	0xFD27	Oscilloscope trigger level B (low-order bit)	0 to 65535	0	-	Real time
Fd-40	0xFD28	Oscilloscope trigger level B (high-order bit)	0 to 65535	0	-	Real time
Fd-41	0xFD29	Oscilloscope trigger setting	0 to 65535	0	-	Real time
Fd-42	0xFD2A	Oscilloscope trigger position setting (low-order bit)	0 to 65535	0	-	Real time
Fd-43	0xFD2B	Oscilloscope trigger position setting (high-order bit)	0 to 65535	0	-	Real time
Fd-44	0xFD2C	Oscilloscope sampling enable	0 to 65535	0	-	Real time
Fd-45	0xFD2D	Oscilloscope 1 channel variable selection	0 to 65535	0	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
Fd-46	0xFD2E	Oscilloscope 2 channel variable selection	0 to 65535	0	-	Real time
Fd-47	0xFD2F	Oscilloscope 3 channel variable selection	0 to 65535	0	-	Real time
Fd-48	0xFD30	Oscilloscope 4 channel variable selection	0 to 65535	0	-	Real time
Fd-49	0xFD31	Oscilloscope 5 channel variable selection	0 to 65535	0	-	Real time
Fd-50	0xFD32	Oscilloscope 6 channel variable selection	0 to 65535	0	-	Real time
Fd-51	0xFD33	Oscilloscope sampling state	0 to 65535	0	-	Real time
Fd-52	0xFD34	Oscilloscope buffer trigger position	0 to 65535	0	-	Real time

20.13 Group FE User-defined Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
FE-00	0x2F00	PZD1 sent by master	0x0 to 0xFFFF	0x7311	-	Real time
FE-01	0x2F01	PZD2 sent by master	0x0 to 0xFFFF	0x7310	-	Real time
FE-02	0x2F02	PZD3 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-03	0x2F03	PZD4 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-04	0x2F04	PZD5 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-05	0x2F05	PZD6 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-06	0x2F06	PZD7 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-07	0x2F07	PZD8 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-08	0x2F08	PZD9 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-09	0x2F09	PZD10 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-10	0x2F0A	PZD11 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-11	0x2F0B	PZD12 sent by master	0x0 to 0xFFFF	0xF000	-	Real time
FE-20	0x2F14	Drive response to PZD1	0x0 to 0xFFFF	0x7044	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
FE-21	0x2F15	Drive response to PZD2	0x0 to 0xFFFF	0x7045	-	Real time
FE-22	0x2F16	Drive response to PZD3	0x0 to 0xFFFF	0xF000	-	Real time
FE-23	0x2F17	Drive response to PZD4	0x0 to 0xFFFF	0xF000	-	Real time
FE-24	0x2F18	Drive response to PZD5	0x0 to 0xFFFF	0xF000	-	Real time
FE-25	0x2F19	Drive response to PZD6	0x0 to 0xFFFF	0xF000	-	Real time
FE-26	0x2F1A	Drive response to PZD7	0x0 to 0xFFFF	0xF000	-	Real time
FE-27	0x2F1B	Drive response to PZD8	0x0 to 0xFFFF	0xF000	-	Real time
FE-28	0x2F1C	Drive response to PZD9	0x0 to 0xFFFF	0xF000	-	Real time
FE-29	0x2F1D	Drive response to PZD10	0x0 to 0xFFFF	0xF000	-	Real time
FE-30	0x2F1E	Drive response to PZD11	0x0 to 0xFFFF	0xF000	-	Real time
FE-31	0x2F1F	Drive response to PZD12	0x0 to 0xFFFF	0xF000	-	Real time

20.14 Group FF Manufacturer Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
FF-00	0xFF00	Manufacturer password	0 to 65535	0	-	Real time
FF-01	0xFF01	AC drive model	14 to 25	15	-	At stop
FF-02	0xFF02	G/P model	1: G model 2: P model	1	-	At stop
FF-03	0xFF03	Drive power	0.0 to 6553.5	15.0	kW	Read-only
FF-04	0xFF04	Temperature curve	1 to 4	1	-	At stop
FF-05	0xFF05	Current sampling gain error between phases U and V	1 to 65535	32768	%	At stop
FF-06	0xFF06	Model change switch	0 to 1	0	-	At stop
FF-07	0xFF07	High/Low accuracy selection of STO and AI3	0: No STO hardware and AI3 supports 12-bit sampling 1: STO hardware present and AI3 supports 16-bit sampling	0	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
FF-08	0xFF08	Voltage calibration coefficient	85.0 to 150.0	100.0	%	Real time
FF-09	0xFF09	Current calibration coefficient	90.0 to 105.0	100.0	%	Real time

20.15 Group FP User Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
If FP-00	0x1F00	User password	0 to 65535	0	-	Real time
FP-01	0x1F01	Parameter initialization	0: Inactive 1: Restore system default parameters 2: Clear fault log 3: Restore all user parameters 4: Reserved 5: Restore all parameters to default (parameters in groups FP and FA excluded)	0	-	At stop
FP-02	0x1F02	Software reset	0: Inactive 1: Soft reset (equivalent to a power cycle for a software reset)	0	-	At stop
FP-04	0x1F04	Password for storage by users	0 to 65535	0	-	Real time
FP-05	0x1F05	User storage mode	0: Inactive 1: Active (advanced password required)	0	-	At stop
FP-07	0x1F07	Customized function mode	0 to 7	0	-	At stop
FP-09	0x1F09	Customization management L	0 to 65535	1	-	At stop
FP-10	0x1F0A	Customization management H	0 to 65535	1	-	At stop

20.16 Group A0 Flux Weakening Control Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
A0-00	0xA000	Field weakening selection	0: Inactive 1: Enable	1	-	Read-only
A0-01	0xA001	MTPA algorithm enable	0 to 1	1	-	At stop
A0-02	0xA002	MTPA flux weakening depth	80 to 125	115	%	Real time
A0-03	0xA003	Field weakening integral gain	0.000 to 1.000	0.320	-	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
A0-04	0xA004	Anti-saturation integral gain	0.000 to 8.000	3.000	-	Real time
A0-05	0xA005	Current limit type	0: Limited by F2-10 1: Calculate the synthesized current limit based on the q-axis current	0	-	Real time
A0-06	0xA006	Q-axis current limit	0.0 to 300.0	200.0	%	Read-only
A0-07	0xA007	Threshold for changing field weakening integral to gain	0 to 65535	1000	rpm	Real time
A0-08	0xA008	Threshold for reverting to flux weakening integral from gain	0 to 65535	3000	rpm	Real time
A0-09	0xA009	Coefficient for changing field weakening integral to gain coefficient	0 to 10	4	-	Read-only
A0-10	0xA00A	Input phase loss algorithm selection	0: Detected by hardware 1: Detected by software	0	-	Real time
A0-11	0xA00B	Maximum current lead angle	140 to 175	155	-	Real time
A0-12	0xA00C	Moving average filter times of voltage feedback	0 to 5	4	-	Real time
A0-13	0xA00D	MTPA coefficient	0 to 65535	100	-	Real time
A0-14	0xA00E	Dynamic tuning of flux weakening gain	0.000 to 1.000	0.000	-	Read-only
A0-17	0xA011	Low-frequency derating enable	0: Inactive 1: Enable	1	-	Real time
A0-19	0xA013	First segment of time of magnetic pole position auto-tuning	50 to 500	150	ms	Real time
A0-22	0xA016	HFINS target current	50 to 300	100	%	Real time
A0-24	0xA018	Derating with carrier frequency	0: Inactive 1: Enable	1	-	Real time
A0-26	0xA01A	HFI current ratio	0 to 100	25	%	Read-only
A0-28	0xA01C	HFIPLLkp	10 to 200	100	-	Real time
A0-40	0xA028	Number of repetitive auto-tuning times	1 to 5	2	-	At stop
A0-41	0xA029	Phase sequence auto-tuning mode	0 to 1	0	-	At stop
A0-42	0xA02A	IF pull current multiple at start	0.00 to 1.20	1.00	-	Real time
A0-43	0xA02B	IF pull S time at start	0.010 to 0.750	0.240	s	Real time
A0-44	0xA02C	Angle error band for power cable mis-connection	5 to 60	40	°	Real time

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
A0-45	0xA02D	Auto-tuned phase sequence	0: UVW_ABC 1: UVW_BCA 2: UVW_CAB 3: UVW_ACB 4: UVW_CBA 5: UVW_BAC 6: Error state 1 7: Error state 2	0	-	At stop
A0-46	0xA02E	HF injection frequency	1: 1000 2: 500 3: 200	1	-	Real time
A0-47	0xA02F	Torque reference update time	0.00 to 5500.00	5500.00	-	Real time
A0-48	0xA030	Hide hardware overcurrent	0 to 1	0	-	Real time
A0-49	0xA031	Avoid overcurrent due to current loop oscillation	0 to 65535	0	-	Real time

20.17 Group A1 Encoder Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
A1-05	0xA105	Encoder fault tolerance count	1 to 31	30	-	Real time
A1-10	0xA10A	Read/Write in encoder ROM	0: Inactive 1: Write parameters to encoder 2: Read parameters from encoder	0	-	Real time
A1-11	0xA10B	Parameter write operation selection after parameter auto-tuning	0: Do not write to encoder 1: Write to encoder	0	-	Real time

20.18 Group A2 CAN Communication Parameters

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
A2-00	0xA200	CAN baud rate	0: 20 kpbs 1: 50 kpbs 2: 125 kbps 3: 250 kbps 4: 500 kbps 5: 1 Mbps	4	-	At stop
A2-01	0xA201	CAN communication station No.	1 to 64	1	-	At stop

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode
A2-02	0xA202	CAN communication disconnection detection time	0.0 to 600.0	0.3	s	Real time
A2-03	0xA203	CAN multi-pump mode	0: Broadcast mode 1: Multi-master mode	0	-	Real time
A2-04	0xA204	CAN slave pump address 1	0 to 65535	0	-	Real time
A2-05	0xA205	CAN slave pump address 2	0 to 65535	0	-	Real time
A2-06	0xA206	CAN slave pump address 3	0 to 65535	0	-	Real time
A2-07	0xA207	CAN slave pump address 4	0 to 65535	0	-	Real time
A2-08	0xA208	Number of CAN bus disconnections	0 to 65535	0	-	Read-only
A2-10	0xA20A	CANopen expert mode	0 to 1	0	-	At stop
A2-11	0xA20B	DO inhibit time in CANopen mode	0.0 to 6553.5	2.0	ms	At stop
A2-12	0xA20C	CANopen event time	0 to 65535	10	ms	At stop
A2-13	0xA20D	Time threshold for clearing stale CANopen commands	0 to 1000	30	ms	Real time
A2-14	0xA20E	CANlink disconnection detection time	0 to 65535	500	ms	Real time
A2-15	0xA20F	580-compatible mode	0: Disable compatibility with IS580 1: Enable compatibility with IS580	1	-	Real time
A2-16	0xA210	Slave pump fault not detected at stop	0: Inactive 1: Enable	0	-	Real time

20.19 Group A3 Oil Pressure Basic Parameters

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A3-00	0xA300	Hydraulic pressure control mode	0: Non-hydraulic pressure control mode 1: Reserved 2: Hydraulic pressure control mode 2 of the drive (set by analog channels) 3: Reserved 4: Hydraulic pressure PN mode 5: Reserved 6: Hydraulic pressure CANopen mode 7: CANopen + AI mode	0	-	At stop
A3-01	0xA301	Maximum speed	1 to 30000	2000	rpm	At stop
A3-02	0xA302	System oil pressure	0.0 to 500.0	175.0	kg/cm²	Real time
A3-03	0xA303	Maximum oil pressure	0.0 to 500.0	250.0	kg/cm²	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A3-04	0xA304	Rising time of 1st group of pressure references	0.000 to 2.000	0.125	ms	Real time
A3-05	0xA305	1st group of oil pressure control Kp	0.0 to 800.0	210.0	-	Real time
A3-06	0xA306	1st group of oil pressure control Ti	0.001 to 10.000	0.040	s	Real time
A3-07	0xA307	1st group of oil pressure control Td	0.000 to 1.000	0.000	s	Real time
A3-08	0xA308	Maximum reverse speed	0.0 to 100.0	10.0	%	Real time
A3-09	0xA309	Base flow	0.0 to 50.0	0.5	%	Real time
A3-10	0xA30A	Base pressure	0.0 to 50.0	0.5	kg/cm²	Real time
A3-11	0xA30B	2nd group of oil pressure control Kp	0.0 to 800.0	210.0	-	Real time
A3-12	0xA30C	2nd group of oil pressure control Ti	0.001 to 10.000	0.040	s	Real time
A3-13	0xA30D	2nd group of oil pressure control Td	0.000 to 1.000	0.000	s	Real time
A3-14	0xA30E	3rd group of oil pressure control Kp	0.0 to 800.0	210.0	-	Real time
A3-15	0xA30F	3rd group of oil pressure control Ti	0.001 to 10.000	0.100	s	Real time
A3-16	0xA310	3rd group of oil pressure control Td	0.000 to 1.000	0.000	s	Real time
A3-17	0xA311	4th group of oil pressure control Kp	0.0 to 800.0	210.0	-	Real time
A3-18	0xA312	4th group of oil pressure control Ti	0.001 to 10.000	0.100	s	Real time
A3-19	0xA313	4th group of oil pressure control Td	0.000 to 1.000	0.000	s	Real time
A3-20	0xA314	Zero drift auto-tuning of analog channel	0: Inactive 1: Active	0	-	At stop
A3-21	0xA315	Pressure sensor disconnection detection time	0.000 to 60.000	0.500	s	Real time
A3-22	0xA316	Maximum output speed in pressure control state	0.0 to 100.0	10.0	%	Real time
A3-23	0xA317	Minimum output oil pressure in pressure control state	0.0 to 100.0	60.0	%	Real time
A3-24	0xA318	Output delay time in pressure control state	0.000 to 10.000	0.100	s	Real time
A3-25	0xA319	Rise S-curve filter time of 1st group of oil pressure references	0.001 to 10.000	0.030	s	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A3-26	0xA31A	Fall S-curve filter time of 1st group of oil pressure references	0.001 to 1.000	0.030	s	Real time
A3-27	0xA31B	Overshoot suppression detection level of 1st group of oil pressure	0 to 2000	80	-	Real time
A3-28	0xA31C	Overshoot suppression coefficient of 1st group of oil pressure	0.000 to 3.000	0.200	-	Real time
A3-29	0xA31D	Oil pressure loop gain coefficient	0.20 to 5.00	1.00	%	Real time
A3-30	0xA31E	Torque upper limit for switchover from pressure mode to speed mode	50.0 to 250.0	160.0	%	Real time
A3-31	0xA31F	Delay of 1st group of oil pressure references	0.000 to 0.500	0.000	s	Real time
A3-32	0xA320	Minimum input of slave speed reference	-100.0 to A3-34	0.0	%	Real time
A3-33	0xA321	Settings corresponding to slave speed reference minimum input	-100.0 to A3-35	0.0	%	Real time
A3-34	0xA322	2nd point input of slave speed reference	A3-32 to A3-36	0.0	%	Real time
A3-35	0xA323	Settings corresponding to the 2nd point input of slave speed reference	A3-33 to A3-37	0.0	%	Real time
A3-36	0xA324	Maximum input of slave speed reference	A3-34 to 100.0	100.0	%	Real time
A3-37	0xA325	Settings corresponding to slave speed reference maximum input	A3-35 to 100.0	100.0	%	Real time
A3-38	0xA326	Whether the slave speed consistent with master speed in multi-pump mode	0: Slave speed enable inhibited 1: Slave speed enable allowed	0	-	Real time
A3-39	0xA327	Pressure holding gain in multi-pump convergent flow mode	20 to 800	100	%	Real time
A3-40	0xA328	Pressure deviation of flow jitter elimination by decreasing PI during multi-pump injection	0.0 to 50.0	5.0	kg/cm²	Real time
A3-41	0xA329	Lower limit of flow jitter elimination by decreasing PI during multi-pump injection	0 to 30000	0	rpm	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A3-42	0xA32A	Detection time of flow jitter elimination by decreasing PI during multi-pump injection	0.200 to 2.000	0.400	s	Real time
A3-43	0xA32B	Pressure deviation when the slave pump does not work in multi-pump CAN communication mode	0.0 to 50.0	5.0	kg/cm²	Real time
A3-44	0xA32C	Flow lower limit when the slave pump does not work in multi-pump CAN communication mode	-100.0 to +100.0	0.0	%	Real time
A3-45	0xA32D	Stop judging delay when the slave pump receives no speed reference	0.010 to 5.000	1.000	s	Real time
A3-46	0xA32E	Time for decelerating to stop when the slave pump receives no speed reference	0.001 to 5.000	0.200	s	Real time
A3-47	0xA32F	Pressure relief delay when starting the valve	0.001 to 5.000	0.100	s	Real time
A3-48	0xA330	Pressure relief delay when exiting from the valve	0.001 to 5.000	0.100	s	Real time
A3-49	0xA331	Pressure relief deviation lower limit when starting the valve	0.0 to A3-02	0.0	kg/cm²	Real time
A3-50	0xA332	Pressure relief lower limit when starting the valve	0.0 to A3-02	0.0	kg/cm²	Real time
A3-51	0xA333	Current lower limit of pressure sensor fault detection	20 to 300	100	%	Real time
A3-52	0xA334	Speed upper limit of pressure sensor fault detection	20 to 100	100	%	Real time
A3-53	0xA335	Fall time of 2nd group of high-speed flow	0.000 to 5.000	0.100	s	Real time
A3-54	0xA336	2nd group of high-speed flow threshold	0.0 to 100.0	100.0	%	Real time
A3-55	0xA337	Pressure relief deviation when stopping the valve	0.0 to A3-02	0.0	kg/cm²	Real time
A3-56	0xA338	Torque upper limit in zero torque mode	0.0 to 250.0	20.0	%	Real time
A3-57	0xA339	Upper limit of pressure sensor fault detection	A3-58 to 11.000	10.000	V	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A3-58	0xA33A	Lower limit of pressure sensor fault detection	-1.000 to A3-57	-0.100	V	Real time
A3-59	0xA33B	Pressure sensor fault detection time	0.000 to 60.000	0.000	s	Real time
A3-60	0xA33C	Pressure sensor signal output mode	0: 0 V to 10 V output (or 4 mA to 20 mA output, determined by DIP switch) 1: 1 V to 5 V output 2: 1 V to 6 V output 3: 1 V to 10 V output 4: 0.25 V to 10.25 V output	0	-	At stop
A3-61	0xA33D	Multi-master pump data update mode 5	10 to 30	10	-	Real time
A3-63	0xA33F	High-/Low-pressure PI parameter switchover enable Kp	0 to 1	0	-	Real time
A3-64	0xA340	1st group of low pressure control Kp	0.0 to 800.0	210.0	-	Real time
A3-65	0xA341	1st group of low pressure control Ti	0.001 to 10.000	0.500	-	Real time
A3-66	0xA342	1st group of high pressure control Kp	0.0 to 800.0	260.0	-	Real time
A3-67	0xA343	1st group high pressure control Ti	0.001 to 10.000	0.020	-	Real time
A3-68	0xA344	Low pressure threshold	0.0 to A3-69	50.0	-	Real time
A3-69	0xA345	High pressure threshold	A3-68 to A3-02	100.0	-	Real time
A3-70	0xA346	Hydraulic pressure threshold upon stop of slave pump	A3-71 to A3-02	0.0	-	Real time
A3-71	0xA347	Allowable fluctuation of hydraulic pressure threshold upon stop of slave pump	0.0 to A3-70	0.0	-	Real time
A3-72	0xA348	F210 limit used by function 52 in early stage	0.000 to 0.500	0.000	-	Real time
A3-74	0xA34A	Draft pressure command	0.0 to 500.0	30.0	kg/cm²	Real time
A3-75	0xA34B	Auto-tuning draft pressure slope level	1 to 10	5	-	Real time
A3-76	0xA34C	Transducer measurement range	0.0 to 6000.0	450.0	mm	At stop
A3-77	0xA34D	Target position of mold opening crosshead	0.0 to A3-76	280.0	mm	Real time
A3-78	0xA34E	Mold opening end position correction value	0.0 to 400.0	0.0	mm	Real time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A3-79	0xA34F	Planning time for mold opening deceleration	0.000 to 60.000	0.400	s	Real time
A3-80	0xA350	Proportional coefficient of mold opening position loop	0.0 to 2000.0	400.0	-	Real time
A3-81	0xA351	First distance at low speed of mold opening	0.0 to A3-76	30.0	mm	Real time
A3-82	0xA352	1st segment of platen speed	0.0 to 3000.0	100.0	mm/s	Real time
A3-83	0xA353	2nd segment of platen speed	0.0 to 3000.0	400.0	mm/s	Real time
A3-84	0xA354	Open loop speed switchover acceleration time	0.000 to 5.000	0.300	s	Real time
A3-85	0xA355	Deceleration time for pressure arrival in high-speed operation	0.000 to 5.000	0.100	-	Real time
A3-86	0xA356	Pressure protection ON during mold opening	0 to 500	1	-	Real time
A3-87	0xA357	Maximum platen speed ratio adjusted based on position	0.0 to 50.0	1.0	-	Real time
A3-88	0xA358	Mold opening speed loop Ki	0.001 to 10.000	7.000	-	Real time
A3-89	0xA359	Advance value for mold opening in place	0.0 to A3-76	5.0	mm	Real time
A3-90	0xA35A	Pressure of mold opening end segment	0.0 to 500.0	5.0	bar	Real time
A3-91	0xA35B	Platen speed limit at the end of mold opening	0.0 to 400.0	50.0	mm/s	Real time
A3-92	0xA35C	Platen speed filter time	0.000 to 5.000	0.020	s	Real time
A3-93	0xA35D	Displacement sensor correction position	1.0 to 6553.5	6553.5	mm	At stop
A3-94	0xA35E	Platen speed auto-tuning enable	0: Inactive 1: Enable	0	-	At stop
A3-95	0xA35F	Max. platen sped	0.0 to 2000.0	450.0	mm/s	At stop
A3-96	0xA360	Auto-tuning of the first segment of motor speed	0 to 2000	300	rpm	Real time
A3-97	0xA361	Auto-tuning of the second segment of motor speed	0 to 2000	500	rpm	Real time
A3-98	0xA362	Platen-based auto-tuning speed deviation upper limit	0.0 to 900.0	20.0	mm/s	Real time
A3-99	0xA363	Draft pressure loop switchover	0 to 1	0	-	At stop

20.20 Groups A4 and A5 Oil Pressure Optimization Parameters

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A4-00	0xA400	Filtering time of displayed speed	0.000 to 5.000	0.005	s	Real-time
A4-01	0xA401	Filtering time of displayed current	0.000 to 5.000	0.010	s	Real-time
A4-02	0xA402	Falling time of 1st group of pressure references	0.001 to 2.000	0.150	-	Real-time
A4-03	0xA403	Rise time of 1st group of flow references	0.000 to 5.000	0.080	s	Real-time
A4-04	0xA404	Fall time of 1st group of flow references	0.000 to 5.000	0.080	s	Real-time
A4-05	0xA405	Quick adjustment of hydraulic pressure	0 to 65535	22720	-	Real-time
A4-06	0xA406	Flow leakage compensation value	0.0 to 50.0	0.0	%	Real-time
A4-08	0xA408	Minimum relief pressure in reverse rotation	0.0 to A3-02	0.0	kg/cm²	Real-time
A4-09	0xA409	Protection time for long-time pressure relief in reverse rotation	0.0 to 500.0	10.0	s	Real-time
A4-10	0xA40A	Rise S-curve filter time of 2nd group of oil pressure references	0.001 to 1.000	0.030	s	Real-time
A4-11	0xA40B	Fall S-curve filter time of 2nd group of oil pressure references	0.001 to 1.000	0.030	s	Real-time
A4-12	0xA40C	Rise time of 2nd group of flow references	0.001 to 5.000	0.080	s	Real-time
A4-13	0xA40D	Fall time of 2nd group of flow references	0.001 to 5.000	0.080	s	Real-time
A4-14	0xA40E	Rise time of 2nd group of oil pressure references	0.001 to 2.000	0.125	s	Real-time
A4-15	0xA40F	Fall time of 2nd group of oil pressure references	0.001 to 2.000	0.150	s	Real-time
A4-16	0xA410	Overshoot suppression detection level of 2nd group of oil pressure	1 to 2000	80	-	Real-time
A4-17	0xA411	Overshoot suppression coefficient of 2nd group of oil pressure	0.001 to 3.000	0.200	s	Real-time
A4-18	0xA412	Delay of 2nd group of oil pressure references	0.000 to 0.500	0.000	s	Real-time
A4-22	0xA416	Oil pressure deviation threshold of oil pressure suppression cancellation	0.0 to A3-02	10.0	kg/cm²	Real-time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A4-23	0xA417	Maximum value of integral limit deviation	0.0 to A3-02	45.0	kg/cm²	Real-time
A4-24	0xA418	Integral limit mode selection	0 to 1	0	-	Real-time
A4-25	0xA419	Pressure loop output upper limit rise	0.0 to 50.0	2.0	-	Real-time
A4-26	0xA41A	Hydraulic pressure PID algorithm selection	0: Standard algorithm 1: Dedicated algorithm 1 2: Dedicated algorithm 2 3: Dedicated algorithm 3	3	-	At stop
A4-29	0xA41D	Overshoot suppression pressure threshold of 1st group of oil pressure impact	0.0 to 100.0	70.0	%	Real-time
A4-30	0xA41E	Overshoot suppression coefficient Kd of 1st group of oil pressure impact	0.00 to 1.00	0.40	-	Real-time
A4-31	0xA41F	Overshoot suppression pressure threshold of 2nd group of oil pressure impact	0.0 to 100.0	70.0	%	Real-time
A4-32	0xA420	Overshoot suppression coefficient Kd of 2nd group of oil pressure impact	0.00 to 1.00	0.40	-	Real-time
A4-33	0xA421	Integral regulation coefficient 1 of algorithm 3	0.08 to 1.00	0.08	-	Real-time
A4-34	0xA422	Integral regulation coefficient 2 of algorithm 3	0.08 to 1.00	0.08	-	Real-time
A4-35	0xA423	Integral regulation coefficient 3 of algorithm 3	0.08 to 1.00	0.08	-	Real-time
A4-36	0xA424	Integral regulation coefficient 4 of algorithm 3	0.08 to 1.00	0.08	-	Real-time
A4-37	0xA425	Rise S-curve filter time of 1st group of speed references	0.001 to 10.000	0.010	-	Real-time
A4-38	0xA426	Rise S-curve filter time of 2nd group of oil pressure references	0.001 to 10.000	0.010	-	Real-time
A4-39	0xA427	Rise time of 1st group of speed references	0.000 to 2.000	0.001	-	Real-time
A4-40	0xA428	Rise time of 2nd group of speed references	0.000 to 2.000	0.001	-	Real-time
A4-41	0xA429	Speed reference smoothing filter time	1 to 300	1	-	Real-time
A4-44	0xA42C	Pressure rise and pressure holding PID switchover	0 to 7	0	-	Real-time
A4-45	0xA42D	Filter time of feedback pressure upon pressure holding switchover	0.000 to 5.000	0.005	s	Real-time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A4-46	0xA42E	Pressure deviation upon pressure holding switchover	0.0 to 10.0	1.0	kg/cm²	Real-time
A4-47	0xA42F	Speed upper limit upon pressure holding switchover	0 to 1000	200	rpm	Real-time
A4-48	0xA430	Pressure loop Kp during first group of pressure holding	0.0 to 800.0	250.0	-	Real-time
A4-49	0xA431	Pressure loop Ki during first group of pressure holding	0.001 to 10.000	0.030	s	Real-time
A4-50	0xA432	Pressure loop Kd during first group of pressure holding	0.000 to 1.000	0.010	s	Real-time
A4-51	0xA433	Pressure loop Kp during 2nd group of pressure holding	0.0 to 800.0	180.0	-	Real-time
A4-52	0xA434	Pressure loop Ki during 2nd group of pressure holding	0.001 to 10.000	0.100	s	Real-time
A4-53	0xA435	Pressure loop Kd during 2nd group of pressure holding	0.000 to 1.000	0.000	s	Real-time
A4-54	0xA436	Pressure loop Kp during 3rd group of pressure holding	0.0 to 800.0	210.0	-	Real-time
A4-55	0xA437	Pressure loop Ki during 3rd group of pressure holding	0.001 to 10.000	0.040	s	Real-time
A4-56	0xA438	Pressure loop Kd during 3rd group of pressure holding	0.000 to 1.000	0.000	s	Real-time
A4-57	0xA439	Encoder position compensation in auto-tuning	0: Inactive 1: Auto-tuning method 1 2: Auto-tuning method 2 3: Auto-tuning method 3 4: Auto-tuning method 4	0	-	Real-time
A4-58	0xA43A	Auto-tuning start delay	0.000 to 60.000	2.000	s	Real-time
A4-59	0xA43B	Startup compensation phase lead ratio	-1.00 to +1.00	0.04	-	Real-time
A4-60	0xA43C	Auto-tuning pressure protection upper limit	0.0 to 250.0	100.0	kg/cm²	Real-time
A4-61	0xA43D	Auto-tuned teeth count check enable	0 to 99	1	-	Real-time
A4-62	0xA43E	Automatic correction of auto-tuned values	0: Inactive 1: Enable	0	-	Real-time
A4-63	0xA43F	Compensation enable	0: Inactive 1: Add compensation 2: Subtract compensation	0	-	Real-time
A4-64	0xA440	Waveform compensation tooth count	0 to 99	0	-	Real-time
A4-65	0xA441	Compensation start position (encoder position)	0 to 65535	0	-	Real-time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A4-66	0xA442	Compensation interval length (encoder position)	0 to 65535	4000	-	Real-time
A4-67	0xA443	Compensation amplitude multiplier	0 to 10000	120	%	Real-time
A4-68	0xA444	Compensation curve selection	1: Compensation curve 1 2: Compensation curve 2 (suitable for shorter oil circuits) 3: Compensation curve 3 4: Compensation curve 4	3	-	Real-time
A4-69	0xA445	Left multiplier of compensation interval	0.0 to 100.0	1.0	-	Real-time
A4-70	0xA446	Right multiplier of compensation interval	0.0 to 100.0	1.0	-	Real-time
A4-71	0xA447	Compensation factor for the 2nd segment of curve 2	0 to 1000	40	%	Real-time
A4-72	0xA448	Segment format of curves 3 and 4	2 to 20	4	-	Real-time
A4-73	0xA449	Compensation pressure lower limit enable	0.0 to 250.0	40.0	kg/cm²	Real-time
A4-74	0xA44A	Compensation amplitude multiplier of low pressure zone	0.00 to 5.00	1.00	-	Real-time
A4-75	0xA44B	Auto-tuning speed reference	0.00 to 20.00	0.00	Hz	Real-time
A4-79	0xA44F	Pressure holding judgment associated with pressure reference change	0 to 1	1	-	Real-time
A4-80	0xA450	Low pressure threshold for automatic inertia ratio adjustment	0.0 to A4-81	10.0	kg/cm²	Real-time
A4-81	0xA451	High pressure threshold for automatic inertia ratio adjustment	A4-80 to A3-02	20.0	kg/cm²	Real-time
A4-82	0xA452	Inertia ratio corresponding to low pressure threshold	0.20 to F2-13	0.50	-	Real-time
A4-83	0xA453	Overshoot suppression KI5	0.00 to 65535.00	1.00	-	Real-time
A4-84	0xA454	Overshoot suppression KI2	0.00 to 65535.00	1.00	-	At stop
A4-85	0xA455	New pressure overshoot suppression algorithm switch	0 to 1	0	-	At stop
A4-86	0xA456	2nd group of maximum speed	1 to 30000	2300	-	At stop
A4-87	0xA457	2nd group of system hydraulic pressure	0.0 to 5000.0	1500.0	-	Real-time
A4-90	0xA45A	Hydraulic pressure fluctuation suppression filter time of short pipe	0 to 10	0	-	Real-time

Parameters	Comm. address	Parameter name	Range	Default value	Unit	Change mode
A4-91	0xA45B	Hydraulic pressure fluctuation suppression coefficient 1 of short pipe	0.0 to 100.0	4.0	-	Real-time
A4-92	0xA45C	Hydraulic pressure fluctuation suppression coefficient 2 of short pipe	0.0 to 100.0	0.0	-	Real-time
A4-93	0xA45D	Hydraulic pressure fluctuation suppression limit of short pipe	0.0 to 100.0	4.0	-	Real-time
A5-08	0xA508	Master switch for edge computing	0 to 65535	0	-	Real-time
A5-09	0xA509	Monitored pressure deviation of maximum hydraulic pressure	0.0 to 50.0	30.0	-	Real-time
A5-10	0xA50A	Master pump output current ratio	0.0 to 500.0	0.0	-	Real-time
A5-11	0xA50B	Master/Slave pump current deviation alarm threshold	0.0 to 49.9	20.0	-	Real-time
A5-12	0xA50C	Master/Slave pump current deviation fault threshold	0.0 to 500.0	50.0	-	Real-time
A5-13	0xA50D	Current filter time	10 to 10000	100	-	Real-time
A5-14	0xA50E	System pressure percentage	0.0 to 90.0	80.0	-	Real-time
A5-15	0xA50F	Maximum speed ratio	0.0 to 90.0	80.0	-	Real-time
A5-16	0xA510	Maximum screw stroke	0.0 to 5000.0	0.0	-	Real-time
A5-17	0xA511	Maximum deviation of screw speed	0.0 to 10.0	5.0	-	Real-time
A5-18	0xA512	Motor-to-screw speed ratio	0.0 to 1000.0	0.0	-	Real-time
A5-19	0xA513	Screw speed compensation coefficient	-5.0 to 5.0	0.0	-	Real-time
A5-20	0xA514	Resistance of braking resistor	0.0 to 300.0	0.0	-	Real-time
A5-21	0xA515	Energy consumption of the inverter	0.0 to 6553.5	0.0	-	Real-time
A5-22	0xA516	Braking power	0.0 to 6553.5	0.0	-	Real-time
A5-23	0xA517	Power statistics clear	0 to 1	0	-	Real-time

20.21 Group A6 Multi-reference and Multi-torque Limit Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
A6-00	0xA600	Speed change point 1 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-01	0xA601	Speed change point 2 in multi-speed mode	1 to A6-16	100	rpm	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
A6-02	0xA602	Speed change point 3 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-03	0xA603	Speed change point 4 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-04	0xA604	Speed change point 5 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-05	0xA605	Speed change point 6 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-06	0xA606	Speed change point 7 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-07	0xA607	Speed change point 8 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-08	0xA608	Speed change point 9 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-09	0xA609	Speed change point 10 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-10	0xA60A	Speed change point 11 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-11	0xA60B	Speed change point 12 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-12	0xA60C	Speed change point 13 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-13	0xA60D	Speed change point 14 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-14	0xA60E	Speed change point 15 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-15	0xA60F	Speed change point 16 in multi-speed mode	1 to A6-16	100	rpm	Real time
A6-16	0xA610	Speed upper limit	1 to 3000	3000	rpm	Real time
A6-17	0xA611	Torque upper limit 1	0.0 to 250.0	200.0	%	Real time
A6-18	0xA612	Torque upper limit 2	0.0 to 250.0	200.0	%	Real time
A6-19	0xA613	Torque upper limit 3	0.0 to 250.0	200.0	%	Real time
A6-20	0xA614	Memory bit check	0x0 to 0xF0F	0x0	-	Real time
A6-21	0xA615	High 16 bits address of memory 1	0x0 to 0xFFFF	0x0	-	Real time
A6-22	0xA616	Low 16 bits address of memory 1	0x0 to 0xFFFF	0x0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
A6-23	0xA617	High 16 bits address of memory 2	0x0 to 0xFFFF	0x0	-	Real time
A6-24	0xA618	Low 16 bits address of memory 2	0x0 to 0xFFFF	0x0	-	Real time
A6-25	0xA619	High 16 bits address of memory 3	0x0 to 0xFFFF	0x0	-	Real time
A6-26	0xA61A	Low 16 bits address of memory 3	0x0 to 0xFFFF	0x0	-	Real time
A6-27	0xA61B	High 16 bits address of memory 4	0x0 to 0xFFFF	0x0	-	Real time
A6-28	0xA61C	Low 16 bits address of memory 4	0x0 to 0xFFFF	0x0	-	Real time
A6-29	0xA61D	High 16 bits address of U0 table pDispValue	0x0 to 0xFFFF	0x0	-	Read-only
A6-30	0xA61E	Low 16 bits address of U0 table pDispValue	0x0 to 0xFFFF	0x0	-	Read-only

20.22 Group A7 Reserved Parameter Overview

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
A7-11	0xA70B	Regenerative power limit percentage	0 to 100	100	%	Real time

20.23 Group B0 Custom Parameter Mappings

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B0-00	0xB000	Customized parameter 0 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-01	0xB001	Customized parameter 1 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-02	0xB002	Customized parameter 2 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-03	0xB003	Customized parameter 3 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-04	0xB004	Customized parameter 4 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-05	0xB005	Customized parameter 5 address mapping	0x0 to 0xFFFF	0xF000	-	At stop

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B0-06	0xB006	Customized parameter 6 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-07	0xB007	Customized parameter 7 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-08	0xB008	Customized parameter 8 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-09	0xB009	Customized parameter 9 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-10	0xB00A	Customized parameter 10 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-11	0xB00B	Customized parameter 11 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-12	0xB00C	Customized parameter 12 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-13	0xB00D	Customized parameter 13 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-14	0xB00E	Customized parameter 14 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-15	0xB00F	Customized parameter 15 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-16	0xB010	Customized parameter 16 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-17	0xB011	Customized parameter 17 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-18	0xB012	Customized parameter 18 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-19	0xB013	Customized parameter 19 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-20	0xB014	Customized parameter 20 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-21	0xB015	Customized parameter 21 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-22	0xB016	Customized parameter 22 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-23	0xB017	Customized parameter 23 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-24	0xB018	Customized parameter 24 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-25	0xB019	Customized parameter 25 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-26	0xB01A	Customized parameter 26 address mapping	0x0 to 0xFFFF	0xF000	-	At stop

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B0-27	0xB01B	Customized parameter 27 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-28	0xB01C	Customized parameter 28 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-29	0xB01D	Customized parameter 29 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-30	0xB01E	Customized parameter 30 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-31	0xB01F	Customized parameter 31 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-32	0xB020	Customized parameter 32 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-33	0xB021	Customized parameter 33 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-34	0xB022	Customized parameter 34 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-35	0xB023	Customized parameter 35 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-36	0xB024	Customized parameter 36 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-37	0xB025	Customized parameter 37 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-38	0xB026	Customized parameter 38 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-39	0xB027	Customized parameter 39 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-40	0xB028	Customized parameter 40 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-41	0xB029	Customized parameter 41 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-42	0xB02A	Customized parameter 42 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-43	0xB02B	Customized parameter 43 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-44	0xB02C	Customized parameter 44 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-45	0xB02D	Customized parameter 45 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-46	0xB02E	Customized parameter 46 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-47	0xB02F	Customized parameter 47 address mapping	0x0 to 0xFFFF	0xF000	-	At stop

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B0-48	0xB030	Customized parameter 48 address mapping	0x0 to 0xFFFF	0xF000	-	At stop
B0-49	0xB031	Customized parameter 49 address mapping	0x0 to 0xFFFF	0xF000	-	At stop

20.24 Group B1 Custom Parameter Values

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B1-00	0xB100	Customized parameter 0 value	0 to 65535	0	-	Real time
B1-01	0xB101	Customized parameter 1 value	0 to 65535	0	-	Real time
B1-02	0xB102	Customized parameter 2 value	0 to 65535	0	-	Real time
B1-03	0xB103	Customized parameter 3 value	0 to 65535	0	-	Real time
B1-04	0xB104	Customized parameter 4 value	0 to 65535	0	-	Real time
B1-05	0xB105	Customized parameter 5 value	0 to 65535	0	-	Real time
B1-06	0xB106	Customized parameter 6 value	0 to 65535	0	-	Real time
B1-07	0xB107	Customized parameter 7 value	0 to 65535	0	-	Real time
B1-08	0xB108	Customized parameter 8 value	0 to 65535	0	-	Real time
B1-09	0xB109	Customized parameter 9 value	0 to 65535	0	-	Real time
B1-10	0xB10A	Customized parameter 10 value	0 to 65535	0	-	Real time
B1-11	0xB10B	Customized parameter 11 value	0 to 65535	0	-	Real time
B1-12	0xB10C	Customized parameter 12 value	0 to 65535	0	-	Real time
B1-13	0xB10D	Customized parameter 13 value	0 to 65535	0	-	Real time
B1-14	0xB10E	Customized parameter 14 value	0 to 65535	0	-	Real time
B1-15	0xB10F	Customized parameter 15 value	0 to 65535	0	-	Real time
B1-16	0xB110	Customized parameter 16 value	0 to 65535	0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B1-17	0xB111	Customized parameter 17 value	0 to 65535	0	-	Real time
B1-18	0xB112	Customized parameter 18 value	0 to 65535	0	-	Real time
B1-19	0xB113	Customized parameter 19 value	0 to 65535	0	-	Real time
B1-20	0xB114	Customized parameter 20 value	0 to 65535	0	-	Real time
B1-21	0xB115	Customized parameter 21 value	0 to 65535	0	-	Real time
B1-22	0xB116	Customized parameter 22 value	0 to 65535	0	-	Real time
B1-23	0xB117	Customized parameter 23 value	0 to 65535	0	-	Real time
B1-24	0xB118	Customized parameter 24 value	0 to 65535	0	-	Real time
B1-25	0xB119	Customized parameter 25 value	0 to 65535	0	-	Real time
B1-26	0xB11A	Customized parameter 26 value	0 to 65535	0	-	Real time
B1-27	0xB11B	Customized parameter 27 value	0 to 65535	0	-	Real time
B1-28	0xB11C	Customized parameter 28 value	0 to 65535	0	-	Real time
B1-29	0xB11D	Customized parameter 29 value	0 to 65535	0	-	Real time
B1-30	0xB11E	Customized parameter 30 value	0 to 65535	0	-	Real time
B1-31	0xB11F	Customized parameter 31 value	0 to 65535	0	-	Real time
B1-32	0xB120	Customized parameter 32 value	0 to 65535	0	-	Real time
B1-33	0xB121	Customized parameter 33 value	0 to 65535	0	-	Real time
B1-34	0xB122	Customized parameter 34 value	0 to 65535	0	-	Real time
B1-35	0xB123	Customized parameter 35 value	0 to 65535	0	-	Real time
B1-36	0xB124	Customized parameter 36 value	0 to 65535	0	-	Real time
B1-37	0xB125	Customized parameter 37 value	0 to 65535	0	-	Real time
B1-38	0xB126	Customized parameter 38 value	0 to 65535	0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B1-39	0xB127	Customized parameter 39 value	0 to 65535	0	-	Real time
B1-40	0xB128	Customized parameter 40 value	0 to 65535	0	-	Real time
B1-41	0xB129	Customized parameter 41 value	0 to 65535	0	-	Real time
B1-42	0xB12A	Customized parameter 42 value	0 to 65535	0	-	Real time
B1-43	0xB12B	Customized parameter 43 value	0 to 65535	0	-	Real time
B1-44	0xB12C	Customized parameter 44 value	0 to 65535	0	-	Real time
B1-45	0xB12D	Customized parameter 45 value	0 to 65535	0	-	Real time
B1-46	0xB12E	Customized parameter 46 value	0 to 65535	0	-	Real time
B1-47	0xB12F	Customized parameter 47 value	0 to 65535	0	-	Real time
B1-48	0xB130	Customized parameter 48 value	0 to 65535	0	-	Real time
B1-49	0xB131	Customized parameter 49 value	0 to 65535	0	-	Real time

20.25 Group B2 Custom Display Parameter Mappings

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B2-00	0xB200	Customized display parameter 0 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-01	0xB201	Customized display parameter 1 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-02	0xB202	Customized display parameter 2 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-03	0xB203	Customized display parameter 3 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-04	0xB204	Customized display parameter 4 address mapping	0x0 to 0xFFFF	0x0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B2-05	0xB205	Customized display parameter 5 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-06	0xB206	Customized display parameter 6 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-07	0xB207	Customized display parameter 7 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-08	0xB208	Customized display parameter 8 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-09	0xB209	Customized display parameter 9 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-10	0xB20A	Customized display parameter 10 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-11	0xB20B	Customized display parameter 11 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-12	0xB20C	Customized display parameter 12 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-13	0xB20D	Customized display parameter 13 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-14	0xB20E	Customized display parameter 14 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-15	0xB20F	Customized display parameter 15 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-16	0xB210	Customized display parameter 16 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-17	0xB211	Customized display parameter 17 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-18	0xB212	Customized display parameter 18 address mapping	0x0 to 0xFFFF	0x0	-	Real time
B2-19	0xB213	Customized display parameter 19 address mapping	0x0 to 0xFFFF	0x0	-	Real time

20.26 Group B3 Custom Display Parameter Numeric Values

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
B3-00	0xB300	Customized display parameter 0 value	0 to 65535	0	-	Read-only
B3-01	0xB301	Customized display parameter 1 value	0 to 65535	0	-	Read-only
B3-02	0xB302	Customized display parameter 2 value	0 to 65535	0	-	Read-only
B3-03	0xB303	Customized display parameter 3 value	0 to 65535	0	-	Read-only
B3-04	0xB304	Customized display parameter 4 value	0 to 65535	0	-	Read-only
B3-05	0xB305	Customized display parameter 5 value	0 to 65535	0	-	Read-only
B3-06	0xB306	Customized display parameter 6 value	0 to 65535	0	-	Read-only
B3-07	0xB307	Customized display parameter 7 value	0 to 65535	0	-	Read-only
B3-08	0xB308	Customized display parameter 8 value	0 to 65535	0	-	Read-only
B3-09	0xB309	Customized display parameter 9 value	0 to 65535	0	-	Read-only
B3-10	0xB30A	Customized display parameter 10 value	0 to 65535	0	-	Read-only
B3-11	0xB30B	Customized display parameter 11 value	0 to 65535	0	-	Read-only
B3-12	0xB30C	Customized display parameter 12 value	0 to 65535	0	-	Read-only
B3-13	0xB30D	Customized display parameter 13 value	0 to 65535	0	-	Read-only
B3-14	0xB30E	Customized display parameter 14 value	0 to 65535	0	-	Read-only
B3-15	0xB30F	Customized display parameter 15 value	0 to 65535	0	-	Read-only
B3-16	0xB310	Customized display parameter 16 value	0 to 65535	0	-	Read-only
B3-17	0xB311	Customized display parameter 17 value	0 to 65535	0	-	Read-only
B3-18	0xB312	Customized display parameter 18 value	0 to 65535	0	-	Read-only
B3-19	0xB313	Customized display parameter 19 value	0 to 65535	0	-	Read-only

20.27 Group AF Communication Process Data Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
AF-00	0xAF00	Communication process data RPDO1	0x0 to 0xFFFF	0x2073	-	Real time
AF-01	0xAF01	Communication process data RPDO1	0x0 to 0xFFFF	0x110	-	Real time
AF-02	0xAF02	Communication process data RPDO1	0x0 to 0xFFFF	0x2073	-	Real time
AF-03	0xAF03	Communication process data RPDO1	0x0 to 0xFFFF	0x210	-	Real time
AF-04	0xAF04	Communication process data RPDO1	0x0 to 0xFFFF	0x2073	-	Real time
AF-05	0xAF05	Communication process data RPDO1	0x0 to 0xFFFF	0x310	-	Real time
AF-06	0xAF06	Communication process data RPDO1	0x0 to 0xFFFF	0x2073	-	Real time
AF-07	0xAF07	Communication process data RPDO1	0x0 to 0xFFFF	0x410	-	Real time
AF-08	0xAF08	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-09	0xAF09	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-10	0xAF0A	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-11	0xAF0B	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-12	0xAF0C	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-13	0xAF0D	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-14	0xAF0E	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-15	0xAF0F	Communication process data RPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-16	0xAF10	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-17	0xAF11	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-18	0xAF12	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-19	0xAF13	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-20	0xAF14	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
AF-21	0xAF15	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-22	0xAF16	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-23	0xAF17	Communication process data RPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-24	0xAF18	Communication process data RPDO4	0x0 to 0xFFFF	0x2073	-	Real time
AF-25	0xAF19	Communication process data RPDO4	0x0 to 0xFFFF	0x910	-	Real time
AF-26	0xAF1A	Communication process data RPDO4	0x0 to 0xFFFF	0x2073	-	Real time
AF-27	0xAF1B	Communication process data RPDO4	0x0 to 0xFFFF	0xA10	-	Real time
AF-28	0xAF1C	Communication process data RPDO4	0x0 to 0xFFFF	0x2073	-	Real time
AF-29	0xAF1D	Communication process data RPDO4	0x0 to 0xFFFF	0xB10	-	Real time
AF-30	0xAF1E	Communication process data RPDO4	0x0 to 0xFFFF	0x2073	-	Real time
AF-31	0xAF1F	Communication process data RPDO4	0x0 to 0xFFFF	0xC10	-	Real time
AF-32	0xAF20	Communication process data TPDO1	0x0 to 0xFFFF	0x2070	-	Real time
AF-33	0xAF21	Communication process data TPDO1	0x0 to 0xFFFF	0x410	-	Real time
AF-34	0xAF22	Communication process data TPDO1	0x0 to 0xFFFF	0x2070	-	Real time
AF-35	0xAF23	Communication process data TPDO1	0x0 to 0xFFFF	0x510	-	Real time
AF-36	0xAF24	Communication process data TPDO1	0x0 to 0xFFFF	0x2070	-	Real time
AF-37	0xAF25	Communication process data TPDO1	0x0 to 0xFFFF	0x610	-	Real time
AF-38	0xAF26	Communication process data TPDO1	0x0 to 0xFFFF	0x2080	-	Real time
AF-39	0xAF27	Communication process data TPDO1	0x0 to 0xFFFF	0x110	-	Real time
AF-40	0xAF28	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-41	0xAF29	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-42	0xAF2A	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
AF-43	0xAF2B	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-44	0xAF2C	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-45	0xAF2D	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-46	0xAF2E	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-47	0xAF2F	Communication process data TPDO2	0x0 to 0xFFFF	0x0	-	Real time
AF-48	0xAF30	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-49	0xAF31	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-50	0xAF32	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-51	0xAF33	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-52	0xAF34	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-53	0xAF35	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-54	0xAF36	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-55	0xAF37	Communication process data TPDO3	0x0 to 0xFFFF	0x0	-	Real time
AF-56	0xAF38	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-57	0xAF39	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-58	0xAF3A	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-59	0xAF3B	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-60	0xAF3C	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-61	0xAF3D	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-62	0xAF3E	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time
AF-63	0xAF3F	Communication process data TPDO4	0x0 to 0xFFFF	0x0	-	Real time

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
AF-64	0xAF40	Communication process data	0x0 to 0xFFFF	0x20F0	-	Real time
AF-65	0xAF41	Communication process data	0x0 to 0xFFFF	0x810	-	Real time

20.28 Group U0 Operation Monitoring Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
U0-00	0x7000	Speed feedback	-32768 to 32767	0	rpm	Read-only
U0-01	0x7001	Speed reference	-32768 to 32767	0	rpm	Read-only
U0-02	0x7002	Bus voltage	0.0 to 6553.5	0.0	V	Read-only
U0-03	0x7003	Output voltage	0 to 65535	0	V	Read-only
U0-04	0x7004	Output current	0.0 to 6553.5	0.0	A	Read-only
U0-05	0x7005	Output power	0.0 to 6553.5	0.0	kW	Read-only
U0-06	0x7006	Output torque	-3276.8 to +3276.7	0.0	%	Read-only
U0-07	0x7007	DI/DO status display	0 to 65535	0	-	Read-only
U0-08	0x7008	Invalid	0 to 65535	0	-	Read-only
U0-09	0x7009	Calibrated AI1 voltage	-32.768 to 32.767	0.000	V	Read-only
U0-10	0x700A	Calibrated AI2 voltage	-32.768 to 32.767	0.000	V	Read-only
U0-11	0x700B	Calibrated AI3 voltage	0.000 to 65.535	0.000	V	Read-only
U0-12	0x700C	AI4 voltage after calibration	0.000 to 65.535	0.000	V	Read-only
U0-13	0x700D	Output voltage	0 to 65535	0	V	Read-only
U0-14	0x700E	Motor speed	-32768 to 32767	0	rpm	Read-only
U0-15	0x700F	Drive energy consumption (high 16 bits)	0.0 to 6553.5	0.0	kWh	Read-only
U0-16	0x7010	Drive energy consumption (low 16 bits)	0.0 to 6553.5	0.0	kWh	Read-only
U0-17	0x7011	Braking power	0.0 to 6553.5	0.0	W	Read-only
U0-19	0x7013	Speed reference	-32768 to 32767	0	-	Read-only
U0-28	0x701C	Mechanical angle	0 to 65535	0	-	Read-only
U0-30	0x701E	AI1 voltage before correction	-32.768 to 32.767	0.000	V	Read-only
U0-31	0x701F	AI2 voltage before correction	-32.768 to 32.767	0.000	V	Read-only
U0-32	0x7020	AI3 voltage before correction	-32.768 to 32.767	0.000	V	Read-only

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
U0-33	0x7021	AI4 voltage before calibration	-32.768 to 32.767	0.000	V	Read-only
U0-34	0x7022	AO1 output voltage	0.000 to 65.535	0.000	V	Read-only
U0-35	0x7023	AO2 output voltage	0.000 to 65.535	0.000	V	Read-only
U0-36	0x7024	Real-time angle	0.0 to 6553.5	0.0	°	Read-only
U0-37	0x7025	Reference oil pressure	0.0 to 6553.5	0.0	kg/cm²	Read-only
U0-38	0x7026	Oil pressure feedback	0.0 to 6553.5	0.0	kg/cm²	Read-only
U0-39	0x7027	Reference flow PID calculation value	-32768 to 32767	0	rpm	Read-only
U0-40	0x7028	Operating speed	-32768 to 32767	0	rpm	Read-only
U0-43	0x702B	Latest fault	0.00 to 655.35	0.00	-	Read-only
U0-45	0x702D	Motor temperature	-3276.8 to +3276.7	0.0	℃	Read-only
U0-46	0x702E	Number of CAN frames received	0 to 65535	0	-	Read-only
U0-47	0x702F	Number of CAN transmission errors	0 to 65535	0	-	Read-only
U0-48	0x7030	Number of CAN reception errors	0 to 65535	0	-	Read-only
U0-49	0x7031	Bus disconnection times	0 to 65535	0	-	Read-only
U0-58	0x703A	Motor temperature sampling value	0 to 65535	0	-	Read-only
U0-61	0x703D	Expansion card version number	0.00 to 655.35	0.00	-	Read-only
U0-62	0x703E	Expansion card type	0 to 65535	0	-	Read-only
U0-63	0x703F	Frequency reference	-327.78 to 327.67	0.00	Hz	Read-only
U0-64	0x7040	Feedback frequency	-327.68 to +327.67	0.00	Hz	Read-only
U0-65	0x7041	Pressure holding flag bit	0 to 65535	0	-	Read-only
U0-67	0x7043	Compensation flag bit	0 to 65535	0	-	Read-only
U0-68	0x7044	Count value	0 to 65535	0	-	Read-only
U0-69	0x7045	Process data monitoring value	0 to 65535	0	-	Read-only
U0-70	0x7046	High frequency output	-32768 to 32767	0	rpm	Read-only
U0-71	0x7047	Low frequency output	-32768 to 32767	0	rpm	Read-only
U0-73	0x7049	Pressure fluctuation wave peak value	0 to 65535	0	-	Read-only
U0-75	0x704B	Pressure holding flag position	0 to 65535	0	-	Read-only
U0-76	0x704C	Stable pressure flag bit	0 to 65535	0	-	Read-only
U0-80	0x7050	Platen feedback location	0 to 65535	0	mm	Read-only
U0-81	0x7051	Template speed setpoint	0 to 65535	0	mm/s	Read-only

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
U0-82	0x7052	Platen feedback speed	0 to 65535	0	mm/s	Read-only
U0-83	0x7053	Motor speed reference	-32768 to 32767	0	rpm	Read-only
U0-84	0x7054	Motor speed feedback	-32768 to 32767	0	rpm	Read-only
U0-85	0x7055	Oil pressure feedback	0 to 65535	0	kg	Read-only
U0-86	0x7056	State bit	0 to 65535	0	-	Read-only
U0-87	0x7057	Mold opening completed flag	0 to 65535	0	-	Read-only
U0-90	0x705A	Real-time inertia ratio	0 to 65535	0	-	Read-only
U0-91	0x705B	VDI input state	0 to 65535	0	-	Read-only

20.29 Group U1 Oil Pressure Monitoring Parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
U1-00	0x7100	Real-time angle	0.0 to 6553.5	0.0	°	Read-only
U1-01	0x7101	Reference oil pressure	0.0 to 6553.5	0.0	kg/cm²	Read-only
U1-02	0x7102	Oil pressure feedback	0.0 to 6553.5	0.0	kg/cm²	Read-only
U1-03	0x7103	Speed feedback	-32768 to 32767	0	rpm	Read-only
U1-04	0x7104	AI1 analog voltage	-32.768 to 32.767	0.000	V	Read-only
U1-05	0x7105	AI2 analog voltage	-32.768 to 32.767	0.000	V	Read-only
U1-06	0x7106	AI3 analog voltage	0.000 to 65.535	0.000	V	Read-only
U1-07	0x7107	AI1 zero drift	-327.68 to +327.67	0.00	V	Read-only
U1-08	0x7108	AI2 zero drift	-327.68 to +327.67	0.00	V	Read-only
U1-09	0x7109	AI3 zero drift	0.00 to 327.67	0.00	V	Read-only
U1-10	0x710A	Host controller flow reference	-327.68 to +327.67	0.00	Hz	Read-only
U1-13	0x710D	CAN communication transmission error counter	0 to 65535	0	-	Read-only
U1-14	0x710E	Accumulative number of CAN transmission	0 to 65535	0	-	Read-only
U1-15	0x710F	Accumulative number of CAN reception	0 to 65535	0	-	Read-only
U1-17	0x7111	AI4 zero drift	0.00 to 327.67	0.00	V	Read-only
U1-18	0x7112	Accumulative number of CAN transmission errors	0 to 65535	0	-	Read-only
U1-19	0x7113	Screw compensation coefficient	-3276.8 to +3276.7	0.0	-	Read-only
U1-20	0x7114	Max. feedback pressure	0.0 to 6553.5	0.0	kg/cm²	Read-only
U1-21	0x7115	Maximum oil pressure feedback	0.0 to 6553.5	0.0	kg/cm²	Read-only

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
U1-22	0x7116	Max. speed feedback	-32768 to 32767	0	-	Read-only
U1-30	0x711E	RPDO1 value 1	0 to 65535	0	-	Read-only
U1-31	0x711F	RPDO1 value 2	0 to 65535	0	-	Read-only
U1-32	0x7120	RPDO1 value 3	0 to 65535	0	-	Read-only
U1-33	0x7121	RPDO1 value 4	0 to 65535	0	-	Read-only
U1-34	0x7122	RPDO2 value 1	0 to 65535	0	-	Read-only
U1-35	0x7123	RPDO2 value 2	0 to 65535	0	-	Read-only
U1-36	0x7124	RPDO2 value 3	0 to 65535	0	-	Read-only
U1-37	0x7125	RPDO2 value 4	0 to 65535	0	-	Read-only
U1-38	0x7126	RPDO3 value 1	0 to 65535	0	-	Read-only
U1-39	0x7127	RPDO3 value 2	0 to 65535	0	-	Read-only
U1-40	0x7128	RPDO3 value 3	0 to 65535	0	-	Read-only
U1-41	0x7129	RPDO3 value 4	0 to 65535	0	-	Read-only
U1-42	0x712A	RPDO4 value 1	0 to 65535	0	-	Read-only
U1-43	0x712B	RPDO4 value 2	0 to 65535	0	-	Read-only
U1-44	0x712C	RPDO4 value 3	0 to 65535	0	-	Read-only
U1-45	0x712D	RPDO4 value 4	0 to 65535	0	-	Read-only

Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit https://www.inovance.com/global to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.
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