# MH800 Series Electro-hydraulic Servo System

# Operation Manual

(V1.1)

INVT Industrial Technology (Shanghai) Co., Ltd

# Preface

INVT MH800 series electro-hydraulic servo is designed especially for hydraulic devices eg injection molding machine, casting machine, oil press, etc. It adopts high performance vector control and is featured with energy saving, high precision, high efficiency and strong durability. MH800 series servo carries abundant external extension interfaces and CAN communication interfaces for forming multi-pump parallel system and realizing hydraulic control of large-flow system.

Thanks for choosing the MH800 series electro-hydraulic servo system manufactured by Shanghai INVT Industry Technology Co., Ltd. Read this manual carefully to ensure proper operation. Please keep this operation manual in a safe place for future reference.

- This manual is suitable for the following users:
  1) Designer of control system
  2) Installation or wiring personnel
  3) Operation or maintenance personnel
- Below requirements must be followed when you have not read through this operation manual :
  1) Installation environment must be free from moisture, corrosive gases and combustible gases;
  2) Do not connect the grid power to the U, V and W terminals of the motor directly during wiring, otherwise, the drive and motor may be damaged;
  3) The grounding wire must be grounded in a reliable way;
  4) When power is applied, do not disassemble the drive, motor, oil pump or change the wiring;
  5) Do not touch the cooling fins during working to avoid scald.

Our company provides all-around after-sale and maintenance service. Do not disassemble the drive, LED panel or motor enclosure by yourself. Any change or damage made to the drive will void the warranty and our company will not assume the liability for the consequences thereof.

If there is any question, please contact the distributor or customer service center of our company.

# Content

# Chapter 1 Safety Precautions

Read this manual carefully and follow all the safety precautions before moving, installing, operating and servicing the product. If you ignore the safety precautions, physical injury or death may occur, or damage may occur to the devices.

If any physical injury or death or damage to the devices occurred due to user's ignoring of the safety precautions in the manual, our company will not be responsible for any damages thereof and we are not legally bound in any manner.

## 1.1 Safety Definition

The precautious related to safety operations are classified into "Danger", "Warning" and "Note".

 **Danger**: This mark indicates the potential danger which may cause serious physical injury or death if operation requirements are not followed.

 **Warning**: This mark indicates the potential danger which may cause physical injury or device damage if operation requirements are not followed.

NOTE: This mark indicates the potential danger which may cause physical injury if operation requirements are not followed.

## 1.2 Safety Guidelines

| | |
|---|---|
|  | 1. The installation and maintenance work can be carried out by trained and qualified professionals only. |
| | 2. Do not check the wiring or replace any component when the power is applied. Before wiring and checking, confirm all the input power sources are disconnected, and wait for at least 10 minutes or confirm the DC bus voltage is less than 36V. |
| | 3. Use insulation protection tools during inspection, otherwise electric shock or physical injury may occur. |
| | 4. Connect the grounding wires in a reliable way and the wiring work can be carried out by professionals only, otherwise electric shock or fire may occur. |
| | 5. Do not install the motor, brake resistor or the drive near the combustible objects, otherwise fire may occur. |
| | 6. Do not refit the product unless authorized, otherwise electric shock, fault, burn or fire may occur. |
|  | 1. When carrying the motor, do not pull up the connection part of the aviation plug to avoid damage to the electrical connection parts and physical injuries caused by the falling of motor. |
| | 2. When installing the motor, do not knock on the motor to avoid damage to the precision components or adverse impact on the precision. |
| | 3. During full load operation, the surface temperature of this servo motor may |

| | |
|---|---|
| | reach 100°C, which is within the allowed range but may cause danger of scald, therefore, motor should be installed in a place where it is hard for human beings or animals to access. |
| | 4. As the external brake resistor may become hot when motor brakes frequently, the cooling air ducts must be in good condition. It is recommended to install the external brake resistor in a place outside the control cabinet (eg in the air outlet of the ventilator on the top) and take reliable preventative measures against waterdrops and human contact; if it must be installed inside the cabinet, it should be installed near the air outlet of the ventilator on the top and far away from other components. |
| | 5. Ensure to check all the external connection cables before the initial power up to avoid major accidents caused by wrong wiring. |
| | 6. The motor should carry no load during initial switch-on, and depending on the operation situation, switch off the enabling anytime if necessary. |
| | 7. Start or stop the servo system by enabling instead of switching on/off. |
| | 8. This product carries electrolytic capacitor, integrated circuit, epoxy plate, etc., all of which should be disposed as industrial waste when discarded, otherwise, physical injury or environmental pollution may occur. |
| **NOTE** | 1. Ensure the drive is free from physical shock and vibration during moving and installation; do not hold the product by its front cover only to avoid fall off. |
| | 2. Users must prevent the screws, cables and other conductive objects from falling into the drive. |
| | 3. R, S and T are power input terminals, while U, V and W are output motor terminals. Connect input power cables and motor cables correctly; otherwise the drive may be damaged. |
| | 4. Before using the drive, ensure its front cover or junction box is closed, otherwise electric shock may occur. |
| | 5. Tighten the screws with proper torque during installation and wiring. |
| | 6. Do not carry out insulation voltage withstand test on the drive; do not use megameter to test the control circuit of the drive. |

※ For application sites susceptible to occasional product faults, namely the occasional fault may cause major accident or loss, please take extra consideration on the device safety.

※ The manufacturer, retailer and service provider will not assume any correlated loss or joint liability caused by the servo system faults, excluding the servo system itself.

# Chapter 2 Product Information

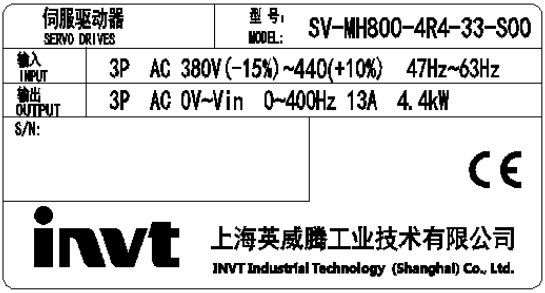
## 2.1 Product Confirmation

Confirm the following items upon receiving the products.

| Items To Be Confirmed | Remark |
|---|---|
| Whether the products received are consistent with the product models you ordered? | Confirm by the “model” column on the nameplate of the servo motor and servo drive |
| Whether the rotating shaft of the servo motor can run smoothly? | The rotating shaft should be able to be rotated manually, |
| Whether there is any damage? | A cosmetic check on the product to ensure no damage is caused during shipment, etc. |
| Whether the attachments and materials are complete? | Check the attachments, certificate of qualification and the warranty certificate according to the packing list. |

If any inconformity occurred, contact the retailer or the sales agency of our company immediately.

## 2.2 Nameplate of the Servo Drive




## 2.3 Model Instruction of the Servo Drive

| SV | -MH800 | -5R5 | -33 | -S | 00 |
|---|---|---|---|---|---|
| Servo product | Electro-hydraulic product series | Power range<br>4R4: 4.4KW<br>5R5: 5.5KW<br>7R5: 7.5KW<br>011: 11KW<br>015: 15KW<br>018: 18KW<br>025: 25KW<br>030: 30KW<br>037: 37KW<br>045: 45KW | Input voltage type<br>33: 3PH 380V<br>32: 3PH 220V<br>22: 1PH220V | Communication plate type<br>S: Standard type<br>N: EtherCat bus type | Extension code<br>00: No differentiation<br>01: Chende<br>02: Beston |

| SV | -MH800 | -5R5 | -33 | -S | 00 |
|---|---|---|---|---|---|
| | | 055: 55KW<br>075: 75KW<br>095: 95KW | | | |
| Basic product model information (Software display) | | | | | |

## 2.4 Specification of the Servo Drive

| Drive model SV-MH800- | 4R4-33-S00 | 5R5-33-S00 | 7R5-33-S00 | 011-33-S00 | 015-33-S00 |
|---|---|---|---|---|---|
| Applicable motor capacity [kW] | 4.4 | 5.5 | 7.5 | 11 | 15 |
| Rated output current [Arms] | 13 | 18 | 22 | 26 | 30 |
| Rated input current [Arms] | 18 | 24 | 28 | 32 | 37 |
| Max output current [Arms] | 25 | 35 | 46 | 53 | 64 |
| Input power | AC380V(-15%) – 440V(+10%) 47Hz – 63Hz | | | | |
| Weight | 6.5Kg | 7.0kg | 9kg | 9.5kg | 9.5kg |
| Regenerative brake resistor | 40Ω 500W | | | | 15Ω500W |

| Drive model SV-MH800- | 018-33-S00 | 025-33-S00 | 030-33-S00 | 037-33-S00 | 045-33-S00 |
|---|---|---|---|---|---|
| Applicable motor capacity [kW] | 18 | 25 | 30 | 37 | 45 |
| Rated output current [Arms] | 38 | 50 | 64 | 80 | 99 |
| Rated input current [Arms] | 47 | 60 | 75 | 94 | 109 |
| Max output current [Arms] | 95 | 113 | 141 | 190 | 255 |
| Input power | AC380V(-15%) – 440V(+10%) 47Hz – 63Hz | | | | |
| Weight | 11.5Kg | 11.5kg | 30kg | 32kg | 51kg |
| Regenerative brake resistor | 15Ω 500W | | 10Ω 2000W | | Connect two 10Ω 2000W resistors in parallel |

| Drive mode SV-MH800- | 055-33-S00 | 075-33-S00 |
|---|---|---|
| Applicable motor capacity [kW] | 55 | 75 |
| Rated output current [Arms] | 123 | 156 |
| Rated input current [Arms] | 135 | 166 |
| Max output current [Arms] | 283 | 318 |
| Input power | AC380V(-15%) – 440V(+10%) 47Hz – 63Hz | |
| Weight | 52 Kg | 67Kg |
| Regenerative brake resistor | Connect two 10Ω 2000W resistors in parallel | Connect two 30Ω 2000W resistors in parallel, it is necessary to install brake unit DBU100H-060-4 |

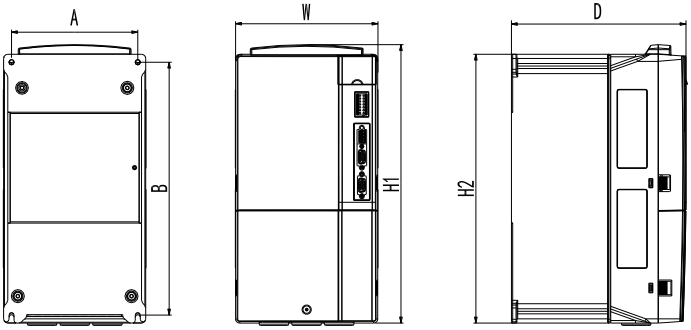
## 2.5 Technical Condition of Servo Drive

| | | | |
|---|---|---|---|
| Basic specification | Control mode | | 3PH full-wave rectification, IGBT PWM control sine ware current drive mode |
| | Max output frequency | | 400 Hz |
| | Motor position sensor | | Resolver resolution: 4096/rev |
| | Application condition | Application/ storage temperature | -20 – +55 °C (derating is needed if the temperature is above 45°C)/ −20 – +85 °C |
| | | RH | Below 95%RH (no condensation) |
| | | Air | Indoors (no sunlight), no corrosive gases, combustible gases, oil gases or dust |
| | | Elevation | Below 2000m |
| | Protection level | | IP20 |
| | Cooling mode | | Forced air cooling |
| | Digital signal | Input | Six inputs: ①servo enable (S-ON); ② alarm clear (ALM－RST); ③4 external control input interfaces(I1, I2, I3, I4). Refer to *4.7* for detailed function |
| | | Output | Four opto-coupler outputs:① alarm output(ALM); ② drive ready(S-RDY); ③ Refer to *4.7* for the function of control output interface;<br>One relay output; displacement switching control of dual-displacement pump (O1) |
| | Analog signal | Input | Three inputs 10-bit A/D (AIN1, AIN2, AIN3) |
| | | Output | Two outputs 10-bit D/A (ANOUT1, ANOUT2), users can set internal parameter output via LED panel or external HMI |
| | Power | Output | Provide 15V reference power to the external |
| | Communication function | CAN communication | Communicate with upper PC; carry out parameter setup and drive control; command reference and parameter save, etc. |
| | | RS485 | |
| | LED display panel and | | 6-bit LED display, four function keys |

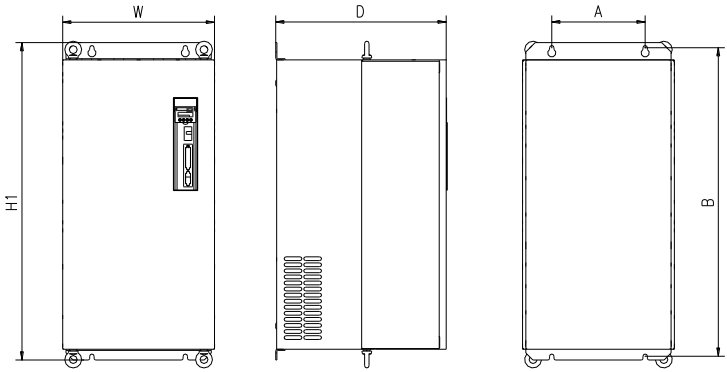
| | | |
|---|---|---|
| | keypad | |
| | External HMI | External HMI realizes communication with the drive, parameter setup, drive control, command reference and parameter save via RS485 port. |
| **Control function performance** | Control mode | Select the mode via parameter setup: ①process control; ②speed control |
| | Control input | Hydraulic control command input: can be set to analog input, CAN communication or RS485 communication<br>Speed command input: CAN communication or RS485 communication |
| | Multi-pump parallel control | Can control 16 pumps; three working modes (multi-pump, composite, multi-mode) |
| | Pressure control precision | ±1bar(screw pump) |
| | Flow control precision | ±0.5%FS |
| | Pressure control step response | ≤100ms flow reference>70% (screw pump) |
| | Speed step response during speed control | ≤50ms feedback pressure is less than 10bar |
| | Flow correction function | Carry out pressure calibration based on the characteristics of various pumps |
| | Speed command input | RS485, CAN communication |
| | Speed control precision | ±0.5% |
| | Torque response time | ≤2ms |
| | Overload capacity | MH800-4R4-33,MH800-5R5-33,MH800-7R5-33,MH800-018-33,MH800-030-33,MH800-037-33, MH800-045-33, MH800-025-33, MH800-075-33: lasts 5m for 141% of rated current; MH800-011-33,MH800-015-33, MH800-055-33: lasts 5m for 130% of rated current; for the max output current, lasts 30s for all models. |
| **Protection function** | Hardware error | Overcurrent, DC overvoltage, DC undervoltage, brake resistor damage, module over-temperature, pressure sensor fault, FWD/REV overspeed, brake overload, etc. |
| | Software error | Software fault, task re-entry, etc. |
| | Alarm record memory | Can store 5 alarm records |

※ If the actual temperature of the application site exceeds 45°C, derate by 3% for every additional 1°C, in addition, the servo drive cannot be used in the environment above 55°C. For cabinet installation, the ambient temperature of the servo motor is the air temperature inside the cabinet.

## 2.6 External Dimension of Servo Drive




4.4-25kW



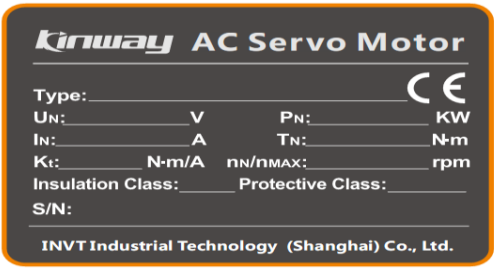

75kW

The external dimension of the servo drive is as below:

| Model | External Dimension | | | Installation Dimension | | Diameter of Installation Bore (mm) |
|---|---|---|---|---|---|---|
| | H1 (mm) | W (mm) | D (mm) | A (mm) | B (mm) | |
| SV-MH800-4R4-33-S-00 | 332 | 170 | 208 | 151 | 301 | M5(φ6) |
| SV-MH800-5R5-33-S-00 | | | | | | |
| SV-MH800-7R5-33-S-00 | 342 | 230 | 208 | 210 | 311 | M5(φ6) |
| SV-MH800-011-33-S-00 | | | | | | |
| SV-MH800-015-33-S-00 | | | | | | |
| SV-MH800-018-33-S-00 | 407 | 255 | 245 | 237 | 384 | M6(φ7) |
| SV-MH800-025-33-S-00 | | | | | | |

| Model | External Dimension | | | Installation Dimension | | Diameter of Installation Bore (mm) |
|---|---|---|---|---|---|---|
| | H1 (mm) | W (mm) | D (mm) | A (mm) | B (mm) | |
| SV-MH800-030-33-S-00 | 555 | 270 | 325 | 130 | 540 | M6(φ7) |
| SV-MH800-037-33-S-00 | | | | | | |
| SV-MH800-045-33-S-00 | 554 | 338 | 329 | 200 | 535 | M8(φ9.5) |
| SV-MH800-055-33-S-00 | | | | | | |
| SV-MH800-075-33-S-00 | 680 | 325 | 365 | 200 | 661 | M8(φ9.5) |

## 2.7 Nameplate of the Servo Motor




## 2.8 Model Instruction of the Servo Motor

K 038 F 18 -C 18 P- 33 R 1 E- A

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫

| | |
|---|---|
| ① Servo motor series | |
| ② Rated torque | 038-38N.m |
| | 111-111N.m |
| ③ Cooling method | F-Air cooling |
| | N-Natural cooling |
| | W-Water cooling |
| | Y-Oil cooling |
| ④ Rated rotary speed | 18-1800 rated rotary speed/100 |
| | 15-1500 rated rotary speed/100 |
| ⑤ Production line code | |
| ⑥ Flange diameter | 11-114mm |
| | 18-180mm |
| | 25-250mm |
| ⑦ Shaft extension type | P- Flat key |

| | |
|---|---|
| | G-Principal axis |
| | N-Internal spline |
| | W-External spline |
| ⑧ Rated input voltage | 33-3-phase 380V input voltage |
| | 32-3-phase 220V input voltage |
| | 12-single-phase 220V input voltage |
| ⑨ Feedback device type | R-Resolver |
| | A-Incremental encoder |
| ⑩ Pole pairs | 1-1 antipode |
| | 3-3 antipode |
| | A-10 antipode |
| ⑪ Brake mode | E-Without braking |
| | B-With braking |
| ⑫ Special configuration | |

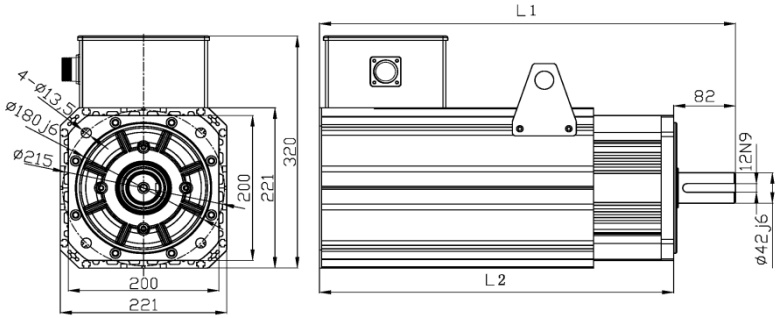
## 2.9 Specification of the Servo Motor

| Model | K038F18C18P-33R1E-A | K058F18C18P-33R1E-A | K072F18C18P-33R1E-A | K091F15C18P-33R1E-A | K111F15C18P-33R1E-A | K132F18C18P-33R1E-A | K187F18C25P-33R1E-A | K235F20C25P-33R1E-A | K341F18C25P-33R1E-A |
|---|---|---|---|---|---|---|---|---|---|
| Rated outpour power kW | 7.5 | 11 | 13 | 15 | 18 | 25 | 35 | 50 | 61 |
| Max output power kW | 18 | 28 | 33 | 39 | 50 | 63 | 91 | 125 | 152 |
| Counter-emf Vrms /1000rpm | 180 | 182 | 180 | 200 | 237 | 198 | 167 | 147 | 142 |
| Rated torque Nm | 38 | 58 | 72 | 91 | 111 | 133 | 187 | 235 | 341 |
| Max torque Nm | 120 | 174 | 220 | 275 | 306 | 400 | 487 | 705 | 975 |
| Rated current A (rms) | 14 | 20 | 25 | 30 | 35.2 | 49 | 74.6 | 113 | 155.3 |
| Max current A (rms) | 56 | 76 | 88 | 102 | 97 | 147 | 194 | 339 | 443 |
| Rated speed rpm | 1800 | 1800 | 1800 | 1500 | 1500 | 1800 | 1800 | 1800 | 1800 |
| Max speed rpm | 2500 | 2500 | 2500 | 2200 | 2200 | 2500 | 2500 | 2500 | 2500 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Torque parameter Nm/Arms | 2.8 | 2.9 | 2.8 | 3.2 | 3.86 | 3.17 | 2.58 | 2.3 | 2.2 |
| Voltage level V (rms) | 380 | | | | | | | | |
| Rated time | Continuous | | | | | | | | |
| Heat resistance level | F | | | | | | | | |
| Insulation voltage withstand | AC1800V 1m <10mA | | | | | | | | |
| Insulation resistor | DC1000V, above 50MΩ | | | | | | | | |
| Vibration level | <15um | | | | | | | | |
| Protection level | Fully-closed self-cooling IP54( except for shaft pass-through part) | | | | | | | | |
| Anti-vibration performance | Withstand vibration test at level 1 and level 2 environment conditions stipulated in table 4.26 in GB/T 7345-94 | | | | | | | | |
| Storage temperature | -25 – +85 °C | | | | | | | | |
| Ambient temperature | -20 – +45 °C | | | | | | | | |
| Ambient RH | 20% – 95% (no condensation) | | | | | | | | |
| Excitation mode | Permanent magnet type | | | | | | | | |
| Installation mode | IMB5 | | | | | | | | |
| Position detection | 1 level of resolver | | | | | | | | |

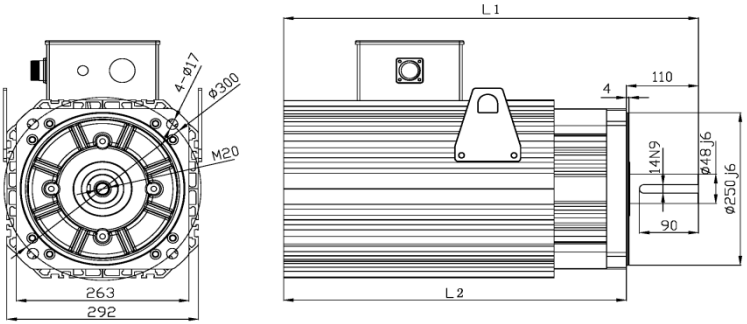
## 2.10 Installation Dimension of the Servo Motor

1) Servo motor dimension of K038F18C18P – K132F18C18P




| Motor Model | Length(mm) | |
|---|---|---|
| | L1 | L2 |
| K038F18C18P | 412.5 | 330.5 |
| K058F18C18P | 447.5 | 365.5 |
| K072F18C18P | 482.5 | 400.5 |
| K091F15C18P | 517.5 | 435.5 |
| K111F15C18P | 552.5 | 470.5 |
| K132F18C18P | 622.5 | 540.5 |

2) Servo motor dimension of K187F18C25P, K235F20C25P, K341F20C25P




| Motor Model | Length(mm) | |
|---|---|---|
| | L1 | L2 |
| K187F18C25P | 647 | 537 |
| K235F20C25P | 727 | 617 |
| K341F18C25P | 845 | 735 |

# Chapter 3 Mechanical Installation

## 3.1 Installation Environment

In order to ensure perfect performance and long-term service life, install MH800 servo drive in below recommended environment to ensure the drive is free from damages.

| | |
|---|---|
| **Note** | 1) Avoid direct sunlight and do not use in outdoor environment directly. |
| | 2) Do not use in the environment where there is corrosive gas or liquid. |
| | 3) Do not use in the environment where there is oil mist or water splash. |
| | 4) Do not use in the environment where there is salt mist. |
| | 5) Do not use in the environment where there is raindrops or humidity. |
| | 6) Filtering devices must be installed if there are metal powders or floating fibers in the air. |
| | 7) Do not use in the environment where there is mechanical shock or vibration. |
| | 8) If the ambient temperature is above 55°C, proper measures must be taken to lower the temperature. |
| | 9) Fault may occur to the device if the ambient temperature is too cold or too hot. It is recommended to use it within -20°C – +55°C. |
| | 10) Away from power noise eg electric welding machine and large-power devices. |
| | 11) Radioactive materials will impact the usage of the device. |
| | 12) Away from combustible objects, diluents and solvents. |

## 3.2 Installation of the Drive

1) The installation direction should be vertical to the wall direction, and the upper and lower part of the drive should reserve enough space (larger than 200mm) for ventilation and cable connection, thus facilitating heat dissipation and operation;

2) Adopt natural convection mode or the fan to cool down the servo drive;

3) Fix the servo unit firmly onto the installation surface through the four installation holes.

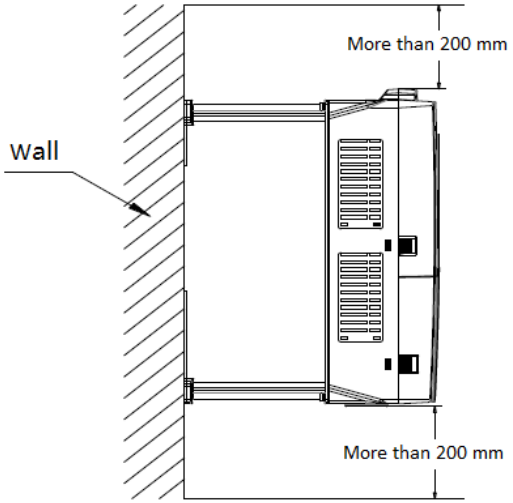
4) When multiple drives are installed inside the machine cabinet:

   a) The front side of the servo drive (installation side of the LED panel) should face the operation staff;

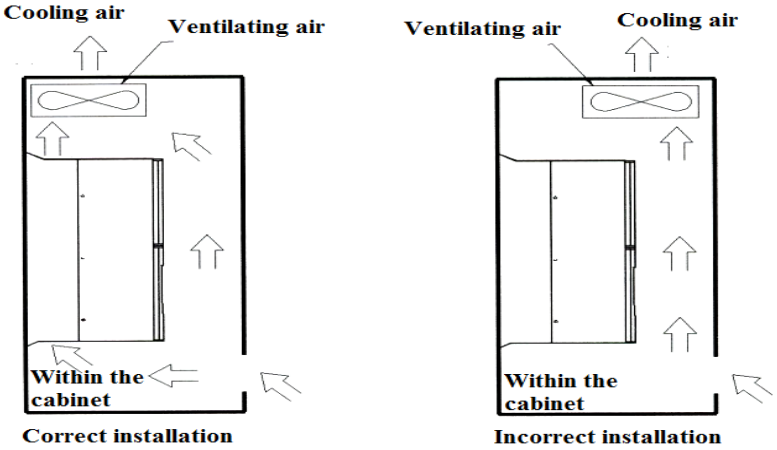
   b) The installation position of the ventilator inside the cabinet must be proper to ensure the drive can be cooled down through the fan and natural convection; if the installation position is improper, the ambient temperature of the drive may rise and the cooling effect will be impacted;

   c) During parallel installation, reserve more than 50mm space on both sides horizontally and more than 200mm space on both sides vertically. In addition, install cooling fan on the upper part of the servo unit. Keep the temperature inside the control cabinet even to prevent overheat of part of the servo unit;

Installation diagram of the drive



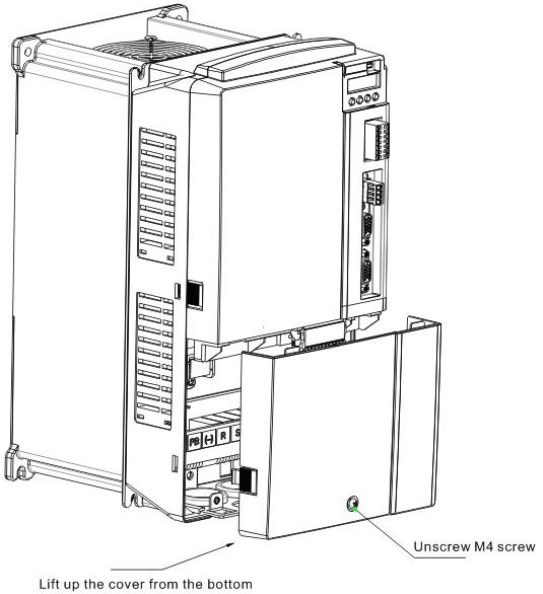

Installation diagram of the ventilator inside the cabinet




## 3.3 Disassemble Junction Box of the Drive

Disassemble the junction box of servo drive: (take SV-MH800-011-33-S00 as an example)

1. Unscrew the two screws used to fix the junction box and take off the screws;
2. Pull out the junction box.




Install junction box of servo drive: (take SV-MH800-011-33-S00 as an example)

1. Place the junction box into the convex groove of the system and push it to match with the gap of the shell;
2. Tighten the two screws used to fix the junction box.

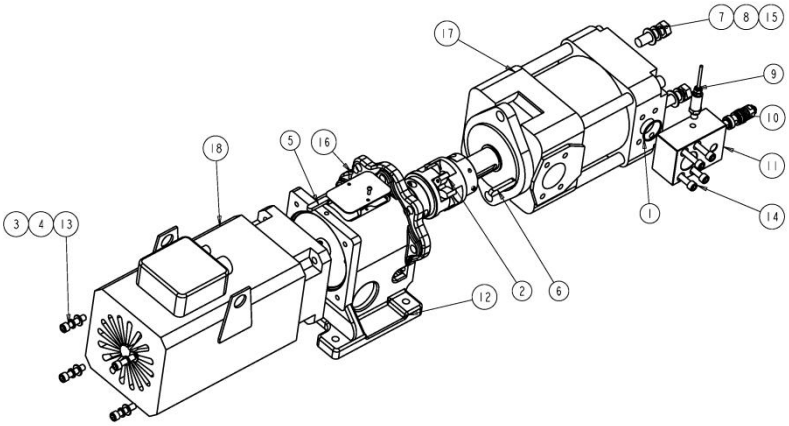
## 3.4 Installation of the Servo Motor

Install the motor according to below installation instruction to ensure a safe and stable operation of the servo motor.

| | |
|---|---|
| **Note** | 1. The servo motor can be installed horizontally or vertically. |
| | 2. It is recommended to use coupling when connecting to machinery. The shaft center of the servo motor should be in the same linear with that of the machinery, otherwise vibration, damage to the bearing or encoder may occur. |
| | 3. There is positioning requirement on the installation of feedback component (optical encoder, resolver), namely there is fixed relative position between the feedback component and motor rotor/stator, which cannot be disassembled or replaced by the users. |
| | 4. Do not apply “tension” on the wire, especially the delicate core wires of the signal cable. Do not stretch the wires too tight during wiring (usage). |
| | 5. During installing the motor, avoid direct shock on the bearing to prevent the precision parts (optical encoder, resolver) on the bearing from being damaged or deteriorated. |

The installation procedures of the motor and pump are listed below:

1) Connect the flat key to the pump and cover up with half of the coupling, and insert the bolt without screwing it tight;
2) Connect the flat key to the motor and cover up with the other half of the coupling, then insert the bolt without screwing it tight;
3) Connect the pump to the motor bracket and screw tight the bolts after confirming the direction;
4) Connect the motor to the motor bracket and screw tight the bolts after confirming the direction;
5) Adjust the clearance of the flexible coupling to 2 – 3mm and screw tight the bolts on both ends; ensure there is no abnormal noise when rotating manually;
6) Put the motor, motor bracket and connection units of the pump in the proper installation place, and determine the screw holes in the holder based on the screw holes on the bracket.
7) Fix the bolt and screw it tight.




①O-type rubber seal ring; ②Coupling component;③Spring washer;④Flat washer;
⑤Motor flat key;⑥Oil pump flat key;⑦Spring ring;⑧Flat washer ring;⑨Pressure sensor;
⑩Assembled thread overflow valve;⑪Integrated block oil outlet plate;⑫Motor bracket;
⑬Hexagon socket cap screws;⑭Hexagon socket cap screws;⑮Hexagon bolt;
⑯Cross recessed round head screw;⑰Oil pump;⑱Servo motor

# Chapter 4 Electrical Wiring

## 4.1 Wiring Precautions

| | |
|---|---|
|  | 1. Wiring can be done by professionals only as improper wiring may cause electric shock or fire. |
| | 2. MH800 series servo drive can be connected to industry-purpose power cables directly, namely transformer is not used for isolation. Users must use the breaker or fuse which is specific for wiring to prevent crossed electric shock from being generated by the servo system. |
| | 3. MH800 series servo drive does not carry built-in grounding protection circuit. Please configure with the current leakage breaker which carries overload and short circuit protection function, or the current leakage breaker used specifically for grounding protection which matches with the wiring-specific breaker. |
| **NOTE** | 1. It is recommended to adopt A, B or C connection mode (grounding resistor is below 10Ω) and single-point grounding is a must. If the servo motor and mechanical firmware insulates with each other, ground the servo motor directly. |
| | 2. Use thick cables for grounding wiring if possible (above 2.0mm$^2$). |
| | 3. Currently, most of the leakage protection switches are electronic current leakage breaker, and the internal leakage detection and process circuit of different breaker brands vary enormously, which causes different anti-interference capacity of the breaker. It is recommended to use the leakage breaker with strong anti-interference capacity eg Chint. |
| | 4. Separate cables with strong electricity eg the power cable and servo motor input cable from the signal wires at a distance of more than 30cm. Do not put them or bundle them together. |
| | 5. The welding machine and electrical discharge machine cannot share the same power source, and even so, if there is high frequency generator nearby, connect noise filter to the input side of the power cable. |
| | 6. Users must install surge suppressor on the coils of the relay, solenoid and electromagnet contactor. |
| | 7. Install the input command device and noise filter near the servo unit to prevent mal-action caused by the noise. |
| | 8. The lead wire diameter, switch capacity and contactor capacity must be properly selected. Refer to *Selection of switch, contactor and cable diameter*. |

※ Improper wiring may lead to system fault or potential physical injuries.

## 4.2 Selection of the Switch, Contactor and Cable Diameter

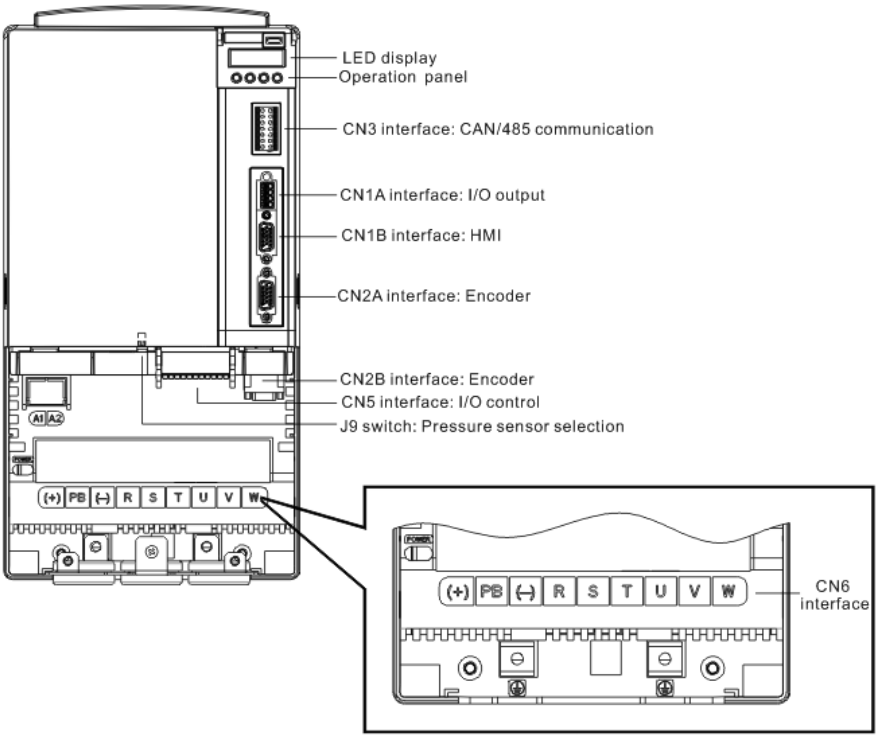
| Drive Model | Power Inlet Disconnect Switch (A) | AC Contactor AC3 Rated Working Current (400V) (A) | Main Circuit | | | | Control Circuit |
|---|---|---|---|---|---|---|---|
| | | | Recommended Cable Cross-section($mm^2$) | | | Max Cable Cross-section ($mm^2$) | Max Cable Cross-section ($mm^2$) |
| | | | Input Cable | (+),(-), PB Cable | Output Cable | | |
| SV-MH800-4R4-33-S00 | 40 | 25 | 2.5 | 2.5 | 2.5 | 16 | 1.5 |
| SV-MH800-5R5-33-S00 | 40 | 25 | 4 | 2.5 | 4 | 16 | 1.5 |
| SV-MH800-7R5-33-S00 | 63 | 32 | 10 | 4 | 10 | 25 | 1.5 |
| SV-MH800-011-33-S00 | 63 | 32 | 10 | 4 | 10 | 25 | 1.5 |
| SV-MH800-015-33-S00 | 63 | 50 | 10 | 6 | 10 | 25 | 1.5 |
| SV-MH800-018-33-S00 | 100 | 80 | 16 | 6 | 16 | 35 | 1.5 |
| SV-MH800-025-33-S00 | 100 | 80 | 16 | 6 | 16 | 35 | 1.5 |
| SV-MH800-030-33-S00 | 125 | 95 | 25 | 10 | 25 | 70 | 1.5 |
| SV-MH800-037-33-S00 | 160 | 115 | 25 | 10 | 25 | 70 | 1.5 |
| SV-MH800-045-33-S00 | 200 | 170 | 35 | 16 | 35 | 120 | 1.5 |
| SV-MH800-055-33-S00 | 200 | 170 | 35 | 16 | 35 | 120 | 1.5 |
| SV-MH800-075-33-S00 | 250 | 230 | 50 | 16 | 50 | 120 | 1.5 |

※ The recommended cable dimension for main circuit can be used in the environment where the temperature is below 40°C and wiring distance is below 10m. If the environment temperature or wiring distance exceeds above limits, enlarge the cable dimension. It is recommended to use 600VIV plastic insulated cable;

※ Max cable cross-section means the max cross-section limited by the connection terminal dimension;

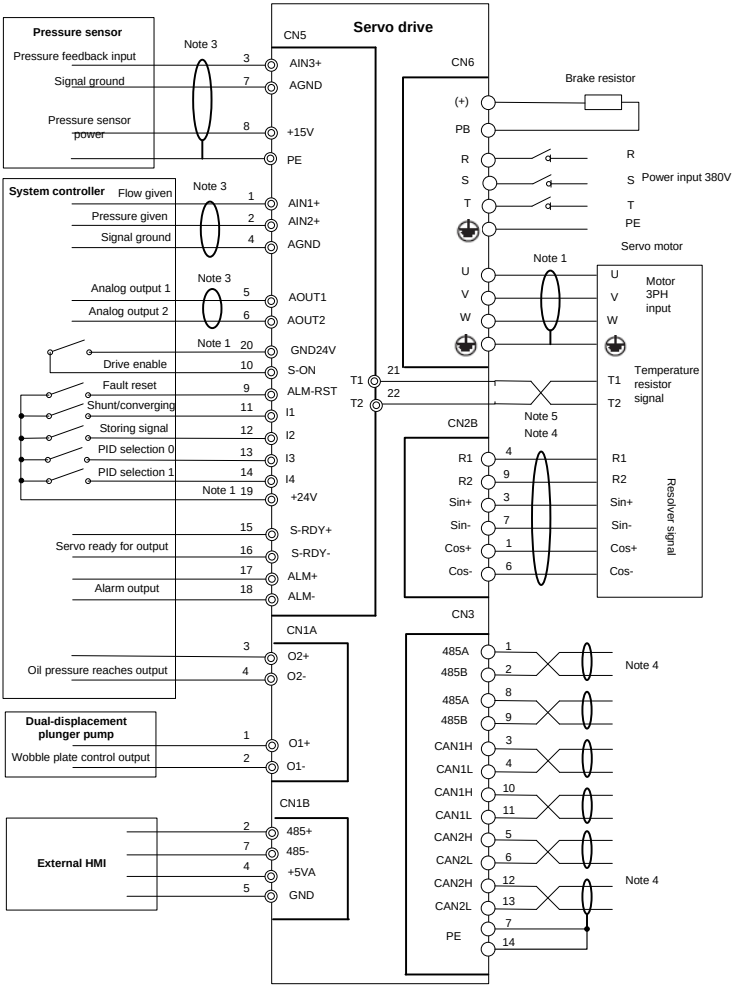
※ Brake resistor carries cables by itself, it it needs to be lengthened, select cables according to above table.

## 4.3 Terminal Layout

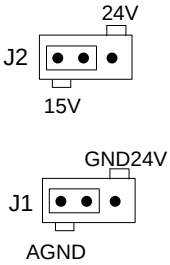



| Terminal Name | Function |
|---|---|
| CN1A | I/O output signal connector |
| CN1B | External HMI connector |
| CN2A | Encoder (resolver) connector |
| CN2B | Encoder (resolver) connector |
| CN3 | CAN/485 connector |
| CN4 | Reserved |
| CN5 | I/O control signal connector |
| CN6 | Main circuit terminal |

## 4.4 Standard Wiring




Note 1: In above wiring diagram, the digital input signal adopts system controller power drive, and the 24V power terminal on the CN5 connector should be connected to external power source. Users can use the internal pressure sensor power of the drive to jump to 15V side via J1 to connect +25V to 24V, or jump to 15V via J2 to connect AGND to GND24V. In default setting, J1 and J2 of the drive jump to 15V and the pressure sensor power is adopted.




Note 2: The pressure sensor power of this drive is 15V, which accepts the pressure signal whose voltage signal is 0 – 10V or 1 – 15V (can be set by J9). Refer to *4.5* and *4.10.1* for details.

Note 3: It is recommended to adopt shielded cables for all the analog signal drive cables and motor 3PH input cables to prevent the drive from being impacted by interference.

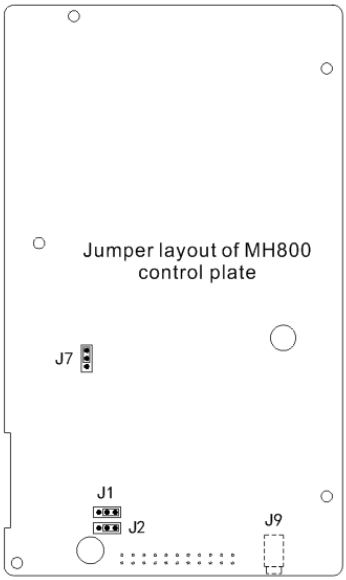
Note 4: The resolver and communication cable must use twisted shielded pair with shielded layer being grounded. The both ends of the communication cable should be added with terminal matched resistor. The CAN communication signal connector of this drive carries built-in 10kΩ terminal resistor and the 485 communication signal connector carries built-in 1kΩ terminal resistor.

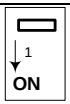
Note 5: It is recommended to use twisted pair to prevent the motor temperature sampling from being impacted by interference. This drive supports two kinds of sampling of motor temperature sensor, namely KTY84 and Pt1000. Users can select the temperature sensor type to be supported via setting motor temperature sensor parameters.

Note 6: AGND terminal can be connected to PE via J7 on the control board, or connected to capacitor via resistors. If the middle pin and PE pin of J7 is short connected, then this grounding mode is suitable for SV-MH800-4R4-33-S00, SV-MH800-5R5-33-S00, SV-MH800-7R5-33-S00, SV-MH800-011-33-S00, SV-MH800-015-33-S00 and SV-800-075-33-S00 drives.

Note 7: When analog output and digital output ports are used, sufficient output load resistor must be ensured to make the output current to be below specified value.

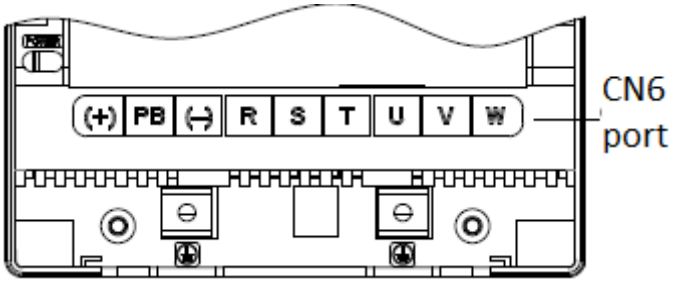
## 4.5 Instruction of Jumper Function



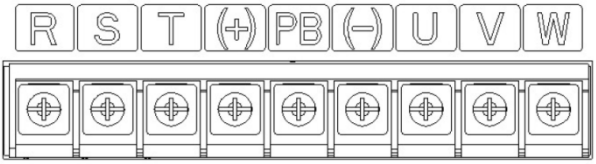

| No. | Position | Function | Position | Function |
|---|---|---|---|---|
| J1 |  | Digital input signal of Internal pressure sensor power drive; connect +15V to +24V |  | Digital input signal of external power drive; connect +15V to +24V |
| J2 |  | Digital input signal of internal pressure sensor power drive; connect AGND to GND24V |  | Digital input signal of external power drive; disconnect AGND from GND24V |
| J7 |  | Connect AGND directly to PE |  | AGND terminal connects to PE via resistors and capacitors |
| J9 |  | 0–10V output voltage pressure sensor |  | 1–5V output voltage pressure sensor |

## 4.6 Main Circuit Wiring

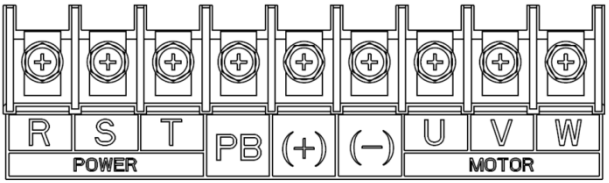
### 4.6.1 Name and Function of Main Circuit Terminal (CN6)



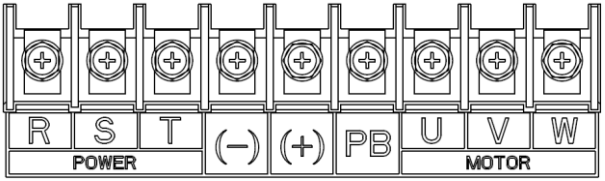

4.4kW – 15kW main circuit terminal diagram



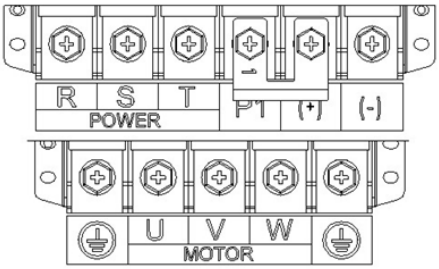

18kW – 25kW main circuit terminal diagram




30kW – 37kW main circuit terminal diagram



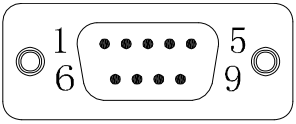

45kW – 55kW main circuit terminal diagram




75kW main circuit terminal diagram

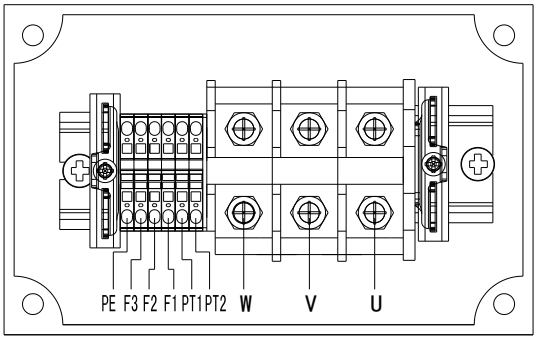
| Terminal Name | Terminal Symbol | Function |
|---|---|---|
| Main circuit power input terminal | R, S, T | AC380V(-15%) – 440V(+10%)<br>47Hz – 63Hz |
| Servo motor connection terminal | U, V, W | Connect to servo motor |
| Grounding terminal | ⏚ | Connect to power grounding terminal and motor grounding terminal, carry out grounding |
| External brake resistor connection terminal(with PB terminal for models under 55kW) | (+), PB | Connect external brake resistor between (+) and PB |
| DC reactor terminal (P1 terminal is included in models above 75kW) | P1, (+) | P1 and(+) connect to external DC reactor |

### 4.6.2 Name and Function of Resolver Signal Connector (CN2A, CN2B)



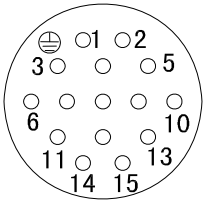

| Signal Name | Code | Pin No. | Function |
|---|---|---|---|
| Resolver sine input+<br>Resolver sine input- | Sin+<br>Sin- | CN2-3<br>CN2-7 | Resolver sine feedback signal |
| Resolver cos input+<br>Resolver cos input- | Cos+<br>Cos- | CN2-1<br>CN2-6 | Resolver cosine feedback signal |
| Excitation signal+<br>Excitation signal- | R1<br>R2 | CN2-4<br>CN2-9 | Resolver excitation signal |

### 4.6.3 Motor Power Cable and Temperature Resistor Terminal (k series motor of our company)



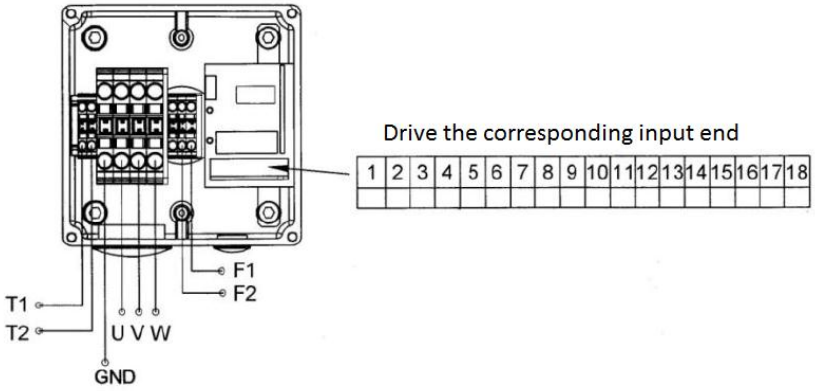

| No. | Name | Definition |
|---|---|---|
| 1 | U | Motor 3PH input |
| 2 | V | |
| 3 | W | |
| 4 | PT1 | Temperature resistor |
| 5 | PT2 | |
| 6 | F1 | Fan power 220V AC |
| 7 | F2 | |
| 9 | PE | Grounding |

### 4.6.4 Motor Resolver Terminal (k series motor of our company)




| No. | Name | Definition |
|---|---|---|
| 1 | NC | Null |
| 2 | R1 | Excitation signal+ |
| 3 | R2 | Excitation signal- |
| 4 | Sin+ | Resolver sine output+ |
| 5 | Sin- | Resolver sine output- |
| 6 | Cos+ | Resolver cosine output+ |
| 7 | Cos- | Resolver cosine output- |
| 8 – 15 | NC | Null |

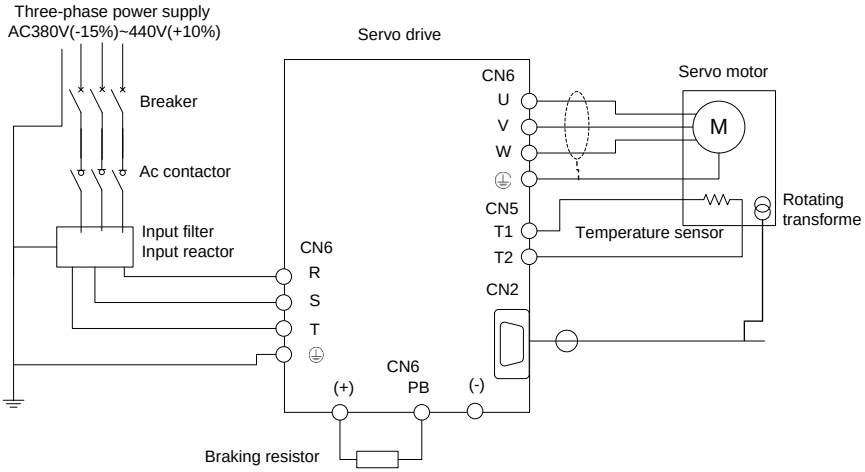
### 4.6.5 Motor Terminal (PHASE motor)



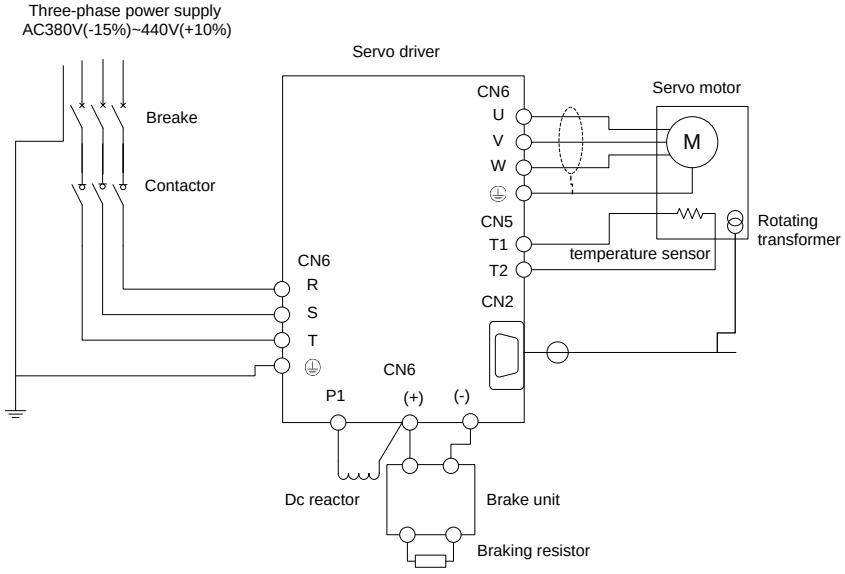

| Terminal | Definition | Terminal | Definition |
|---|---|---|---|
| U | Motor 3PH input | 1 | $R-$ revolver excitation input signal- |
| V | | 2 | $R+$ revolver excitation input signal+ |
| W | | 3 | $Sin-$ revolver sine output signal- |
| GND | Motor grounding | 4 | $Sin+$ revolver sine output signal+ |
| T1 | Motor internal temperature resistor | 5 | $Cos-$ revolver cosine output signal- |
| T2 | | 6 | $Cos+$ revolver cosine output signal+ |
| F1 | Motor internal cooling fan 220VAC power input | 7 – 14 | Null |
| F2 | | 15 | PTC+ |
| 17 – 18 | Null | 16 | PTC- |

### 4.6.6 Typical Main Circuit Wiring Instance

| | |
|---|---|
| **NOTE** | 1. Each cable insert port of the connector can be inserted with one cable only. |
| | 2. Motor 3PH cable should use shielded cable, one end of which should connect to the ground wire of the drive and the other end should connect to the ground wire of the motor connector. |
| | 3. The screws should be rotated to a proper degree of tightness to ensure smooth connection. |




Main circuit wiring diagram for models below 55kW




Main circuit wiring diagram for models above 75kW

### 4.6.7 Wiring Process of Main Circuit Terminals (CN6)

1) Connect input power cables to the input terminals R, S and T of the drive respectively, and connect the grounding conductor of the input power cable to any grounding screw (PE) of the drive, then

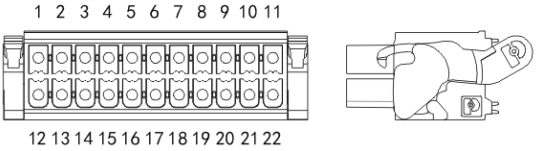
rotate the screw to a proper degree of tightness to ensure smooth connection;

2) Connect the 3PH input terminals W, V and U of the motor to the W, V and U terminals of the drive servo motor, then rotate the screw to a proper degree of tightness to ensure smooth connection. Connect the motor ground wire terminal to any grounding screw (PE) of the drive; connect the motor temperature resistor terminal to the T1 and T2 terminals of the drive and rotate the screw to a proper degree of tightness to ensure smooth connection; connect motor resolver connection terminal to the CN2 of the drive connector and screw tight the fixation screws;

3) Connect the two connection terminals of the brake resistor to the U+ and PB terminals of the drive, and rotate the screw to a proper degree of tightness to ensure smooth connection.

## 4.7 IO Signal Wiring

### 4.7.1 Name and Function of IO Signal Connector (CN5)

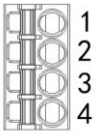



Definition of CN5 connector

| Signal Name | Code | Pin No. | Function |
|---|---|---|---|
| Analog reference 1 input+ | AIN1+ | CN5-1 | Flow command input;<br>Input gain can be changed via LED and HM |
| Analog reference 2 input+ | AIN2+ | CN5-2 | Pressure command input:<br>Input gain can be changed via LED panel and HMI |
| Feedback input+ | AIN3+ | CN5-3 | Pressure feedback input:<br>Input gain can be changed via LED panel and HMI |
| Analog output 1 | AOUT1 | CN5-5 | Monitor output, select internal parameter output via LED panel and HMI |
| Analog output 2 | AOUT2 | CN5-6 | |
| Pressure sensor power | +15V | CN5-8 | Voltage: +15VDC, ±5%(full scale range), 25°C output<100mA |
| Analog GND | AGND | CN5-4<br>CN5-7 | |
| Fault reset signal | ALM-RST | CN5-9 | Clear servo alarm state |
| Drive enable | S-ON | CN5-10 | Motor changes to power-up state by releasing part of the grid block |
| Digital input 1<br>Digital input 2 | I1<br>I2 | CN5-11<br>CN5-12 | I1: Shunt/converging selection (used in conjunction with multi-pump distribution operation function); converging at high level and shunt at low level<br>I2: Storing signal input (used in conjunction with electronic backpressure function); high level injection |

<table>
<tr><th>Signal Name</th><th>Code</th><th>Pin No.</th><th>Function</th></tr>
<tr><td></td><td></td><td></td><td>molding machine works in storing state and low level injection molding machine works in other states.<br>Motor rotation direction signal (match with node flow loop)<br>FWD for low level and REV for high level</td></tr>
<tr><td>Digital input 3</td><td>I3</td><td>CN5-13</td><td rowspan="2">Single pump pressure control stepwise PID parameter selection (four-step)<br>I4 I3 KP no. KI no. KD no.<br>low low 0 0 0<br>low high 1 1 1<br>high low 2 2 2<br>high high 3 3 3<br>Multi-pump parallel pressure control stepwise PID parameter selection (four-step)<br>I4 I3 KP no. KI no. KD no.<br>low low 0 0 0<br>low high 1 1 1<br>high low 2 2 2<br>high high 3 3 3</td></tr>
<tr><td>Digital input 4</td><td>I4</td><td>CN5-14</td></tr>
<tr><td>Servo ready+<br>Servo ready-</td><td>S-RDY+<br>S-RDY-</td><td>CN5-15<br>CN5-16</td><td>Conducting when no servo alarm occurred under the condition that the drive enable end is LOW and main circuit is powered up.</td></tr>
<tr><td>Alarm output+<br>Alarm output-</td><td>ALM+<br>ALM-</td><td>CN5-17<br>CN5-18</td><td>Conducting when abnormity is detected,<br>opto-coupler output, max voltage: DC30V; max current: DC50mA</td></tr>
<tr><td>Control power input used for digital signal</td><td>+24V</td><td>CN5-19</td><td>+24V power is prepared by the user.<br>Actable voltage range: +8V – +25V</td></tr>
<tr><td>Digital signal GND</td><td>GND24V</td><td>CN5-20</td><td></td></tr>
<tr><td>Motor temperature sensor 1</td><td>T1</td><td>CN5-21</td><td rowspan="2">There is no differentiation of positive and negative pole for motor temperature sensor terminals (T1, T2). The drive supports motor temperature sensor (resistor) in KTY84-130 and PT1000 type, which can be changed via LED panel and HMI. The hardware circuit will select corresponding temperature sensor detection circuit automatically.</td></tr>
<tr><td>Motor temperature sensor 2</td><td>T2</td><td>CN5-22</td></tr>
</table>

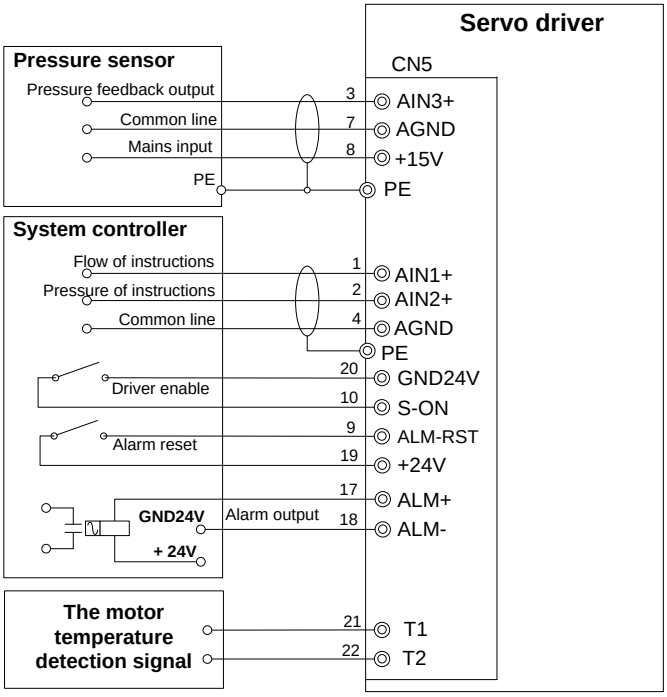
### 4.7.2 I/O Output Signal Connector Terminal (CN1A)



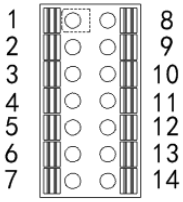

Definition of CN1A connector

| Signal Name | Code | Pin No. | Function |
|---|---|---|---|
| Digital output 1 | O1+<br>O1- | CN1A-1<br>CN 1A-2 | Wobble plate output signal (used in match with dual-displacement pump wobble plate control function)<br>Conducting small displacement, disconnecting large displacement<br>Relay output contact capacity: 3A /250VAC 1A/30VDC |
| Digital output 2 | O2+<br>O2- | CN1A-3<br>CN1A-4 | Conducting when oil pressure reaches output and feedback pressure reaches a certain percentage of the reference pressure, the percentage is settable. Opto-coupler output, max voltage: DC30V, max current: DC50mA |

### 4.7.3 Typical Wiring Diagram of Control Signal



## 4.8 CAN/485 Connector Terminal (CN3)




Definition of CN3 connector

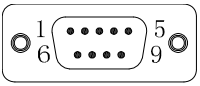
The drive carries two CAN communication interfaces and one 485 communication interface, in which the 485 communication interface supports standard Modbus RTU communication protocol. 485 communication connects to 1kΩ terminal resistor internally.

CAN communication port 1 supports standard CANOPEN communication protocol and connects to 10kΩ terminal resistor internally.

CAN communication port 2 is the CAN communication interface between multiple drives of multi-pump parallel system and is the specific CAN communication port for PC debugging software SCM. CAN communication port 2 connects to 10kΩ terminal resistor internally.

| Signal Name | Code | Pin No. | Function |
|---|---|---|---|
| RS485 communication port | RS485_A<br>RS485_B | CN3-1,8<br>CN3-2,9 | Half-duplex, supportable baud rate: 9600bps,19200bps,38400 bps,57600bps,115200bps(9600bps by default) |
| CAN communication port 1 | CAN1H<br>CAN1L | CN3-3,10<br>CN3-4,11 | CAN protocol standard signal, adopt optical coupling isolation, can be connected to CAN-BUS directly. |
| CAN communication port 2 | CAN2H<br>CAN2L | CN3-5,12<br>CN3-6,13 | |
| Case ground | PE | CN3-7,14 | Connect to the case |

## 4.9 Name and Function of Serial Communication Signal Connector (CN1B)




The serial communication connector is the external HMI common connector of our company. If external HMI needs to be used for commissioning, insert the connection wire of external HMI.

| Signal Name | Code | Pin No. | Function |
|---|---|---|---|
| RS485 communication interface | RS485_A<br>RS485_B | CN1B-2<br>CN1B-7 | Half-duplex, max communication rate: 115200bits/s(19200 bits/s by default) |

| | | | |
|---|---|---|---|
| Communication power | +5VA | CN1B-4,8 | Max output current 200mA, precision ± 5% |
| GND | GND_5VA | CN1B-5,9 | |

## 4.10 Interface Circuit

### 4.10.1 Analog Input Circuit Interfaces

The analog input circuit is as below:

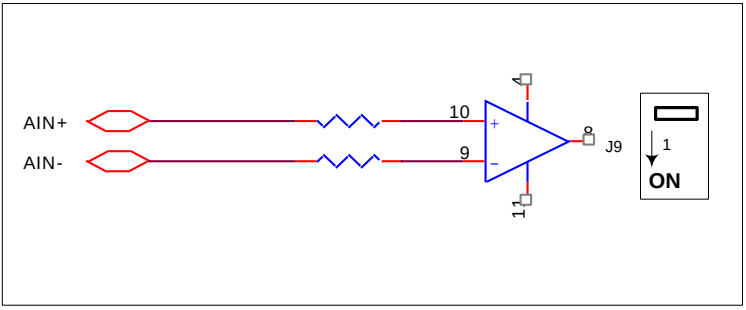
1) Instruction for terminal 1 (flow reference) and 2 (pressure reference) of CN5 connector.

Input impedance of voltage input mode: about 20kΩ, max allowed voltage is 15V.

2) Instruction for terminal 3 of CN5 connector (feedback input).

Analog signal is oil pressure feedback signal, users can choose 0 – 10V or 1 – 5V output pressure sensor via toggle switch J9. ON side is 1 – 5V while OFF side is 10V, the default is 10V.

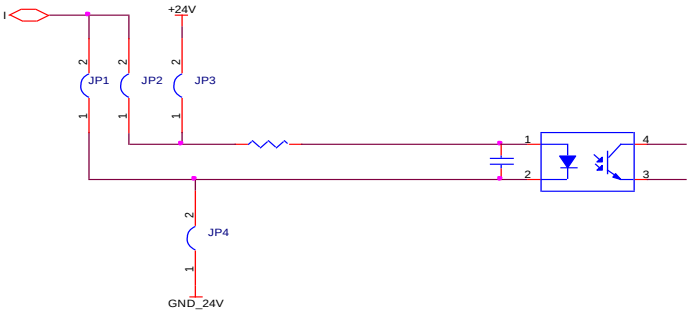
Input impedance: about 100kΩ, max allowed voltage is 15V.




## 4.11 Digital Input Circuit Interface

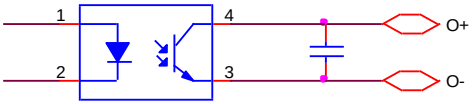
1) Instructions for terminal 9 – 14 of CN5 connector are shown below:

Users can select active-high circuit or (JP2, PJ4 disconnected, JP1, JP3 short connected) active-low circuit input mode via jumpers (JP2, JP4 short connected; JP1, JP3 disconnected), S-ON connected as active-low circuit mode, while I1~I4 connected as active-high circuit mode. If uses need active-low circuit mode, inform the manufacturer to modify the interface logic, which is shown below:



### 4.11.1 Digital Output Circuit Interfaces

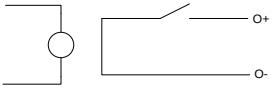
Instructions for 15 – 18 terminal of CN5 connector and the digital output terminal 3 and 4 of CN1A connector: digital output signal (S_RDY, ALM, COIN, O2) is opto-coupler open collector output. Please use opto-coupler circuit, relay circuit or bus receiver circuit for receiving, below is the interface circuit.




- Max voltage: DC30V\
- Max current: DC50mA

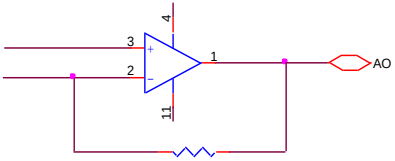
2) Instruction for relay output circuit:

Instruction for digital output terminal 1 and 2 of CN1A connector: digital output signal (O1) is relay output. Below is interface circuit.




3) Analog output circuit is as below:

Instruction for terminal 5 and 6 (analog output) of CN5 connector: Analog output signal (AOUT1, AOUT2) is operational amplifier output which forms an output circuit with AGND. Users can select internal parameter output via LED panel, HMI and SCM, the default setting is AOUT1 pressure output and AOUT2 motor flow output. Below is the interface circuit.



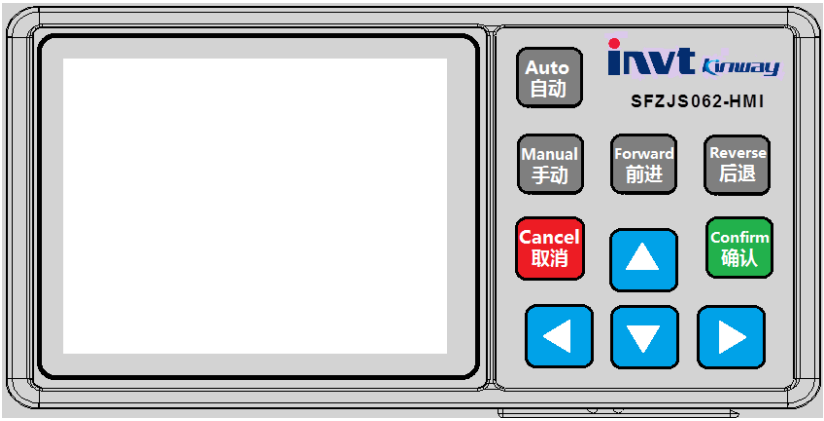

- Output precision: 10-bit D/A
- Voltage range: 0 – 10V
- Max current: DC10mA

# Chapter 5 Display and Function

## 5.1 External HMI Display and Operation

### 5.1.1 HMI Panel Interface Instruction

Control panel is divided into LCD display area and keypad area. LCD adopts 5.7-inch 320x240 screen and keypad area is comprised of 10 buttons which are divided into operation key area, direction key area and setup key area as shown below.




The layout diagram of LCD area display is shown below:

| The menu bar | Monito Setting Tuning |
|---|---|
| Parameters of the display area | |
| The system status bar | System state: Presure:<br>Speed: Torque: Location: |

Menu bar: Display the menu options under different states, the selected menu option is displayed in blue letters on white background while other menu options are displayed in white letters on blue background. The menu bar can display 3 menu options simultaneously at most, and the options can be selected via direction keys.

Parameter display area: Display the parameter name, value and unit of the selected menu.

System state bar: Display current system state and torque, speed and resolver value. The unit is default value (torque: nm, speed: r/m).

The content of menu bar and parameter display area vary with the key operations. The content of system state bar varies with the system operation state.

## 5.2 Function of Control Panel Keys

### 5.2.1 Key Function of Operation Key Area

| | |
|---|---|
| Auto 自动 | Press this button to switch between “enable” and “disable”. |
| Manual 手动 | Reserved |
| Forward 前进 | Under commissioning menu, if “jogging enable” is enabled, press forward key and the motor will rotate forward according to the set jogging speed. |
| Reverse 后退 | Under commissioning menu, if “jogging enable” is enabled, press backward key and the motor will rotate backward according to the set jogging speed. |

### 5.2.2 Key Function in Direction Key Area

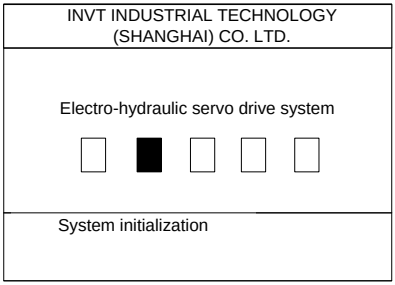
| | |
|---|---|
| ▶ | 1. When switching the menus, press this key to select the menu rightward;<br>2. When setting parameters, press this key to control the selected block “□” to jump rightward between “save”/“cancel” and parameter numbers. |
| ◀ | 1. When switching the menus, press this key to select the menu leftward;<br>2. When setting parameters, press this key to control the selected block “□” to jump leftward between “save”/“cancel” and parameter numbers. |
| ▲ | 1. When checking parameters, press this key to select corresponding parameter upward.<br>2. When setting parameters, press this key to change the selected number in plus-one mode and realize carry shift. |
| ▼ | 1. When checking parameters, press this key to select corresponding parameters in downward mode.<br>2. When setting parameters, press this key to change the selected number in minus-one mode and realize decomposition shift. |

### 5.2.3 Key Function of Setup Key Area

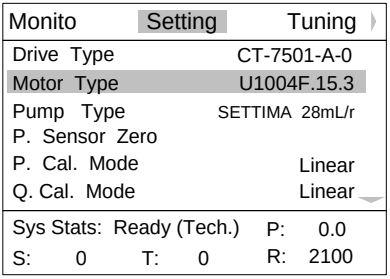
| | |
|---|---|
| Confirm 确认 | 1. Press this key to enter parameter setup from parameter checking, or realize disable/enable function.<br>2. When selecting “save”/“cancel” virtual button, press this key to save/cancel parameter setup. |
| Cancel 取消 | 1. Press this key to return from parameter setup to parameter checking. |

## 5.3 External HMI Function

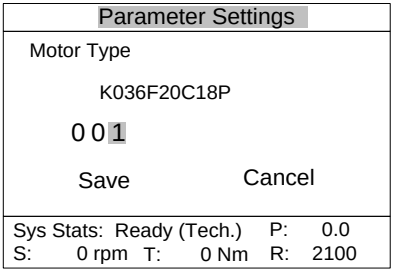
When HMI is connected to the drive and powered up, the screen will pop out initialization process, and after initialization is done, users can use the keys to operate HMI.



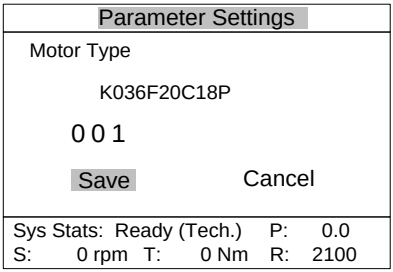

Reference parameter list, users can use ◀ and ▶ keys to switch menu bars and select “monitor”, “set”, “debugging”, “multi-pump” or “parameter programming” menu bars, the selected menu bar will be displayed in highlighted cursor. Stop the highlighted cursor at the desired parameter.




After parameter is selected by highlighted cursor, press Confirm 确认 key to enter parameter modification interface:




Use ◀ and ▶ keys to stop the highlighted cursor at the currently selected motor and select motor model via ▲ and ▼ key;




Then stop the highlighted cursor at "save" via ◀ and ▶ key, and press Confirm 确认 key to save and exit to setup menu bar, HMI will transmit current parameters to the drive.

Some debugging parameters differ from the setup parameters eg when diagnosis enable parameter is selected by highlighted cursor, press Confirm 确认 key to modify the parameter content directly.

### 5.3.1 Monitoring Menu List

| Menu No. | Menu Name | Meaning | Parameter Range | Unit |
|---|---|---|---|---|
| **1st screen** | | | | |
| 0 | Flow reference+ Analog signal voltage | Flow reference value and voltage value of flow reference analog signal | [0,2400.0] [0,10.00] | L/min V |
| 1 | Pressure reference+ Analog signal voltage | Pressure reference value and voltage value of pressure reference analog signal | [0,250.0] [0,10.00] | bar V |
| 2 | System fault | System fault alarm (can display multiple faults that occurred simultaneously) | Refer to *10.1* | |
| 3 | Motor current | Valid value of motor winding current | [0,900.0] | A |
| 4 | AC voltage | AC input voltage | [0,500] | Vrms |
| 5 | DC voltage | DC bus voltage | [0,800] | V |
| **2nd screen** | | | | |
| 6 | Torque limit | Real-time torque output capacity of the system | [0,1800] | Nm |
| 7 | Motor temperature | Motor winding temperature | [-52,244] | °C |
| 8 | Drive temperature | IGBT module temperature | [-46,244] | °C |
| 9 | Environment temperature | Air temperature of the drive | [-18,114] | °C |
| 10 | Machine material | The drive no. which can be modified by the user | [undefined, 1,999] | |
| 11 | Max system pressure | Max pressure for oil pump to discharge hydraulic pressure oil | [0,250.0] | bar |

| Menu No. | Menu Name | Meaning | Parameter Range | Unit |
|---|---|---|---|---|
| **3rd screen** | | | | |
| 12 | Max system flow | Max flow for the oil pump to discharge hydraulic pressure oil | [0,2400.0] | L/min |
| 13 | Power | Mechanical power outputted by the motor | [0,327.67] | kW |
| 14 | Present PID step | The drive supports usage of multi-step single-pump /multi-pump pressure to control PID function under different working conditions. This menu displays the single pump or multi-pump pressure currently used to control the PID step no. | [0,3] | |
| 15 | Converging type | Select the working mode of the drive under multi-pump operation | 0: single pump; 1: Composite;<br>2: Multi-pump;<br>3: Multi-mode | |
| 16 | Software version | Drive software version | | |
| 17 | Interface version | HMI software version | | |
| **4th screen** | | | | |
| 18 | Operation time | Accumulated running time of the drive | [0,99]<br>[0,364]<br>[0,23]<br>[0,59] | Year<br>Day<br>Hour<br>Minute |
| 19 | | | [0,9.99] | |

### 5.3.2 Setup Menu List

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **1st screen** | | | | | |
| 0 | Drive model selection | Drive model | Refer to drive model list in *5.5.5* | The same with drive label | |
| 1 | Motor model selection | Motor model | Refer to motor model list in *5.5.5* | U1013F.17.3 | |
| 2 | Pump selection | Oil pump model | Refer to oil pump model list in *5.5.5* | PUMP 100 mL/r | |
| 3 | Pressure feedback zero position | Pressure sensor zero position offset can be | Pressure feedback zero position | The default pressure | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | calibration | removed by pressure feedback zero position calibration | calibration | feedback zero position offset is 0V | |
| 4 | Pressure calibration mode | Calibration mode of pressure reference analog signal | Linear pressure calibration<br>Polyline pressure calibration | Linear pressure calibration | |
| 5 | Flow calibration mode | Calibration mode of flow reference analog signal | Linear flow calibration<br>Polyline flow calibration | Linear flow calibration | |
| **2nd screen** | | | | | |
| 6 | Linear/polyline pressure calibration | Used to select pressure linear calibration or polyline calibration. During calibrating, the drive enable should be disabled. During linear calibration, set the injection molding machine controller to provide zero position and full range voltage. Polyline calibration should be carried out when the pressure reference value of injection molding machine system drive is the same with that of the polyline point. | Under linear calibration mode:<br>Zero position<br>Full range<br>Under polyline calibration mode:<br>Polyline point 0<br>Polyline point 1<br>Polyline point 2<br>Polyline point 3<br>Polyline point 4<br>Polyline point 5<br>Polyline point 6<br>Polyline point 7<br>Polyline point 8<br>Polyline point 9<br>Polyline point 10<br>Polyline point 11<br>Polyline point 12 | Zero position | |
| 7 | Linear/polyline flow calibration | Used to select flow linear calibration or polyline calibration. During calibrating, the drive enable should be disabled. During linear calibration, set the injection molding machine | Under linear calibration mode:<br>Zero position<br>Full range<br>Under polyline calibration mode:<br>Polyline point 0 | Zero position | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | controller to provide zero position and full range flow. Polyline calibration should be carried out when the flow reference value of injection molding machine system drive is the same with that of the polyline point. | Polyline point 1<br>Polyline point 2<br>Polyline point 3<br>Polyline point 4<br>Polyline point 5<br>Polyline point 6<br>Polyline point 7<br>Polyline point 8<br>Polyline point 9<br>Polyline point 10<br>Polyline point 11<br>Polyline point 12 | | |
| 8 | Pressure filter | Calculation times of the average filter of pressure reference sampling value | [1,32] | 1 | |
| 9 | Flow filter | Calculation times of the average filter of flow reference sampling value | [1,32] | 1 | |
| 10 | Pressure full range | Set the pressure full range of the node | [1,250] | 175 | bar |
| 11 | Flow full range | Set the flow full range of the node | [1,2400] | 200 | L/min |
| **3rd screen** | | | | | |
| 12 | Max flow | Set the max flow value of the node | [0,2400] | 200 | L/min |
| 13 | Max pressure | Set the max pressure value of the node | [0,250] | 180 | bar |
| 14 | Flow reference zero position deadzone | Small signal vibration of flow reference analog signal | [0,100.00] | 0.5 | % |
| 15 | Pressure reference zero position deadzone | Pressure reference analog signal small signal control | [0,100.00] | 0.5 | % |
| 16 | Pressure feedback zero position deadzone | Pressure feedback analog input signal small signal control | [0,100.00] | 0 | % |
| 17 | Pressure full range voltage | Corresponding DC voltage when pressure reference input reaches full range | [0,11.00] | 10.00 | V |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **4th screen** | | | | | |
| 18 | Flow full range voltage | Corresponding DC voltage when flow reference input reaches full range | [0,11.00] | 10.00 | |
| 19 | Pressure feedback gain | Enlargement multiple of pressure feedback signal | [0,32767] | 8182 | |
| 20 | Pressure reference rising slope | Step length of the rising of pressure reference per ms | [0,32767] | 16000 | 0.007629 bar/ms |
| 21 | Pressure reference declining slope | Step length of the declining of pressure reference per ms | [0,32767] | 16000 | |
| 22 | Flow reference rising slope | Step length of the rising of pressure reference per ms | [0,32767] | 16000 | “0.07324L/min” per second |
| 23 | Flow reference declining slope | Step length of the declining of pressure reference per ms | [0,32767] | 16000 | |
| **5th screen** | | | | | |
| 24 | Pressure multi-step PID enable | Used to select whether to use multi-step mode for pressure PID parameter | 0: Disable 1: Enable | 0: Disable | |
| 25 | Pressure proportional gain 0 | The 0th step of proportional parameter of pressure PID control | [0,32767] | 13000 | |
| 26 | Pressure integral gain 0 | The 0th step of integral parameter of pressure PID control | [0,32767] | 100 | |
| 27 | Pressure differential gain 0 | The 0th step of differential parameter of pressure PID control | [0,32767] | 0 | |
| 28 | Pressure proportional gain 1 | The 1st step of proportional parameter of pressure PID control | [0,32767] | 13000 | |
| 29 | Pressure integral gain 1 | The 1st step of integral parameter of pressure PID control | [0,32767] | 100 | |
| **6th screen** | | | | | |
| 30 | Pressure differential gain 1 | The 1st step of differential parameter of pressure PID | [0,32767] | 0 | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | control | | | |
| 31 | Pressure proportional gain 2 | The 2nd step of proportional parameter of pressure PID control | [0,32767] | 13000 | |
| 32 | Pressure integral gain 2 | The 2nd step of integral parameter of pressure PID control | [0,32767] | 100 | |
| 33 | Pressure differential gain 2 | The 2nd step of differential parameter of pressure PID control | [0,32767] | 0 | |
| 34 | Pressure proportional gain 3 | The 3rd step of proportional parameter of pressure PID control | [0,32767] | 13000 | |
| 35 | Pressure integral gain 3 | The 3rd step of integral parameter of pressure PID control | [0,32767] | 100 | |
| **7th screen** | | | | | |
| 36 | Pressure differential gain 3 | The 3rd step of differential parameter of pressure PID control | [0,32767] | 0 | |
| 37 | Speed gain switching 0 | When below speed gain switching 0, speed loop PI parameter is speed proportional gain, speed integral gain; when above speed gain switching 1, speed loop PI parameter is speed proportional gain 1, speed integral gain 1. Between these two, PI parameter is obtained by the linear change of two groups of parameters. | [0,6000] | 5994 | rpm |
| 38 | Speed gain switching 1 | | [0,6000] | 5994 | rpm |
| 39 | Speed multi-step PI enable | Used to select whether to use multi-step mode for speed PI parameter | 0: Disable 1: Enable | 0: Disable | |
| 40 | Speed proportional gain 0 | The 0th step of proportional parameter of speed PI | [0,32767] | 7000 | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | control | | | |
| 41 | Speed integral gain 0 | The 0th step of integral parameter of speed PI control | [0,32767] | 170 | |
| 41 | Motor rotation direction | Set motor rotation direction | FWD<br>REV | FWD | |
| **8th screen** | | | | | |
| 42 | High speed speed proportional gain | Proportional parameter of high speed speed PI control | [0,32767] | 7000 | |
| 43 | High speed speed integral gain | Integral parameter of high speed speed PI control | [0,32767] | 140 | |
| 44 | Speed proportional gain 1 | The 1st step of proportional parameter of speed PI control | [0,32767] | 7000 | |
| 45 | Speed integral gain 1 | The 1st step of integral parameter of speed PI control | [0,32767] | 140 | |
| 46 | Speed proportional gain 2 | The 2nd step of proportional parameter of speed PI control | [0,32767] | 7000 | |
| 47 | Speed integral gain 2 | The 2nd step of integral parameter of speed PI control | [0,32767] | 140 | |
| **9th screen** | | | | | |
| 48 | Speed proportional gain 3 | The 3rd step of proportional parameter of speed PI control | [0,32767] | 7000 | |
| 49 | Speed integral gain 3 | The 3rd step of integral parameter of speed PI control | [0,32767] | 140 | |
| 50 | Pump displacement (reset) | Oil pump displacement per revolution | [0,32767] | 100 | mL/rev |
| 51 | Pump leakage (reset) | The ratio of oil pump discharge displacement and outlet pressure | [0,100.00] | 0 | L/min /bar |
| 52 | Pump REV speed limit | Max REV speed of oil pump | [0,-6000] | -300 | rpm |
| 53 | Max motor speed | Max motor speed in FWD and REV rotation | [0,6000] | 2200 | rpm |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **10th screen** | | | | | |
| 54 | DC voltage calibration | Use the actually detected DC bus voltage to calibrate the drive DC voltage | [0,800] | Null | V |
| 55 | AC voltage calibration | Use the actually detected AC input voltage to calibrate the drive AC voltage | [0,800] | Null | V |
| 56 | Base flow enable | Used to set whether the oil pressure control is base flow mode | Without base flow<br>With base flow | Without base flow | |
| 57 | Base flow pressure | If the system is in base flow control mode, this parameter is used to set the target pressure value of the base flow | [250.0] | 3.0 | bar |
| 58 | Flow value of base flow | If the system is in base flow control mode, this parameter is used to set the flow value used to make the system reach base flow pressure value | [327.6] | 1.0 | L/min |
| 59 | Overshoot limit value | When the gap between oil pump feedback pressure and reference pressure exceeds this set value, the motor will decelerate rapidly to limit the pressure overshoot | [5,50] | 30 | bar |
| **11th screen** | | | | | |
| 60 | Motor rotation direction | Set the motor rotation direction | FWD<br>REV | FWD | |
| 61 | Resolver direction | Set the resolver direction | FWD<br>REV | FWD | |
| 62 | Backpressure mode | Select the control mode of backpressure storing of injection molding machine | Manual<br>Automatic | Manual | |
| 63 | Pressure sensor model selection | Pressure sensor type | 5v<br>10v | 10v | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | | 400bar | | |
| 64 | Plunger pump model selection | Select displacement type | Single displacement Dual displacement | Single displacement | |
| 65 | Plunger pump displacement ratio | Displacement ratio of big and small dual-displacement pump | [0,100.0] | 20 | % |
| **12th screen** | | | | | |
| 66 | Wobble plate switching pressure threshold | Wobble plate switches to the feedback pressure threshold value of small displacement | [0,250.0] | 195 | bar |
| 67 | Displacement switching mode | 0: Over-pressure;<br>1: Over-pressure occurred during holding pressure | | 0: Over-pressure | |
| 68 | Displacement pressure judging delay | When the system meets the wobble plate switching condition and the duration exceeds the displacement pressure judging delay, wobble plate will start switching | [0,32767] | 100 | ms |
| 69 | Displacement switching rising delay | The time from when the drive wobble plate control digital output port converts to disconnection to when the pump displacement increases to large displacement value | [0,32767] | 10 | ms |
| 70 | Displacement switching declining delay | The time from when the drive wobble plate control digital output port converts to connection to when the pump displacement declines to large displacement value | [0,32767] | 10 | ms |
| 71 | Speed switching upper limit | Speed threshold value of wobble plate switching to | [0,6000] | 1200 | rpm |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | large displacement | | | |
| **13rd screen** | | | | | |
| 72 | Speed switching lower limit | Speed threshold value of wobble plate switching to small displacement | [0,6000] | 200 | rpm |
| 73 | O2 connection pressure coefficient | When the ratio of feedback pressure and reference pressure exceeds this coefficient, the digital output O2 is connected | [0,100.00] | 90 | % |
| 74 | Negative torque control | When negative torque control is enabled, motor negative torque amplitude is zero | 0: Disable<br>1: Enable | 0: Disable | |
| 75 | Rated motor voltage | During motor autotuning, input motor nameplate parameter | [0,800] | 334 | V |
| 76 | Rated motor current | During motor autotuning, input motor nameplate parameter | [0,900] | 64 | A |
| 77 | Rated motor speed | During motor autotuning, input motor nameplate parameter | [0,6000] | 1467 | rpm |
| **14th screen** | | | | | |
| 78 | Rated motor frequency | During motor autotuning, input motor nameplate parameter | [0,600.0] | 97.8 | Hz |
| 79 | Rated motor counter-emf | During motor autotuning, input motor nameplate parameter | [0,800.0] | 183.1 | V/Krpm |
| 80 | Motor temperature sensor | Select according to the motor sensor type | 0: NTC<br>1: PTC<br>2: KTY84<br>3: PT1000 | 2: KTY84 | |
| 81 | Upper limit of reverse torque | Proportional coefficient of max motor reverse torque reduction | [0,100] | 100 | % |
| 82 | Oil circuit pressure | The pressure discharge | 0: Normal oil circuit | 0: Normal oil | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | discharge mode | mode of system high pressure oil, adopt oil pump reversion (normal oil circuit) or electromagnet overflow valve (valve pressure discharge oil circuit) | 1: Valve pressure discharge oil circuit | circuit | |
| 83 | Advanced parameter operation enable | When advanced parameter is enabled, the setup parameters larger than no. 66 of HMI can be displayed and set; when it is disabled, only those smaller than no.65 of HMI can be displayed | 11111: Disable<br>99999: Enable<br>Other value: No action | 0 | |
| **15th screen** | | | | | |
| 84 | Pressure sensor range | Set the pressure range of pressure sensor | [0,250] | 250 | bar |
| 85 | Pressure feedback fine tuning parameter | Adjust pressure feedback gain coefficient via this parameter | [50,200] | 100 | % |
| 86 | Min value of flow reference | Set the min value of flow analog input | [0,2400.0] | 0 | L/Min |
| 87 | Over-modulation enable | After over modulation is enabled, the output voltage modulation ratio of the drive can reach 105% to the max | Disable<br>Enable | Disable | |
| 88 | Over modulation ratio | Set the modulation ratio of the max output voltage of the drive | [1.00,1.05] | 1.05 | % |
| 89 | Carrier frequency | Select the carrier frequency of the drive | [4,5,8,10,<br>3,2] | 3 | kHz |
| **16th screen** | | | | | |
| 90 | Speed feedback filter mode | Select speed operation mode | 0: Moving averages<br>1: Least squares<br>2 – 3: Reserved | 0: Moving averages | |
| 91 | Speed control rigidness | 1: Corresponding speed loop speed is the lowest; | [1,14] | 9 | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | 14: Corresponding speed loop speed is the fastest | | | |
| 92 | Motor inertia | Set automatically during motor model selection | [0,0.655] | 0.018 | $KgM^2$ |
| 93 | Motor autotuning direction | Default value: 0: FWD | 0: FWD<br>1: REV | 0: FWD | |
| 94 | Rated drive power | Set automatically during motor model selection | [0.00, 327.67] | 4R4→4.00<br>5R5→5.50<br>7R5→7.50<br>011→11.00<br>015→15.00<br>075→75.00 | Kw |
| 95 | Rated drive current | | [0,900] | 4R4→18.4<br>5R5→25.5<br>7R5→31.1<br>011→36.8<br>015→42.4<br>075→220.6 | A |
| **17th screen** | | | | | |
| 96 | Torque limit | Max torque of motor electromotion and power generation | [0,1800] | 425 | Nm |
| 97 | Disturbance compensation gain | Output torque coefficient of pressure disturbance compensation function | [0,200] | 0 | % |
| 98 | Disturbance compensation filter frequency | Filter frequency setup | [0,5000] | 500 | Hz |
| 99 | Disturbance compensation lag cycle | Output torque lag cycle of pressure disturbance compensation function | [0,15] | 5 | Cycle (Speed loop cycle) |
| 100 | PWM voltage compensation | A kind of PWM generation mode used to reduce the electromagnet interference of analog signal | 0: Disable<br>1: Enable | 0: Disable | |
| 101 | Pump stuck detection | Gear pump stuck detection and reset function | 0: Disable<br>1: Enable | 1: Enable | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **18th screen** | | | | | |
| 102 | Speed integral torque boost | Speed integral gain parameter increases based on this parameter according to the ratio of feedback torque and max motor torque | [0,1000] | 0 | % |
| 103 | Valve pressure discharge starting speed | Threshold of the starting speed of electromagnet overflow valve | [300,-300] | -1 | rpm |
| 104 | Valve pressure discharge starting pressure | Threshold of the starting pressure of electromagnet overflow valve | [0,500] | 20 | bar |
| 105 | Valve pressure discharge closing pressure | Electromagnet overflow valve is closed when feedback pressure is lower than this value | [0,500] | 1 | bar |
| 106 | Cut-in speed of pressure-hold feedforward | Judge whether the system enters the upper speed limit of pressure-hold state | [0,6000] | 100 | rpm |
| 107 | Cut-in pressure of pressure-hold feedforward | Judge whether the system enters the lower pressure limit of pressure-hold state | [0,500] | 200 | bar |
| **19th screen** | | | | | |
| 108 | Pressure-hold feedforward gain | Improve this parameter can improve the stability of holding pressure | [0,32767] | 0 | |
| 109 | PID terminal usage mode | Input terminal function setup | 0: Common<br>1: Specific for casting machine | 0 | |
| 110 | ALM-RST input selection | | 0: No function<br>1: Fault reset<br>2: Drive enable<br>3: Shunt/converging selection<br>4: Storing signal input | 1: Fault reset | |
| 111 | S-ON input selection | | | 2: Drive enable | |
| 112 | I1 input selection | | | 3: Shunt/converging selection | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 113 | I2 input selection | | 5: Motor rotation direction<br>6: PID terminal 1<br>7: PID terminal 2<br>8: PID terminal 3<br>9: PID terminal 4 | 4: Storing signal input | |
| **20th screen** | | | | | |
| 114 | I3 input selection | Input terminal function setup | 10: Trigger mode selection<br>11: Swash plate control enable (used when swash plate is controlled by overpressure mode during holding pressure).<br>12: Swash plate switching command<br>13: PQ selection signal<br>14: Following unit enable<br>15-63: Reserved | 6: PID terminal 1 | |
| 115 | I4 input selection | | | 7: PID terminal 2 | |
| 116 | I5 input selection | | | 0: No function | |
| 117 | I6 input selection | | | 0: No function | |
| 118 | I7 input selection | | | 0: No function | |
| 119 | I8 input selection | | | 0: No function | |
| **21st screen** | | | | | |
| 120 | S-RDY output | Output terminal function setup | 0: No output<br>1: Servo ready<br>2: Alarm output<br>3: I2 terminal state<br>4: Swash plate control output<br>5: Oil pressure reaches output<br>6: Valve pressure discharge output<br>7-63: Reserved | 1: Servo ready | |
| 121 | ALM output selection | | | 2: Alarm output | |
| 122 | COIN output selection | | | 0: No function | |
| 123 | O1 output selection | | | 4: Swash plate control output | |
| 124 | O2 output selection | | | 5: Oil pressure reaches output | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 125 | Overload protection mode | Current limit mode serves to limit the max output current based on the temperature of drive cooling fins; overload protection function does not work. It protection mode serves to determine whether threshold value is exceeded by judging the overload operation time, thus protecting IGBT | [0: Current limit mode, 1: It Protection mode 2 – 3: Reserved | 0: Current limit mode | |
| **22nd screen** | | | | | |
| 126 | Bus overvoltage @ | Bus voltage delay overvoltage protection voltage threshold | [0,800] | 750 | V |
| 127 | Bus overvoltage @ time | Bus voltage delay overvoltage protection detection time | [0,30000] | 20 | 5ms |
| 128 | Bus overvoltage | Bus voltage transient overvoltage protection voltage threshold | [0,800] | 780 | V |
| 129 | Bus undervoltage @ | Bus voltage delay undervoltage protection voltage threshold | [0,800] | 380 | V |
| 130 | Bus undervoltage @ time | Bus voltage delay overvoltage protection detection time | [0,30000] | 150 | 5ms |
| 131 | Bus undervoltage | Bus voltage immediate undervoltage protection voltage threshold | [0,800] | 320 | V |
| **23rd screen** | | | | | |
| 132 | Bus undervoltage during enable | Voltage threshold value of bus voltage undervoltage protection when motor is enabled | [0,800] | 315 | V |
| 133 | AC overvoltage @ | Voltage threshold of AC voltage delay overvoltage | [0,800] | 487 | V |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | protection | | | |
| 134 | AC overvoltage @ time | Detection time of AC voltage delay overvoltage protection | [0,30000] | 40 | 5ms |
| 135 | AC overvoltage | Voltage threshold of AC voltage transient overvoltage protection | [0,800] | 495 | V |
| 136 | AC undervoltage @ | Voltage threshold of AC voltage delay overvoltage protection | [0,800] | 290 | V |
| 137 | AC undervoltage @ time | Detection time of AC delay undervoltage protection | [0,30000] | 100 | 5ms |
| **24th screen** | | | | | |
| 138 | AC undervoltage | Voltage threshold value of AC voltage transient overvoltage protection | [0,800] | 0 | V |
| 139 | Time of power-up overtime | Max delay time of soft start of relay closing | [0,30000] | 2000 | 5ms |
| 140 | Motor protection temperature | Motor over-temperature protection value | [0,500] | 125 | °C |
| 141 | Module protection temperature | Module over-temperature protection value | [0,500] | 86 | °C |
| 142 | Air protection temperature | Over-temperature protection value of ambient temperature | [0,500] | 400 | °C |
| 143 | Overcurrent protection value | Software check overcurrent protection value | [0,900] | 4R4→50<br>5R5→70<br>7R5→95<br>011→105<br>015→120<br>075→530 | A |
| **25th screen** | | | | | |
| 144 | Overspeed protection time | FWD/REV overspeed protection delay time | [0,5000] | 100 | ms |
| 145 | FWD speed protection value | Set automatically during motor model selection | [0,6000] | 2700 | rpm |
| 146 | REV speed protection value | Set automatically during motor model selection | [-6000,0] | -2700 | rpm |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 147 | Overpressure protection value | Upper limit of pressure feedback overpressure alarm | [0,250] | 195 | bar |
| 148 | Pressure sensor fault value | Min voltage threshold of 5V pressure sensor, 32767 corresponds to 5V | [0,32767] | 0 | |
| 149 | AC/DC error threshold | Calculate the rectification voltage via AC voltage, then compares it with the actual DC voltage, if their difference exceeds this parameter, rectification unit fault will be reported | [0,800] | 80 | V |
| **26th screen** | | | | | |
| 150 | Brake resistor heating factor | Automatically set to the brake resistor heating factor matched with the drive during motor model selection | [0,500] | 4R4,5R5,7R5,011,015→36<br>018,025,030,<br>035,045,055→40<br>075,095→0 | |
| 151 | Brake resistor cooling factor | Automatically set to the brake resistor cooling factor matched with the drive during drive model selection | [0,500] | 1 | |
| 152 | Brake resistor overload threshold | Automatically set to the brake resistor cooling factor matched with the drive during drive model selection | [0,30000] | 4R4,5R5,7R5,011,015→429<br>018,025,030,035,045,055→292<br>075,095→374 | |
| 153 | Motor short-circuit protection value | Motor 3PH grounding short-circuit, check current threshold value | [0,900] | 10 | A |
| 154 | Phase loss protection selection | Input voltage phase loss check during drive operation | 0: Disable<br>1: Enable | 1: Enable | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 155 | Rectification overload protection selection | Current overload protection of rectification unit | 0: Disable<br>1: Enable | 0: Disable | |
| **27th screen** | | | | | |
| 156 | Brake resistor fault detection | Brake resistor fault protection function | 0: Disable<br>1: Enable | 1: Enable | |
| 157 | Resolver fault detection | Resolver fault protection function | 0: Disable<br>1: Enable | 1: Enable | |

### 5.3.3 Commissioning Menu List

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **1st screen** | | | | | |
| 0 | Operation enable | Turn on/off motor drive function | Disable<br>Enable | Related to the drive enable IO level | |
| 1 | Diagnosis enable | Turn on/off diagnosis function | Disable<br>Enable | Disable | |
| 2 | Drive test (valid only after diagnosis enable is turned on) | Test the drive | Disable<br>Enable | Disable | |
| 3 | Measure initial angle (valid only after diagnosis enable is turned on) | Refer to *9.2.5* | Disable<br>Enable | Disable | |
| 4 | Jogging enable (valid only after diagnosis enable is turned on) | Refer to *9.2.6* | Disable<br>Enable | Disable | |
| 5 | Motor parameter autotuning (valid only after diagnosis enable is turned on) | During motor autotuning, input motor nameplate parameter first, the precision of the motor parameter obtained via “static” mode depends on the accuracy of motor nameplate. When “dynamic” mode is used, no-load or light-load of | 0: Disable<br>1: Dynamic<br>2: Static | 0: Disable | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | motor is required for obtaining accurate motor parameters | | | |
| **2nd screen** | | | | | |
| 6 | Control mode | Set the drive control mode | Speed mode<br>Process mode | Process mode | |
| 7 | Speed reference (speed mode is valid) | | The FWD/REV speed reference value cannot exceed the max motor speed | 0 | rpm |
| 8 | Process command mode | Used to select command input mode | Digital input, analog input, CAN continuous, 485 continuous, CANopen input, EtherCAT input, internal reference | Analog input | |
| 9 | Flow reference | Flow reference value is valid when command input mode is digital input | [0, max flow] | 0 | L\min |
| 10 | Pressure reference | Pressure reference value is valid when command input mode is digital mode | [0, max pressure] | 0 | bar |
| 11 | Max jogging speed | Max speed of the motor when forward and backward button is pressed | [0,1000] | 100 | rpm |
| **3rd screen** | | | | | |
| 12 | Resolver offset quantity | Resolver and motor zero position offset angle | [0, 4095] | 0 | |
| 13 | DA1 | Set the output variable of analog output port 1 | Pressure reference<br>Pressure feedback<br>Flow reference<br>Flow feedback<br>Speed reference<br>Speed feedback<br>Torque reference | Pressure feedback | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | | Torque feedback<br>Resolver feedback<br>DC voltage<br>Phase current<br>Fault word 1<br>Fault word 2<br>Communication command | | |
| 14 | Max value of DA1 | The corresponding digital input of max output of analog output port 1 | [-32767,32767] | 32767 | |
| 15 | Min value of DA1 | The corresponding digital input of min. output of analog output port 1 | [-32767,32767] | 0 | |
| 16 | DA2 | Set the output variable of analog output port 2 | Pressure reference<br>Pressure feedback<br>Flow reference<br>Flow feedback<br>Speed reference<br>Speed feedback<br>Torque reference<br>Torque feedback<br>Resolver feedback<br>DC voltage<br>Phase current<br>Fault word 1<br>Fault word 2<br>Communication command | Speed feedback | |
| 17 | Max value of DA2 | Corresponding digital input of max output of analog output port 2 | [-32767,32767] | 16384 | |
| **4th screen** | | | | | |
| 18 | Min value of DA2 | Corresponding digital input of minimum output of | [-32767,32767] | -16384 | |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | analog output port 2 | | | |
| 19 | Output value of DA | Analog output port outputs this variable when DA variable output selects communication command | [-32767,32767] | 0 | |
| 20 | Clear fault manually | Void drive enable can clear the faults other than Err08, Err11, Err12, Err18 and Err24, while all the faults can be cleared via manual clearance | 0: No action<br>1: Clear | 0: No action | |
| 21 | Internal flow reference 0 | Internal flow reference Dimension is flow full range | [ 0, 100.0] | 0 | % |
| 22 | Internal pressure reference 0 | Internal pressure reference Dimension is pressure full range | | | |
| 23 | Internal flow reference 1 | Internal flow reference Dimension is flow full range | | | |
| **5th screen** | | | | | |
| 24 | Internal pressure reference 1 | Internal pressure reference Dimension is pressure full range | [ 0, 100.0] | 0 | % |
| 25 | Internal flow reference 2 | Internal flow reference Dimension is flow full range | | | |
| 26 | Internal pressure reference 2 | Internal pressure reference Dimension is pressure full range | | | |
| 27 | Internal flow reference 3 | Internal flow reference Dimension is flow full range | | | |
| 28 | Internal pressure reference 3 | Internal pressure reference Dimension is pressure full range | | | |
| 29 | Internal flow reference 4 | Internal flow reference Dimension is flow full range | | | |
| **6th screen** | | | | | |
| 30 | Internal pressure reference 4 | Internal pressure reference Dimension is pressure full range | [ 0, 100.0] | 0 | % |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 31 | Internal flow reference 5 | Internal flow reference Dimension is flow full range | | | |
| 32 | Internal pressure reference 5 | Internal pressure reference Dimension is pressure full range | | | |
| 33 | Internal flow reference 6 | Internal flow reference Dimension is flow full range | | | |
| 34 | Internal pressure reference 6 | Internal pressure reference Dimension is pressure full range | | | |
| 35 | Internal flow reference 7 | Internal flow reference Dimension is flow full range | | | |
| **7th screen** | | | | | |
| 36 | Internal pressure reference 7 | Internal pressure reference Dimension is pressure full range | [ 0, 100.0] | 0 | % |

### 5.3.4 Multi-Pump Menu List

| Menu No. | Menu Name | Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **1st screen** | | | | | |
| 0 | Network enable/disable | Network enable control | Disable<br>Enable | Disable | |
| 1 | Drive enable/disable on the network | Used to void the motor enable of all nodes, suitable for multi-pump mode only | Disable<br>Enable | Related to the drive enable IO level | |
| 2 | Converging type | Select converging type | Single-pump<br>Composite<br>Multi-pump<br>Multi-mode | Single-pump | |
| 3 | Node no. | If node no. is 0, it means master, if it is 1 – 15, it means slave | [0,15] | 0 | |
| 4 | Number of slave node | If node number is 0, slave node number means the number of slaves related to this master | [0,15] | 0 | |
| 5 | Node type | Set the working mode of | Independent unit | Independent | |

| Menu No. | Menu Name | Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | the drive in the node | Control unit<br>Following unit<br>Flow loop unit | unit | |
| **2nd screen** | | | | | |
| 6 | Flow cut-in threshold | The condition for the next pump to engage, when the system flow exceeds the flow cut-in threshold of current pump, the next pump will engage in the operation | [0,100.0] | 25 | % |
| 7 | Upper limit of flow cut-in hysteresis | The condition for the next pump to engage, used to prevent the repeated start and stop of the pump when the flow is in threshold point | [0,100.0] | 5 | % |
| 8 | Lower limit of flow cut-in hysteresis | The condition for the next pump to engage, used to prevent the repeated start and stop of the pump when the flow is in threshold point | [0,100.0] | 2.5 | % |
| 9 | Multi-pump pressure proportional gain 0 | The 0th step of proportional parameter of multi-pump pressure PID control | [0,32767] | 8000 | |
| 10 | Multi-pump pressure integral gain 0 | The 0th step of integral parameter of multi-pump pressure PID control | [0,32767] | 88 | |
| 11 | Multi-pump pressure differential gain 0 | The 0th step of differential parameter of multi-pump pressure PID control | [0,32767] | 0 | |
| **3rd screen** | | | | | |
| 12 | Multi-pump pressure proportional gain 1 | The 1st step of proportional parameter of multi-pump pressure PID control | [0,32767] | 8000 | |
| 13 | Multi-pump pressure integral gain 1 | The 1st step of integral parameter of multi-pump | [0,32767] | 88 | |

| Menu No. | Menu Name | Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | pressure PID control | | | |
| 14 | Multi-pump pressure differential gain 1 | The 1st step of differential parameter of multi-pump pressure PID control | [0,32767] | 0 | |
| 15 | Multi-pump pressure proportional gain 2 | The 2nd step of proportional parameter of multi-pump pressure PID control | [0,32767] | 8000 | |
| 16 | Multi-pump pressure integral gain 2 | The 2nd step of integral parameter of multi-pump pressure PID control | [0,32767] | 88 | |
| 17 | Multi-pump pressure differential gain 2 | The 2nd step of differential parameter of multi-pump pressure PID control | [0,32767] | 0 | |
| **4th screen** | | | | | |
| 18 | Multi-pump pressure proportional gain 3 | The 3rd step of proportional parameter of multi-pump pressure PID control | [0,32767] | 8000 | |
| 19 | Multi-pump pressure integral gain 3 | The 3rd step of integral parameter of multi-pump pressure PID control | [0,32767] | 88 | |
| 20 | Multi-pump pressure differential gain 3 | The 3rd step of differential parameter of multi-pump pressure PID control | [0,32767] | 0 | |
| 21 | ECAT synchronization mode | Set the synchronization mode between EtherCAT communication master and slave | 0-Free,<br>1-SM2INT<br>2-Sync0 | 0 | |
| 22 | ECAT synchronization time | Set the synchronous interruption cycle of DC Sync0 when EtherCAT communication uses DC mode | 0-500us,<br>1-1ms<br>2-2ms<br>3-4ms | 0 | |
| 23 | 485 local communication address | Set the local (slave) communication address during 485 serial communication | [1-255] | 10 | |
| **5th screen** | | | | | |
| 24 | 485 communication | Select by parameters the | 0:N,8,1 | 0 | |

| Menu No. | Menu Name | Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | check mode | check mode during 485 communication, support RTU mode only | 1:E,8,1<br>2:O,8,1<br>3:N,8,2<br>4:E,8,2<br>5:O,8,2 | | |
| 25 | 485 communication baud rate selection | The baud rate when selecting 485 communication by parameters | [9600,19200, 38400,57600, 115200] | 9600 | bps |
| 26 | CANOpen communication node number | Set the local (slave) communication node number during CAN communication | [1-127] | 32 | |
| 27 | CANOpen communication baud rate | The baud rate when selecting CAN communication by parameters | [1000,500, 250,125,50, 20] | 500 | kbps |

### 5.3.5 Parameter Programming Menu List

| Menu No. | Menu Name | Meaning |
|---|---|---|
| **1st screen** | | |
| 0 | Parameter programming | Program internal RAM parameter of the drive to EEPROM |
| 1 | Restore default value | Used to restore the default parameters |
| 2 | Read parameters in batches | Read the parameters in EEPROM in DSP in batches |
| 3 | Program parameters in batches | Write parameters into the EEPROM in DSP in batches |
| 4 | Delete parameters in batches | Delete the parameters stored in EEPROM in HMI |
| 5 | Fault record check | Read fault record |

※ When “restore default setup” is executed and “parameter programming” is not executed, if drive is powered off and re-powered on; the default parameter will not be restored.

※ After “programming parameters in batches” is executed, the drive needs to be powered off and re-powered on for the parameters written into EEPROM to be effective.

### 5.3.6 Shortcut Menu List

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| **1st screen** | | | | | |
| 0 | Operation enable | Turn on/off motor drive function | Disable<br>Enable | Related to the drive enable IO level | |
| 1 | Diagnosis enable | Turn on/off diagnosis function | Disable<br>Enable | Disable | |
| 2 | Motor model selection | Motor model | Refer to *5.5.5* for details | U1013F. 17.3 | |
| 3 | Pump model selection | Oil pump model | Refer to *5.5.5* for details | PUMP 100 mL/r | |
| 4 | Pressure feedback zero position calibration | The zero position offset of pressure sensor can be removed by pressure feedback zero position calibration | Pressure feedback zero position calibration | | |
| 5 | Measure initial angle | Initial angle test can be done only when operation enable is voided | Disable<br>Enable | Disable | |
| **2nd screen** | | | | | |
| 6 | Pressure full range | Set the pressure full range of the node<br>This value will set both the pressure full range and max pressure value and meanwhile, adjust the pressure reference gain to make the pressure reference correspond to the newly set pressure full range value when pressure reference input is 9.9V | [1,250] | 175 | bar |
| 7 | Flow full range | Set the flow full range of the node<br>This value will set both the flow full range and max flow value and meanwhile, adjust the flow reference gain to make the flow reference correspond to the newly set flow full range | [1,2400] | 200 | L/min |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| | | value when flow reference input is 9.9V | | | |
| 8 | Pressure zero position calibration | Calibrate when the upper PC outputs corresponding analog signal | Disable<br>Enable | Disable | |
| 9 | Pressure full range calibration | Calibrate when the upper PC outputs corresponding analog signal | Disable<br>Enable | Disable | |
| 10 | Flow zero position calibration | Calibrate when the upper PC outputs corresponding analog signal | Disable<br>Enable | Disable | |
| 11 | Flow full range calibration | Calibrate when the upper PC outputs corresponding analog signal | Disable<br>Enable | Disable | |
| **3rd screen** | | | | | |
| 12 | Parameter programming | Program the internal RAM parameter of the drive to EEPROM | Parameter programming | Parameter programming | |
| 13 | Jogging enable | Valid only if diagnosis enable is turned on, after the key enters jogging mode, press “forward” or “backward” key to make the motor rotate forward or backward. | Disable<br>Enable | Disable | |
| 14 | Motor parameter autotuning (valid only if diagnosis enable is turned on ) | During motor autotuning, input motor nameplate parameters first, the precision of the motor parameters obtained by “static” mode depends on the accuracy of motor nameplate parameter, when “dynamic” mode is used, no-load or light-load of motor is required to obtain accurate motor parameters | 0: Disable<br>1: Dynamic<br>2: Static | Disable | |
| 15 | Pressure sensor model selection | Pressure sensor type | 5v<br>10v<br>400bar | 10v | |

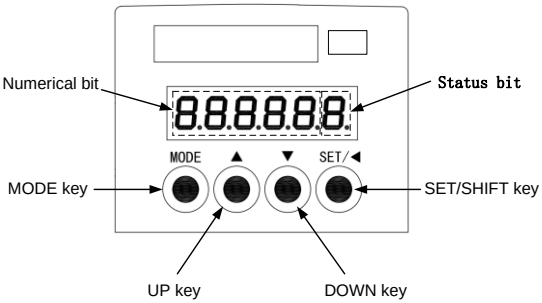
| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 16 | Pressure proportional gain 0 | The 0th step of proportional parameter of pressure PID control | [0,32767] | 13000 | |
| 17 | Pressure integral gain 0 | The 0th step of integral parameter of pressure PID control | [0,32767] | 100 | |
| **4th screen** | | | | | |
| 18 | Pressure proportional gain 1 | The 1st step of proportional parameter of pressure PID control | [0,32767] | 13000 | |
| 19 | Pressure integral gain 1 | The 1st step of integral parameter of pressure PID control | [0,32767] | 100 | |
| 20 | Speed proportional gain 0 | The 0th step of proportional parameter of speed PI control | [0,32767] | 7000 | |
| 21 | Speed integral gain 0 | The 0th step of integral parameter of speed PI control | [0,32767] | 140 | |
| 22 | Speed proportional gain 1 | The 1st step of proportional parameter of speed PI control | [0,32767] | 7000 | |
| 23 | Speed integral gain 1 | The 1st step of integral parameter of speed PI control | [0,32767] | 140 | |
| **5th screen** | | | | | |
| 24 | Multi-step PID quick setup | Set whether to use multi-step mode for speed PI parameter and pressure PID parameter simultaneously | Disable<br>Enable | Disable | |
| 25 | Speed proportion torque boost | Speed proportional gain parameter increases based on this parameter according to the ratio of feedback torque and max motor torque | [0,1000] | 0 | % |
| 26 | Speed integral torque boost | Speed integral gain parameter increases based on this parameter according to the ratio of feedback torque and max motor torque | [0,1000] | 0 | % |

| Menu No. | Menu Name | Meaning | Parameter Range | Default Value | Unit |
|---|---|---|---|---|---|
| 27 | Pump reverse rotation speed limit | Max reverse speed of oil pump | [0,-6000] | -300 | rpm |
| 28 | Upper limit of reverse torque | Proportional coefficient of max motor reverse torque reduction | [0,100] | 100 | % |
| 29 | Over-pressure protection value | Upper limit of over-pressure alarm | [0,250] | 195 | bar |
| **6th screen** | | | | | |
| 30 | Pump stuck detection | | | | |

## 5.4 LED Display and Operation

### 5.4.1 LED Panel Instruction

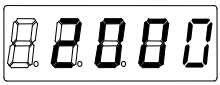
| Displayed Character | Corresponding Letter | Displayed Character | Corresponding Letter | Displayed Character | Corresponding Letter | Displayed Character | Corresponding Letter | Displayed Character | Corresponding Letter | Displayed Character | Corresponding Letter |
|---|---|---|---|---|---|---|---|---|---|---|---|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




| Button | Instruction | Button | Instruction |
|---|---|---|---|
| MODE | Menu skip and cancel button | ▲ | Upward button |
| SET/◄ | Long press (about 0.5s): set<br>Short press: move leftward | ▼ | Downward button |

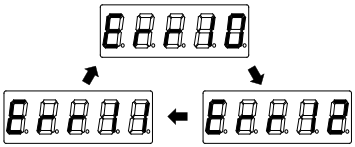
LED display reference table:

LED digital tube is lit up once servo drive is powered on. The first five characters display the value, and the last one indicates system state. LED value bit displays motor speed (rpm) by default (precision reaches to ones).



If fault occurred during power on or operation, the decimals points of LED state bit will flicker at 1s interval, and LED value bit will display fault code. The fault code is comprised of fault identifier (the first three bits from left to right of digital tube display Err) and fault code number (the last two bits from left to right of digital tube display two digits). After fault occurred, the fault code flickers at 1s interval.

If multiple faults occurred simultaneously, then multiple fault codes will display cyclically.



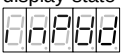
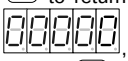
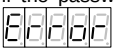
Keypad unlock:

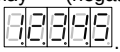
A. In speed or fault display state, to operate on the keypad, users need to keep ▲ and ▼ keys pressed down for 1s, and the LED value bit will display ULOCK, which means the system keypad is unlocked and ready to be operated.

If the drive is in good condition, the drive keypad operation enters shortcut mode; if the drive is faulty, users need to press MODE to enter shortcut mode.

During keypad operation, if ▲ and ▼ are pressed together for 1s, LED value bit will display

LOCK which means the system keypad is locked, and LED value bit returns to speed or fault display state.

B. Users can also unlock the keypad in speed or fault display state by entering password. Press MODE key to enter password input prompt interface  (press MODE to return to the previous interface), and press SET key to enter password input interface  , (press MODE key to return to the previous interface), users can change the flickering bit by ◀ key and change the value of the flickering bit via ▲ or ▼. After password is set, press SET key and if the password is correct, it will enter shortcut mode, if not, enter password error interface  and after staying for a few seconds, enter password input interface. The initial password is 0.

When the negative number is less than 9999, the five-bit LED cannot display "-" (negative); when the decimal points of 1, 2, 3 and 4 are lit up, it means negative number  .

#### 5.4.2 LED State Bit Instruction

The last bit of LED digital tube displays in real time the present running state of MH800 system, and its meaning is shown below:

| No. | Displayed Content | Cycle | Control State |
|---|---|---|---|
| 1 |  | 1s | Electronic |
| 2 |  | 0s | Electricity |
| 3 |  | 0s | Ready to run |
| 4 |  | 1s | Run |
| 5 |  | 1s | Fault |
| 6 |  | 2s | Diagnosis |
| 7 |  | 2s | Factory test |

## 5.5 LED Panel Function

#### 5.5.1 Keypad Operation Mode

This drive carries six kinds of keypad operation modes which can be switched via MODE key after keypad is unlocked.

Shortcut mode: used to display critical parameters

Quick setting mode: used to set critical setup parameters and motor commissioning

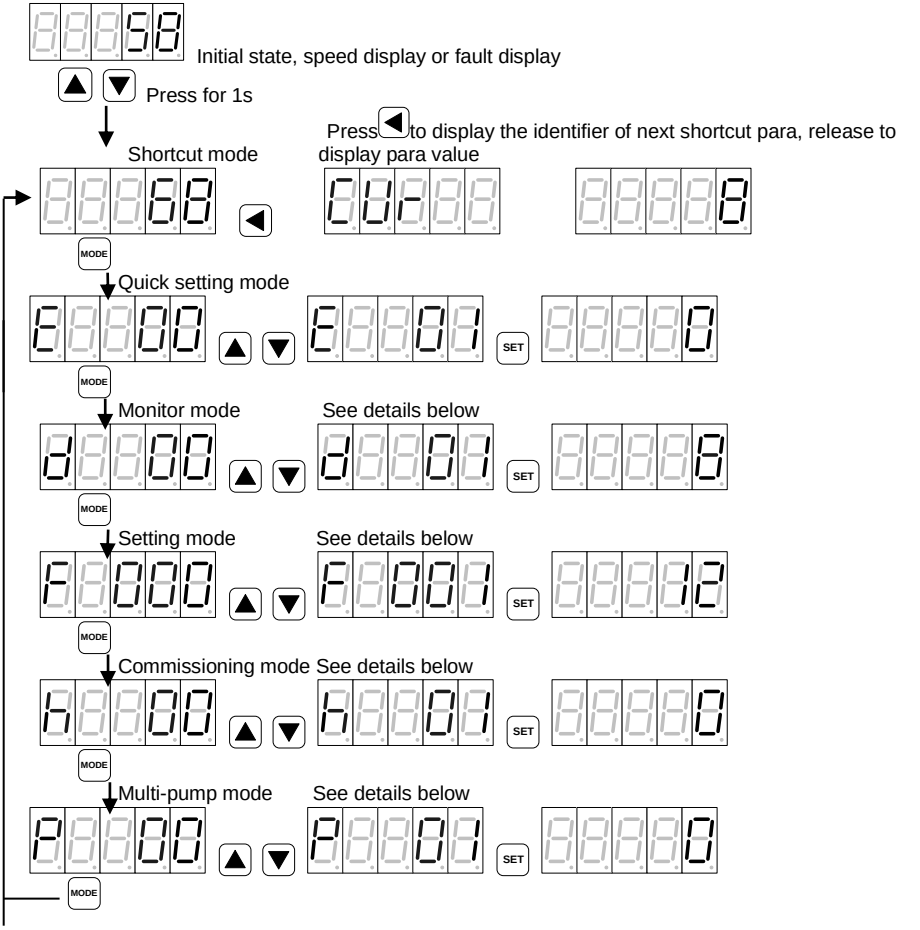
Monitor mode: used to display state parameter

Setting mode: used to set basic parameters

Commissioning mode: used for motor commissioning and parameter storage

Multi-pump mode: used to set multi-pump parallel parameters

The operation flowchart is shown below:




### 5.5.2 Short-cut Mode

Users can observe critical parameters of the drive under shortcut mode via pressing ◀ key. When ▲ and ▼ are pressed simultaneously for 1s in LOCK state, it will enter "shortcut mode" and LED displays the selected parameter value; press ◀, LED displays the next parameter identifier to be displayed, release ◀ key, LED displays corresponding parameter value.

※ Under shortcut mode, if no button operation is performed within 4 minutes, it will switch to speed and fault display interface automatically.

Shortcut mode display parameter table:

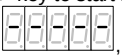
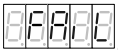
| Identifier | Definition and Instruction | Parameter Range | Unit |
|---|---|---|---|
| SPD | Speed feedback | [-6000,6000] | rpm |

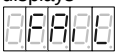
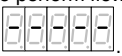
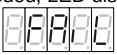
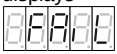
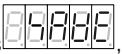
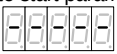
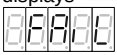
| Identifier | Definition and Instruction | Parameter Range | Unit |
|---|---|---|---|
| CUR | Current feedback | [0,900.0] | A |
| RES | Resolver feedback | [0,4096] | |
| PRS | Pressure feedback | [-250,250] | bar |
| PIDS | PID step number | [0,3] | |

### 5.5.3 Quick Setting Mode

When pressing MODE key to select "quick setting mode", LED value bit displays "E--xx", in which xx represents different parameter identifiers. Press ▲ or ▼ key to select the parameter identifier to be set, and then press SET key, LED value bit will display corresponding parameter value. When modifying parameter value, users can change the flickering bit via ◀ key and modify the value of the flickering bit via ▲ or ▼. After modification, press SET key to save the modified value and stop the flickering, then if SET or ▲▼ is pressed again, the bit which can be modified will flicker and the parameter value can be changed again. Press MODE key to exit.

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| E00 | Operation enable<br>Press SET key to enter operation enable mode, LED displays operation enable state "ON" or "OFF", press SET to switch operation enable state. | OFF: Disable<br>ON: Enable | Related to drive enable IO level | |
| E01 | Motor model selection<br>LED displays 11-013, in which the first two bits are the selection number and the last two bits are the motor model code, press ▲ or ▼ key to select the motor to be set; press SET key, LED displays ----- to set the motor. If setup is performed properly, newly selected motor model will be displayed, if failed, the LED displays FAIL. | See motor model list below for details | U1013F. 17.3 | |
| E02 | Pump model selection<br>LED displays 00018, in which the first two bits are selection number and the last three bits are oil pump displacement, press ▲ or ▼ key to select the oil pump to be set; press SET key, LED displays ----- to set the oil pump. If setup is performed properly, the newly selected oil pump model will be displayed, if failed, the LED displays FAIL. | See oil pump model list below for details | PUMP 100 mL/r | |
| E03 | Pressure feedback zero position calibration<br>LED displays pressure sensor analog voltage feedback value, press SET to calibrate, if calibration is succeeded, | | | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | LED displays  , if failed, LED displays  . | | | |
| E04 | Measure initial angle<br>Initial angle test can be done only when operation enable is OFF. Press SET key to enter measure initial angle menu, and LED displays the previous resolver offset quantity, press SET key to start measuring initial angle, and LED displays  , which means measuring is on. After measuring is succeeded, LED displays newly measured resolver offset quantity, if failed, LED displays  . During measuring, users can press MODE key to exit. | | | |
| E05 | Pressure full range<br>This value sets the pressure full range and max pressure value simultaneously, and meanwhile, adjusts the pressure reference gain to make the pressure reference correspond to the newly set pressure full range value when pressure reference is 9.9V. After entering, present pressure full range value will be displayed, press ◀ ▲ ▼ keys to change to the desired value and press SET key to confirm. | [1,250] | 175 | bar |
| E06 | Flow full range<br>This value sets the flow full range and max flow value simultaneously, and meanwhile, adjusts the flow reference gain to make the flow reference correspond to the newly set flow full range value when flow reference is 9.9V. After entering, present flow full range value will be displayed, press ▲ ▼ keys to change to the desired value and press SET key to confirm. | [1,2400] | 200 | L/min |
| E07 | Pressure zero position calibration<br>After pressing SET key, LED displays pressure reference analog value, press SET key to perform pressure zero position calibration, and LED displays  . If calibration is succeeded, LED displays  , if failed, LED displays  . | Analog voltage range [0.00,9.99] | | V |
| E08 | Pressure full range calibration<br>After pressing SET key, LED displays present pressure reference analog value, confirm the value and press SET key to perform pressure full range calibration, and LED | Analog voltage range [0.00,9.99] | | V |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | displays  . If calibration is succeeded, LED displays  , if failed, LED displays  . | | | |
| E09 | Flow zero position calibration<br>After pressing SET key, LED displays flow reference analog value, press SET key to perform flow zero position calibration, and LED displays  . If calibration is succeeded, LED displays  , if failed, LED displays  . | Analog voltage range [0.00,9.99] | | V |
| E10 | Flow full range calibration<br>After pressing SET key, LED displays present flow reference analog value, confirm the value and press SET key to perform flow full range calibration, and LED displays  . If calibration is succeeded, LED displays  , if failed, LED displays  . | Analog voltage range [0.00,9.99] | | V |
| E11 | Parameter programming<br>After pressing SET key, LED displays  , press SET key to start parameter programming, and LED displays  . If programming is succeeded, LED displays  , if failed, LED displays  . | | | |
| E12 | Jogging<br>After pressing SET key to enter jogging mode, LED displays “JOG”, then press ▲ or ▼ key to make the motor rotate forward or backward, press MODE key can exit from jogging mode and return to “Exx” menu. | ▲: Forward<br>▼: Reverse | | |
| E13 | Diagnosis enable<br>Press SET key to enter diagnosis enable mode, and LED displays diagnosis enable state “ON” or “OFF”, press SET to switch diagnosis enable state. | OFF: Disable<br>ON: Enable | OFF | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| E14 | Motor parameter autotuning<br>Effective only if diagnosis enable activates motor parameter autotuning function.<br>Press SET key to enter motor parameter autotuning menu, and LED displays "0", select the parameter autotuning mode and press SET key to start motor parameter autotuning. When LED displays -----, it means autotuning is on. If autotuning is succeeded, LED displays dE, if failed, LED displays FAIL. During autotuning, users can press MODE key to exit form autotuning, and LED displays 0. | 0: Disable<br>1: Dynamic<br>2: Static | 0: Disable | |
| E15 | Pressure sensor model selection | 5V:1 – 5V sensor<br>10V: 0 – 10V sensor | 10V | |
| E16 | Pressure proportional gain | [0,32767] | 13000 | |
| E17 | Pressure integral gain | [0,32767] | 100 | |
| E18 | Speed proportional gain | [0,32767] | 7000 | |
| E19 | Speed integral gain | [0,32767] | 170 | |
| E20 | Speed proportional torque boost | [0,1000] | 0 | % |
| E21 | Speed integral torque boost | [0,1000] | 0 | % |
| E22 | Max speed of pump reverse rotation | [0,-6000] | -300 | Rpm |
| E23 | Upper limit of reverse torque | [0,100] | 100 | % |
| E24 | Over-pressure protection value | [0,500] | 195 | bar |
| E25 | Pump stuck detection | 0: Disable<br>1: Enable | 1: Enable | |

※ See 5.3.2, 5.3.3 and 5.3.5 for parameter instruction.

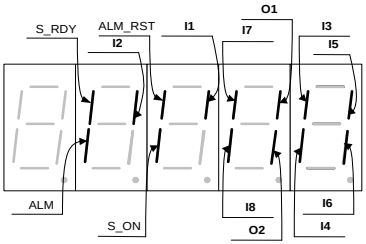
### 5.5.4 Monitoring MODE

When pressing MODE key to select "monitor mode", LED value bit displays "d--xx", in which xx is the identifier of the parameter. Press ▲ or ▼ key to select the parameter identifier to be displayed and press SET after selection, then the LED panel will display corresponding parameter value, press MODE key to exit.

※ Under monitor mode, if there is no button operation within 4m, the system will switch to speed and fault display interface automatically.

The definition of the monitor parameters of the drive is shown below:

| Code | Name | Parameter Range | Unit |
|---|---|---|---|
| d00 | Flow reference | [0,2400.0] | L/min |
| d01 | Pressure reference | [0,250.0] | bar |
| d02 | System fault | System fault alarm (can display multiple faults which occurred simultaneously) | |
| d03 | Motor current | [0,900.0] | A |
| d04 | AC voltage | [0,500] | Vrms |
| d05 | DC voltage | [0,800] | V |
| d06 | Torque limit | [0,1800] | Nm |
| d07 | Speed feedback | [-6000,6000] | Rpm |
| d08 | Resolver feedback | [0,32767] | |
| d09 | Pressure feedback | [-250,250] | bar |
| d10 | Torque feedback | [-1800,1800] | Nm |
| d11 | Running mode | 3: Speed mode<br>4: Process mode | |
| d12 | Motor temperature | [-52,244] | °C |
| d13 | Drive temperature | [-46,244] | °C |
| d14 | Ambient temperature | [-18,114] | °C |
| d15 | Machine material | [0,999] | |
| d16 | DSP software version | | |
| d17 | Panel software version | | |
| d18 | Max system pressure | [0,250.0] | bar |
| d19 | Max system flow | [0,2400.0] | L/min |
| d20 | Power | [0.00,327.67] | kW |
| d21 | Converging type | 0: Single pump; 1: Composite; 2: Multi-pump; 3: Multi-mode | |
| d22 | Present PID step | [0,3] | |
| d23 | Flow reference voltage | [0,10.00] | V |
| d24 | Pressure reference voltage | [0,10.00] | V |
| d25 | Pressure feedback voltage | [0,10.00] | V |
| d26 | Output voltage | [-1000,1000] | V |

| Code | Name | Parameter Range | Unit |
|---|---|---|---|
| d27 | Digital IO |  If input port indicator lights up, it means low level (if S_ON input port lights up, it means high level); if output port indicator lights up, it means cut-off | |
| d28 | Motor configuration table version | | |

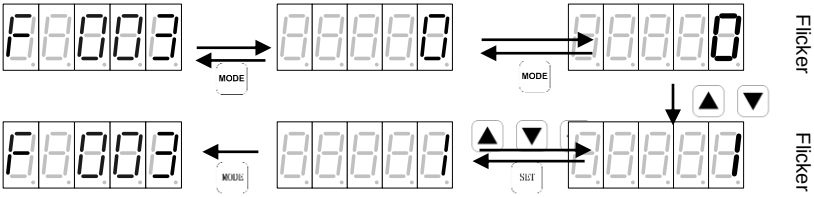
※ See 5.3.1 for parameter instructions.

### 5.5.5 Setting Mode

When pressing MODE key to select "setting mode", LED value bit displays "F--xx", in which xx is the parameter identifier. Press ▲ or ▼ key to select the parameter identifier to be set and press SET key after selection, then LED panel will display corresponding parameter value. Press ◀ or ▲ ▼ key the bit which can be modified will flicker. When modifying parameter values, users can change the flickering bit by ◀ key and modify the value of the flickering bit via ▲ or ▼. After modification, press SET key to save the modified parameter and stop the flickering, then press ◀ or ▲▼ again to re-modify the parameter value and the bit can be modified will flicker. Press MODE key to exit.

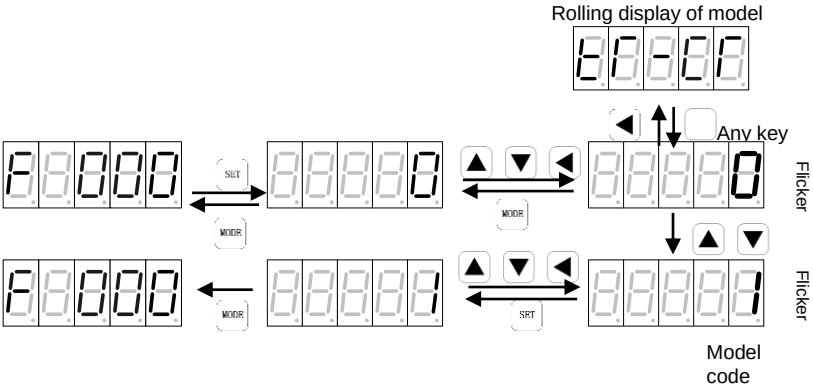
The selection of drive, motor and oil pump differ with other parameter selections, see details below:

Parameter setup operation flowchart:

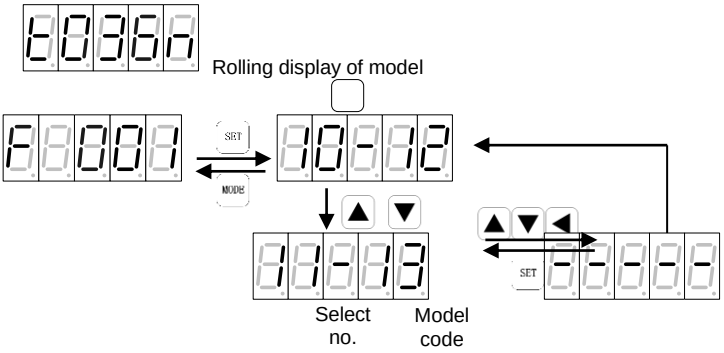



※ For calibration command eg pressure linear zero position calibration, if LED displays 0 after setup, it means calibration is succeeded; if LED keeps displaying 1, it means calibration is failed.

**Drive setup operation flowchart:**



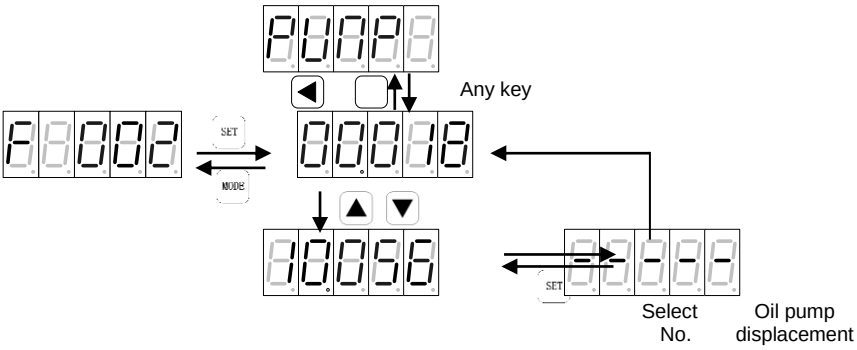

**Motor setup operation flowchart:**




Select no.: the serial number for each motor model.

Model code: the code of each motor model

**Oil pump setup operation flowchart:**



Select no.: the serial number of each oil pump model.

※ Under setting mode, if there is no button operation within 4m, the system will switch to speed and fault display interface automatically.

1) Drive model list

| Drive Selection Order | LED Display Mode | Drive Model | Drive Model Code |
|---|---|---|---|
| 2 | 4r4-0 | SV-MH800-4R4-33-S | 42 |
| 3 | 5r5-0 | SV-MH800-5R5-33-S | 43 |
| 4 | 7r5-0 | SV-MH800-7R5-33-S | 44 |
| 5 | 011-0 | SV-MH800-011-33-S | 45 |
| 6 | 015-0 | SV-MH800-015-33-S | 46 |
| 7 | 018-0 | SV-MH800-018-33-S | 47 |
| 8 | 025-0 | SV-MH800-025-33-S | 48 |
| 9 | 030-0 | SV-MH800-030-33-S | 49 |
| 10 | 035-0 | SV-MH800-035-33-S | 50 |
| 11 | 045-0 | SV-MH800-045-33-S | 51 |
| 12 | 055-0 | SV-MH800-055-33-S | 52 |
| 13 | 075-0 | SV-MH800-075-33-S | 53 |

2) Motor model list:

| Motor Selection No. | Motor Model | Motor Model Code | Brand | Winding Temperature Resistor Model |
|---|---|---|---|---|
| 0 | K038F18C18P | 60 | KINWAY | Pt1000 |
| 1 | K036F20C18P | 65 | KINWAY | Pt1000 |
| 2 | K058F18C18P | 33 | KINWAY | Pt1000 |
| 3 | K060F18C18P | 66 | KINWAY | Pt1000 |
| 4 | K072F18C18P | 61 | KINWAY | Pt1000 |
| 5 | K091F15C18P | 34 | KINWAY | Pt1000 |
| 6 | K111F15C18P | 35 | KINWAY | Pt1000 |
| 7 | K132F18C18P | 62 | KINWAY | Pt1000 |
| 8 | K187F18C25P | 63 | KINWAY | Pt1000 |
| 9 | K208F15C25P | 98 | KINWAY | Pt1000 |
| 10 | K070F20D18P | 68 | KINWAY | Pt1000 |
| 11 | K087F20D18P | 64 | KINWAY | Pt1000 |
| 12 | K105F20D18P | 69 | KINWAY | Pt1000 |
| 13 | K189F15D25P | 70 | KINWAY | Pt1000 |
| 14 | K172F18D25P | 71 | KINWAY | Pt1000 |
| 15 | K260F20D25P | 72 | KINWAY | Pt1000 |
| 16 | K053F20E18P | 47 | ANXIN | KTY84 |
| 17 | K070F20E18P | 48 | ANXIN | KTY84 |

| Motor Selection No. | Motor Model | Motor Model Code | Brand | Winding Temperature Resistor Model |
|---|---|---|---|---|
| 18 | K087F20E18P | 49 | ANXIN | KTY84 |
| 19 | K105F20E18P | 50 | ANXIN | KTY84 |
| 20 | K189F15E25P | 51 | ANXIN | KTY84 |
| 21 | K172F18E25P | 52 | ANXIN | KTY84 |
| 22 | K260F20E25P | 53 | ANXIN | KTY84 |
| 23 | U1004F.15.3 | 12 | PHASE | KTY84 |
| 24 | U1004F.17.3 | 13 | PHASE | KTY84 |
| 25 | U1004F.20.3 | 14 | PHASE | KTY84 |
| 26 | U1005F.15.3 | 15 | PHASE | KTY84 |
| 27 | U1005F.17.3 | 16 | PHASE | KTY84 |
| 28 | U1005F.20.3 | 17 | PHASE | KTY84 |
| 29 | U1007F.15.3 | 18 | PHASE | KTY84 |
| 30 | U1007F.17.3 | 9 | PHASE | KTY84 |
| 31 | U1007F.20.3 | 19 | PHASE | KTY84 |
| 32 | U1008F.15.3 | 20 | PHASE | KTY84 |
| 33 | U1008F.17.3 | 21 | PHASE | KTY84 |
| 34 | U1008F.20.3 | 22 | PHASE | KTY84 |
| 35 | U1010F.15.3 | 6 | PHASE | KTY84 |
| 36 | U1010F.18.3 | 10 | PHASE | KTY84 |
| 37 | U1010F.20.3 | 4 | PHASE | KTY84 |
| 38 | U1013F.15.3 | 23 | PHASE | KTY84 |
| 39 | U1013F.17.3 | 24 | PHASE | KTY84 |
| 40 | U1013F.18.3 | 25 | PHASE | KTY84 |
| 41 | U1013F.20.3 | 8 | PHASE | KTY84 |
| 42 | U1320F.15.3 | 26 | PHASE | KTY84 |
| 43 | U1320F.17.3 | 11 | PHASE | KTY84 |
| 44 | U1320F.18.3 | 27 | PHASE | KTY84 |
| 45 | U1320F.20.3 | 28 | PHASE | KTY84 |
| 46 | U1330F.15.3 | 36 | PHASE | KTY84 |
| 47 | U1330F.18.3 | 37 | PHASE | KTY84 |
| 48 | U1330F.20.3 | 38 | PHASE | KTY84 |
| 49 | S18-357 | 41 | SHENDA | KTY84 |
| 50 | S18-480 | 42 | SHENDA | KTY84 |
| 51 | S18-5103 | 43 | SHENDA | KTY84 |
| 52 | S18-6128 | 44 | SHENDA | KTY84 |
| 53 | S18-8186 | 45 | SHENDA | KTY84 |
| 54 | S25-4230 | 40 | SHENDA | KTY84 |

| Motor Selection No. | Motor Model | Motor Model Code | Brand | Winding Temperature Resistor Model |
|---|---|---|---|---|
| 55 | K130F22C18P | 90 | KINWAY | KTY84 |
| 56 | K135F25C25P | 91 | KINWAY | KTY84 |
| 57 | K341F18C25P | 30 | KINWAY | Pt1000 |
| 58 | K105F20C18P | 31 | KINWAY | Pt1000 |
| 59 | K122F23C25P | 92 | KINWAY | Pt1000 |
| 60 | K148F21C25P | 93 | KINWAY | Pt1000 |
| 61 | K148F23C25P | 94 | KINWAY | Pt1000 |
| 62 | K194F23C25P | 95 | KINWAY | Pt1000 |
| 63 | K224F23C25P | 96 | KINWAY | Pt1000 |
| 64 | K240F22C25P | 97 | KINWAY | Pt1000 |
| 65 | K290F18C25P | 99 | KINWAY | Pt1000 |
| 66 | K395F15C25P | 100 | KINWAY | Pt1000 |
| 67 | MM18-5R5B47 | 101 | KINWAY | Pt1000 |
| 68 | MM18-4R4B47 | 102 | KINWAY | Pt1000 |
| 69 | K156F20E25P | 58 | ANXIN | KTY84 |
| 70 | K235F20C25P | 78 | KINWAY | Pt1000 |
| 71 | U1315F.15.3 | 59 | PHASE | KTY84 |
| 72 | K078F20C18P | 79 | KINWAY | Pt1000 |
| 73 | K239F18C25P | 83 | KINWAY | Pt1000 |

Note: If the motor selected is not listed in above table, users can obtain relevant motor parameters by motor parameter autotuning. See *6. Motor parameter autotuning* for details.

3) Oil pump model list:

| Oil Pump Selection No. | Oil Pump Model | Oil Pump Displacement mL/r | Default Max Flow |
|---|---|---|---|
| 0 | PUMP 018 mL/r | 18 | 40 L/min |
| 1 | PUMP 025 mL/r | 25 | 55 L/min |
| 2 | PUMP 028 mL/r | 28 | 62 L/min |
| 3 | PUMP 031 mL/r | 31 | 68 L/min |
| 4 | PUMP 032 mL/r | 32 | 70 L/min |
| 5 | PUMP 036 mL/r | 36 | 79 L/min |
| 6 | PUMP 037 mL/r | 37 | 81 L/min |
| 7 | PUMP 040 mL/r | 40 | 88 L/min |
| 8 | PUMP 045 mL/r | 45 | 99 L/min |
| 9 | PUMP 050 mL/r | 50 | 110 L/min |
| 10 | PUMP 056 mL/r | 56 | 123 L/min |
| 11 | PUMP 062 mL/r | 62 | 136 L/min |

| Oil Pump Selection No. | Oil Pump Model | Oil Pump Displacement mL/r | Default Max Flow |
|---|---|---|---|
| 12 | PUMP 063 mL/r | 63 | 139 L/min |
| 13 | PUMP 064 mL/r | 64 | 141 L/min |
| 14 | PUMP 071 mL/r | 71 | 142 L/min |
| 15 | PUMP 075 mL/r | 75 | 150 L/min |
| 16 | PUMP 078 mL/r | 78 | 156 L/min |
| 17 | PUMP 080 mL/r | 80 | 160 L/min |
| 18 | PUMP 090 mL/r | 90 | 180 L/min |
| 19 | PUMP 100 mL/r | 100 | 200 L/min |
| 20 | PUMP 101 mL/r | 101 | 202 L/min |
| 21 | PUMP 120 mL/r | 120 | 240 L/min |
| 22 | PUMP 125 mL/r | 125 | 250 L/min |
| 23 | PUMP 130 mL/r | 130 | 260 L/min |
| 24 | PUMP 140 mL/r | 140 | 280 L/min |
| 25 | PUMP 150 mL/r | 150 | 300 L/min |
| 26 | PUMP 160 mL/r | 160 | 320 L/min |

Parameter table definition of setting mode is shown below:

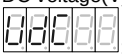
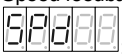
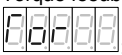
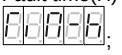
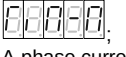
| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| F000 | Drive model selection | See drive model list above for details | The same with drive label | |
| F001 | Motor model selection | See motor model list above for details | U1013F.17.3 | |
| F002 | Pump model selection | See oil pump model list above for details | PUMP 100 mL/r | |
| F003 | Pressure feedback zero position calibration | 0: No calibration<br>1: Calibration | 0 | |
| F004 | Pressure calibration mode | 0: Linear pressure calibration<br>1: Polyline pressure calibration | 0 | |
| F005 | Flow calibration mode | 0: Linear flow calibration<br>1: Polyline flow calibration | 0 | |
| F006 | Pressure calibration | 0: No action<br>1: Linear zero position<br>2: Linear range<br>3: Polyline point 0<br>4: Polyline point 1<br>5: Polyline point 2 | 0 | During linear zero position or range calibration, if LED displays 0, it means |

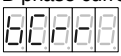
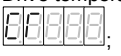
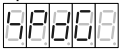
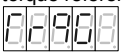
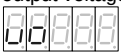
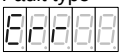
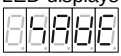
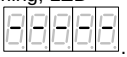
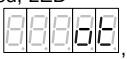
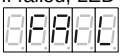
| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | 6: Polyline point 3<br>7: Polyline point 4<br>8: Polyline point 5<br>9: Polyline point 6<br>10: Polyline point 7<br>11: Polyline point 8<br>12: Polyline point 9<br>13: Polyline point 10<br>14: Polyline point 11<br>15: Polyline point 12 | | calibration is succeeded, otherwise, it is failed. For polyline calibration, if LED displays the original value after setup, it means calibration is succeeded, otherwise, it is failed |
| F007 | Flow calibration | 0: No action<br>1: Linear zero position<br>2: Linear range<br>3: Polyline point 0<br>4: Polyline point 1<br>5: Polyline point 2<br>6: Polyline point 3<br>7: Polyline point 4<br>8: Polyline point 5<br>9: Polyline point 6<br>10: Polyline point 7<br>11: Polyline point 8<br>12: Polyline point 9<br>13: Polyline point 10<br>14: Polyline point 11<br>15: Polyline point 12 | 0 | During linear zero position or range calibration, if the LED displays 0, it means calibration is succeeded, otherwise, it is failed. After polyline calibration, if LED displays the original value, it means calibration is succeeded, otherwise, it is failed. |
| F008 | Pressure filter | [1,32] | 6 | Moving average sampling times(1ms) |
| F009 | Flow filter | [1,32] | 6 | Moving average |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | | | sampling times(1ms) |
| F010 | Pressure full range<br>This value will set pressure full range and max pressure value simultaneously, and meanwhile, adjust the pressure reference gain to make the pressure reference correspond to the newly set pressure full range value when pressure reference input is 9.99V | [1,250] | 175 | bar |
| F011 | Flow full range<br>This value will set flow full range and max flow value simultaneously and meanwhile, adjust the flow reference gain to make the flow reference correspond to the newly set flow full range value when flow reference input is 9.99V | [1,2400] | 200 | L/min |
| F012 | Max pressure | [0,250] | 180 | bar |
| F013 | Max flow | [0,2400] | 220 | L/min |
| F014 | Speed proportional gain | [0,32767] | 7000 | |
| F015 | Speed integral gain | [0,32767] | 170 | |
| F016 | Pressure feedback gain | [0,32767] | 8182 | |
| F017 | Pressure reference rising slope | [0,32767] | 16000 | |
| F018 | Pressure reference declining slope | [0,32767] | 16000 | |
| F019 | Pressure proportional gain 0 | [0,32767] | 13000 | |
| F020 | Pressure integral gain 0 | [0,32767] | 100 | |
| F021 | Pressure differential gain 0 | [0,32767] | 0 | |
| F022 | Pressure proportional gain 1 | [0,32767] | 13000 | |
| F023 | Pressure integral gain 1 | [0,32767] | 100 | |
| F024 | Pressure differential gain 1 | [0,32767] | 0 | |
| F025 | Pressure proportional gain 2 | [0,32767] | 13000 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| F026 | Pressure integral gain 2 | [0,32767] | 100 | |
| F027 | Pressure differential gain 2 | [0,32767] | 0 | |
| F028 | Pressure proportional gain 3 | [0,32767] | 13000 | |
| F029 | Pressure integral gain 3 | [0,32767] | 100 | |
| F030 | Pressure differential gain 3 | [0,32767] | 0 | |
| F031 | Pump displacement | [0,32767] | 100 | mL/r |
| F032 | Pump leakage | [0,1.00] | 0 | L/min/bar |
| F033 | Max pump reverse speed | [0,-6000] | -300 | rpm |
| F034 | Max motor speed | [0,6000] | 2200 | rpm |
| F035 | DC voltage calibration | [0,800](fine tuning only) | DC voltage when entering the menu | V |
| F036 | AC voltage calibration | [0,800](fine tuning only) | AC voltage when entering the menu | V |
| F037 | Base flow enable | 0: no base flow<br>1: with base flow | 0 | |
| F038 | Base flow pressure | [0,250.0] | 3 | bar |
| F039 | Flow of base flow | [0,327.67] | 0.95 | L/Min |
| F040 | Overshoot limit value | [5,50] | 30 | bar |
| F041 | Motor rotation direction | 0: Forward<br>1: Reverse | 0 | |
| F042 | Resolver direction | 0: Forward<br>1: Reverse | 0 | |
| F043 | Backpressure mode | 0: Manual<br>1: Automatic | 0 | |
| F044 | Pressure sensor model selection | 5V<br>10V<br>400bar | 10V | |
| F045 | Plunger pump model selection | 0: Single displacement<br>1: Dual displacement | 0 | |
| F046 | Plunger pump displacement ratio | [0,100.0] | 20 | % |
| F047 | Wobble plate switching pressure threshold | [0,250.0] | 195 | bar |
| F048 | Displacement pressure judging delay | [0,32767] | 100 | ms |
| F049 | DA1 | 0: Pressure reference | 1 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | 1: Pressure feedback<br>2: Flow reference<br>3: Flow feedback<br>4: Speed reference<br>5: Speed feedback<br>6: Torque reference<br>7: Torque feedback<br>8: Resolver feedback<br>9: DC voltage<br>10: Phase current<br>11: Fault word 1<br>12: Fault word 2<br>13: Communication command | | |
| F050 | DA1 max value | [-32767,32767] | 32767 | |
| F051 | DA1 min value | [-32767,32767] | 0 | |
| F052 | DA2 | 0: Pressure reference<br>1: Pressure feedback<br>2: Flow reference<br>3: Flow feedback<br>4: Speed reference<br>5: Speed feedback<br>6: Torque reference<br>7: Torque feedback<br>8: Resolver feedback<br>9: DC voltage<br>10: Phase current<br>11: Fault word 1<br>12: Fault word 2<br>13: Communication command | 5 | |
| F053 | DA2 max value | [-32767,32767] | 16384 | |
| F054 | DA2 min value | [-32767,32767] | -16384 | |
| F055 | DA output value | [-32767, 32767] | 0 | |
| F056 | Wobble plate switching rising delay | [0, 32767] | 10 | ms |
| F057 | Wobble plate switching declining delay | [0, 32767] | 10 | ms |
| F058 | Upper limit of speed switching | [0, 6000] | 1200 | rpm |
| F059 | Lower limit of speed switching | [0, 6000] | 200 | rpm |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| F060 | Flow reference zero position deadzone | [0.00, 100.00] | 0.5 | % |
| F061 | Pressure reference zero position deadzone | [0.00, 100.00] | 0.5 | % |
| F062 | Pressure feedback zero position deadzone | [0.00, 100.00] | 0 | % |
| F063 | OUT2 connection pressure coefficient | [0.00, 100.00] | 90 | % |
| F064 | Negative torque suppression control | 0: Disable 1: Enable | 0 | |
| F065 | Displacement switching mode | 0: Overpressure<br>1: Overpressure during holding pressure | 0 | |
| F066 | Restore default parameters | 0: Disable 1: Restore | 0 | |
| F067 | Check fault record (display fault code) | 1: Fault 1<br>2: Fault 2<br>3: Fault 3<br>4: Fault 4<br>5: Fault 5<br>After entering, it displays the last fault occurred (no. is 1).<br>Press ◀ key to display the last but one fault (no. is 2), press ▲ to display in order the following information when fault occurred:<br>DC voltage(V)<br>  ;<br>Speed feedback(rpm)<br>  ;<br>Torque feedback(Nm)<br>  ;<br>Fault time(H)<br>  ;<br>Fault time(m)<br>  ;<br>A phase current (Apk)<br>  ; | | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | B phase current (Apk)  ; Motor current(A)  ; Drive temperature (°C)  ; Motor temperature (°C)  ; Speed reference (rpm)  ; torque reference (Nm)  ; output voltage (V)  ; Fault type  . | | |
| F068 | Parameter programming | Parameter programming After pressing SET key, LED displays  , press SET key to start parameter programming, LED displays  . If programming is succeeded, LED displays  , if failed, LED displays  . | | |
| F069 | Keypad unlock password | [0,99999] | 00000 | |
| F070 | Rated motor voltage | [0,800] | 334 | V |
| F071 | Rated motor current | [0,900] | 64 | A |
| F072 | Rated motor speed | [0,6000] | 1467 | rpm |
| F073 | Rated motor frequency | [0,600] | 97.8 | Hz |
| F074 | Motor counter-emf | [0.0,800.0] | 183.1 | V/Krpm |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| F075 | Motor temperature sensor | 0: NTC<br>1: PTC<br>2: KTY84<br>3: PT1000 | 2 | |
| F076 | Reserved | | | |
| F077 | Reserved | | | |
| F078 | Reserved | | | |
| F079 | Pressure sensor range | [0,250.0] | 250 | bar |
| F080 | Pressure feedback fine-turning coefficient | [50,200] | 100 | % |
| F081 | Min value of flow reference | [0,2400.0] | 0 | L/min |
| F082 | Over-modulation enable | [0,1] | 0 | 1: Enable |
| F083 | Over-modulation ratio | [100,115] | 105 | % |
| F084 | Carrier frequency | [4k,5k,8k,10k,3k,2k] | 3k | Hz |
| F085 | Overload protection mode | [0: Current limit mode,<br>1: It protection mode, 2,<br>3: Reserved] | 0 | |
| F086 | Bus overvoltage protection@ | [0,1000] | 750 | V |
| F087 | Bus overvoltage protection @ time | [0,30000] | 20 | 5ms |
| F088 | Bus overvoltage protection | [0,1000] | 780 | V |
| F089 | Bus undervoltage protection@ | [0,1000] | 380 | V |
| F090 | Bus undervoltage protection @ time | [0,30000] | 150 | 5ms |
| F091 | Bus undervoltage protection | [0,1000] | 320 | V |
| F092 | Bus undervoltage protection during enable | [0,1000] | 315 | V |
| F093 | AC overvoltage protection@ | [0,1000] | 487 | V |
| F094 | AC overvoltage protection @ time | [0,30000] | 40 | 5ms |
| F095 | AC overvoltage | [0,1000] | 495 | V |
| F096 | AC undervoltage protection@ | [0,1000] | 290 | V |
| F097 | AC undervoltage protection @ time | [0,30000] | 100 | 5ms |
| F098 | AC undervoltage | [0,1000] | 0 | V |
| F099 | Time of power-on overtime | [0,30000] | 2000 | 5ms |
| F100 | Motor protection temperature | [0,500] | 125 | °C |
| F101 | Module protection temperature | [0,500] | 86 | °C |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| F102 | Air protection temperature | [0,500] | 400 | °C |
| F103 | Overcurrent protection value | [0,900] | 4R4→50<br>5R5→70<br>7R5→95<br>011→105<br>015→120<br>018→180<br>025→220<br>030→260<br>037→360<br>045→440<br>055→480<br>075→530 | A |
| F104 | Forward speed protection value | [0,6000] | 2700 | rpm |
| F105 | Reverse speed protection value | [-6000,0] | -2700 | rpm |
| F106 | Overpressure protection value | [0,250] | 195 | bar |
| F107 | Pressure sensor fault value | [0,32767] | 0 | |
| F108 | ACDC sampling error voltage | [0,800] | 80 | V |
| F109 | Brake resistor heating factor | [0,500] | 4R4→35<br>5R5→35<br>7R5→35<br>011→35<br>015→69<br>018→69<br>025→69<br>030→40<br>037→40<br>045→40<br>055→40<br>075→0 | |
| F110 | Brake resistor cooling factor | [0,500] | 1 | |
| F111 | Brake resistor overload threshold | [0,30000] | 4R4→374<br>5R5→374<br>7R5→374<br>011→374<br>015→374<br>018→374<br>025→374 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | | 030→292<br>037→292<br>045→292<br>055→292<br>075→374 | |
| F112 | Motor short-circuit protection value | [0,900] | 10 | A |
| F113 | Phase loss protection selection | 0: Disable 1: Enable | 1 | |
| F114 | Rectification overload protection selection | 0: Disable<br>1: Enable | Disable | |
| F115 | Speed feedback filter mode | 0: Moving average;1: Least squares;<br>Effective only after re-power on | 0 | |
| F116 | Speed proportional gain1 | [0,32767] | 7000 | |
| F117 | Speed integral gain 1 | [0,32767] | 170 | |
| F118 | Speed gain switching speed 0 | [0,6000] | 5994 | rpm |
| F119 | Speed gain switching speed 1 | [0,6000] | 5994 | rpm |
| F120 | Speed control rigidness | [1,14] | 9 | |
| F121 | Motor inertia | [0,0.655] | 0.018 | Kgm2 |
| F122 | Motor torque coefficient | [0,100.00] | 2.6 | Nm/Arms |
| F123 | Motor autotuning direction | 0: Forward;1: Reverse | 0 | |
| F124 | Rated drive power | [0.00,327.67] | 4R4→4.40<br>5R5→5.50<br>7R5→7.50<br>011→11.00<br>015→15.00<br>018→18.00<br>025→25.00<br>030→30.00<br>037→37.00<br>045→45.00<br>055→55.00<br>075→75.00 | kW |
| F125 | Rated drive current | [0,900] | 4R4→18.4<br>5R5→25.5<br>7R5→31.1<br>011→36.8<br>015→42.4 | A |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | | 018→53.8<br>025→70.7<br>030→90.5<br>037→113.1<br>045→140.0<br>055→173.9<br>075→220.6 | |
| F126 | Torque limit | [0,1800] | 425 | Nm |
| F127 | Disturbance compensation gain | [0,200] | 0 | % |
| F128 | Disturbance compensation filter frequency | [0,5000] | 500 | Hz |
| F129 | Disturbance compensation lag cycle | [0,15] | 5 | Cycle (speed loop cycle) |
| F130 | Overspeed protection time | [0,5000] | 100 | ms |
| F131 | Flow reference rising slope | [0,32767] | 16000 | |
| F132 | Flow reference declining slope | [0,32767] | 16000 | |
| F133 | Brake resistor fault detection | 0: Disable<br>1: Enable | 1 | |
| F134 | PWM voltage compensation | 0: Disable<br>1: Enable | 0 | |
| F135 | Pump stuck detection | 0: Disable<br>1: Enable | 1 | |
| F136 | Oil circuit pressure discharge mode | 0: Normal oil circuit<br>1: Valve pressure discharge oil circuit | 0 | |
| F137 | Upper limit of reverse torque | [0,100] | 100 | % |
| F138 | Speed integral torque boost | [0,1000] | 0 | % |
| F139 | Speed multi-step PI enable | 0: Disable<br>1: Enable | 0 | |
| F140 | Pressure multi-step PI enable | 0: Disable<br>1: Enable | 0 | |
| F141 | Speed multi-step proportion 1 | [0,32767] | 7000 | |
| F142 | Speed multi-step integral 1 | [0,32767] | 140 | |
| F143 | Speed multi-step proportion 2 | [0,32767] | 7000 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| F144 | Speed multi-step integral 2 | [0,32767] | 140 | |
| F145 | Speed multi-step proportion 3 | [0,32767] | 7000 | |
| F146 | Speed multi-step integral 3 | [0,32767] | 140 | |
| F147 | Starting speed of valve pressure discharge | [-300,300] | 0.9 | rpm |
| F148 | Starting pressure of valve pressure discharge | [0,250] | 20 | bar |
| F149 | Closing pressure of valve pressure discharge | [0,250] | 0.5 | bar |
| F150 | Cut-in speed of pressure-hold feedforward | [-6000,6000] | 100 | Rpm |
| F151 | Cut-in pressure of pressure-hold feedforward | [0,250] | 0.8 | bar |
| F152 | Pressure-hold gain | [0,32767] | 0 | |
| F153 | Pressure full range voltage | [0,1100] | 1000 | 0.01V |
| F154 | Flow full range voltage | [0,1100] | 1000 | 0.01V |
| F155 | Resolver fault detection | 0: Disable<br>1: Enable | 1 | |
| F156 | PID terminal usage mode | 0: Commonly used<br>1: Specific for casting machine | 0 | |
| F157 | ALM_RST input selection | 0: No function<br>1: Fault reset<br>2: Drive enable<br>3: Shunt/converging selection<br>4: Storing signal input<br>5: Motor rotation direction<br>6: PID terminal 1<br>7: PID terminal 2<br>8: PID terminal 3<br>9: PID terminal 4<br>10: Trigger mode selection<br>11: Swash plate control enable(used when | 1 | |
| F158 | S_ON input selection | | 2 | |
| F159 | I1 input selection | | 3 | |
| F160 | I2 input selection | | 4 | |
| F161 | I3 input selection | | 6 | |
| F162 | I4 input selection | | 7 | |
| F163 | Reserved | | 0 | |
| F164 | Reserved | | 0 | |
| F165 | Reserved | | 0 | |
| F166 | Reserved | | 0 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | swash plate is controlled by overpressure mode during holding pressure)<br>12: Swash plate switching command<br>13: Pressure flow control selection signal<br>14: Following unit enable<br>15 – 63: Reserved | | |
| F167 | S_RDY output selection | 0: No function<br>1: Servo ready<br>2: Alarm output<br>3: I2 terminal state<br>4: Swash plate control output<br>5: Oil pressure reaches output<br>6: Valve pressure discharge output<br>7 – 63: Reserved | 1 | |
| F168 | ALM output selection | | 2 | |
| F169 | Reserved | | 0 | |
| F170 | O1 output selection | | 4 | |
| F171 | O2 output selection | | 5 | |

※ See 5.3.2 and 5.3.5 for parameter instructions.

### 5.5.6 Commissioning Mode

When pressing MODE key to select “commissioning mode”, LED panel will display “h--xx”, in which xx is parameter identifier. Press ▲ or ▼ to select the parameter identifier to be set, after selection, press SET key, and LED panel will display corresponding parameter value. Wen modifying parameter values, users can change the flickering bit by ◀, and modify the value of the flickering bit via ▲ or ▼ key. After modification, press SET key to save the modified value and stop the flickering, then press SET or ▲▼ key again to re-modify the parameter value, and the bit can be modified will flicker. Press MODE key to exit.

※ Under commissioning mode, if there is no button operation within 4m, the system will switch to speed and fault display interface automatically.

Parameter table definition of setup mode is shown below:

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| H00 | Operation enable | 0: Disable<br>1: Enable | Related to the drive enable IO level | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| H01 | Diagnosis enable | 0: Disable<br>1: Enable | 0 | |
| H02 | Diagnosis content (effective only when diagnosis enable is turned on) | 0: No action<br>1: Measure initial angle<br>2: Jogging enable<br>3 – 5: Invalid<br>6: Drive test | 0 | |
| H03 | Jogging (effective only when diagnosis enable is turned on) | ▲: Forward<br>▼: Reverse | | |
| H04 | Control mode | 3: Speed mode<br>4: Process mode | 4 | |
| H05 | Speed reference (control mode is: speed mode valid) | Related to motor model | 0 | rpm |
| H06 | Process command mode | Digital input,<br>Analog input,<br>CAN continuous,<br>485 continuous,<br>CANopen input,<br>EtherCAT input,<br>Internal reference | 1 | |
| H07 | Flow reference (process command mode is communication input) | [0, max flow] | 0 | l/m |
| H08 | Pressure reference (process command mode is communication input) | [0, max pressure] | 0 | kg |
| H09 | Max jogging speed | The max motor speed when ▲ and ▼keys are pressed, [0,100] | | rpm |
| H10 | Resolver offset quantity | [0,4095] | 0 | |
| H11 | Motor parameter autotuning (effective only when diagnosis enable is turned on) | 0: Disable<br>1: Dynamic<br>2: Static | 0 | |
| H12 | Advanced parameter operation enable | 11111: Disable<br>99999: Enable<br>Other value: No action | 00000 | |
| H13 | Fault clear | 0: No action 1: Clear | 0 | |
| H14 | Internal flow reference 0 | [0, 100.0] | 0 | % |
| H15 | Internal flow reference 1 | [0, 100.0] | 0 | % |
| H16 | Internal flow reference 2 | [0, 100.0] | 0 | % |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| H17 | Internal flow reference 3 | [0, 100.0] | 0 | % |
| H18 | Internal flow reference 4 | [0, 100.0] | 0 | % |
| H19 | Internal flow reference 5 | [0, 100.0] | 0 | % |
| H20 | Internal flow reference 6 | [0, 100.0] | 0 | % |
| H21 | Internal flow reference 7 | [0, 100.0] | 0 | % |
| H22 | Internal pressure reference 0 | [0, 100.0] | 0 | % |
| H23 | Internal pressure reference 1 | [0, 100.0] | 0 | % |
| H24 | Internal pressure reference 2 | [0, 100.0] | 0 | % |
| H25 | Internal pressure reference 3 | [0, 100.0] | 0 | % |
| H26 | Internal pressure reference 4 | [0, 100.0] | 0 | % |
| H27 | Internal pressure reference 5 | [0, 100.0] | 0 | % |
| H28 | Internal pressure reference 6 | [0, 100.0] | 0 | % |
| H29 | Internal pressure reference 7 | [0, 100.0] | 0 | % |

※ See *5.3.3* for parameter instructions

### 5.5.7 Multi-pump Mode

When pressing MODE key to select “multi-pump mode”, LED panel will display “p--xx”, in which xx is parameter identifier. Press ▲ or ▼ to select the parameter identifier to be set, after selection, press SET key, and LED panel will display corresponding parameter value. Wen modifying parameter values, users can change the flickering bit by ◀, and modify the value of the flickering bit via ▲ or ▼ key. After modification, press SET key to save the modified value and stop the flickering, then press SET or ▲▼ key again to re-modify the parameter value, and the bit can be modified will flicker. Press MODE key to exit.

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| P00 | Network enable | 0: Disable<br>1: Enable | 0 | |
| P01 | Drive enable on the network | 0: Disable<br>1: Enable | Related to drive enable IO level | |
| P02 | Converging type | 0: Single pump<br>1: Composite<br>2: Multi-pump<br>3: Multi-mode | 0 | |
| P03 | Node number | [0,15] | 0 | |
| P04 | Slave node number | [0,15] | 0 | |
| P05 | Node type | 0: Independent unit | 0 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| | | 1: Control unit<br>2: Following unit<br>3: Flow loop unit | | |
| P06 | Flow cut-in threshold | [0,100.0] | 25 | % |
| P07 | Upper limit of flow cut-in hysteresis | [0,100.0] | 5 | % |
| P08 | Lower limit of flow cut-in hysteresis | [0,100.0] | 2.5 | % |
| P09 | Multi-pump pressure proportional gain 0 | [0,32767] | 8000 | |
| P10 | Multi-pump pressure integral gain 0 | [0,32767] | 88 | |
| P11 | Multi-pump pressure differential gain 0 | [0,32767] | 0 | |
| P12 | Multi-pump pressure proportional gain 1 | [0,32767] | 8000 | |
| P13 | Multi-pump pressure integral gain 1 | [0,32767] | 88 | |
| P14 | Multi-pump pressure differential gain 1 | [0,32767] | 0 | |
| P15 | Multi-pump pressure proportional gain 2 | [0,32767] | 8000 | |
| P16 | Multi-pump pressure integral gain 2 | [0,32767] | 88 | |
| P17 | Multi-pump pressure differential gain 2 | [0,32767] | 0 | |
| P18 | Multi-pump pressure proportional gain 3 | [0,32767] | 8000 | |
| P19 | Multi-pump pressure integral gain 3 | [0,32767] | 88 | |
| P20 | Multi-pump pressure differential gain 3 | [0,32767] | 0 | |
| P21 | ECAT synchronization mode | 0: Free operation<br>1: Sync manager interruption<br>2: Sync clock | 0 | |
| P22 | ECAT synchronization time | 0: 500us<br>1: 1ms<br>2: 2ms<br>3: 4ms | 1 | |
| P23 | 485 local communication address | [1,255] | 10 | |
| P24 | 485 communication check mode | 0: (N,8,1)<br>1: (E,8,1)<br>2: (O,8,1)<br>3: (N,8,2)<br>4: (E,8,2)<br>5: (O,8,2) | 0 | N: No check bit;<br>E: Even parity;<br>O: Odd parity;<br>8-bit data;<br>1/2-bit stop bit; |
| P25 | 485 communication baud rate selection | 0: 9600bps<br>1: 19200bps<br>2: 38400bps<br>3: 57600bps<br>4: 115200bps | 1 | |

| Code | Definition and Instruction | Parameter Range | Default Value | Unit |
|---|---|---|---|---|
| P26 | CANOpen communication node number | [1,127] | 32 | |
| P27 | CANOpen communication baud rate | 0: 1000kbps<br>1: 500kbps<br>2: 250kbps<br>3: 125kbps<br>4: 50kbps<br>5: 20kbps | 1 | |

※ See *5.3.4* for parameter instructions.

# Chapter 6 Motor Parameter Autotuning

There are two kinds of motor parameter autotuning mode: static and dynamic.

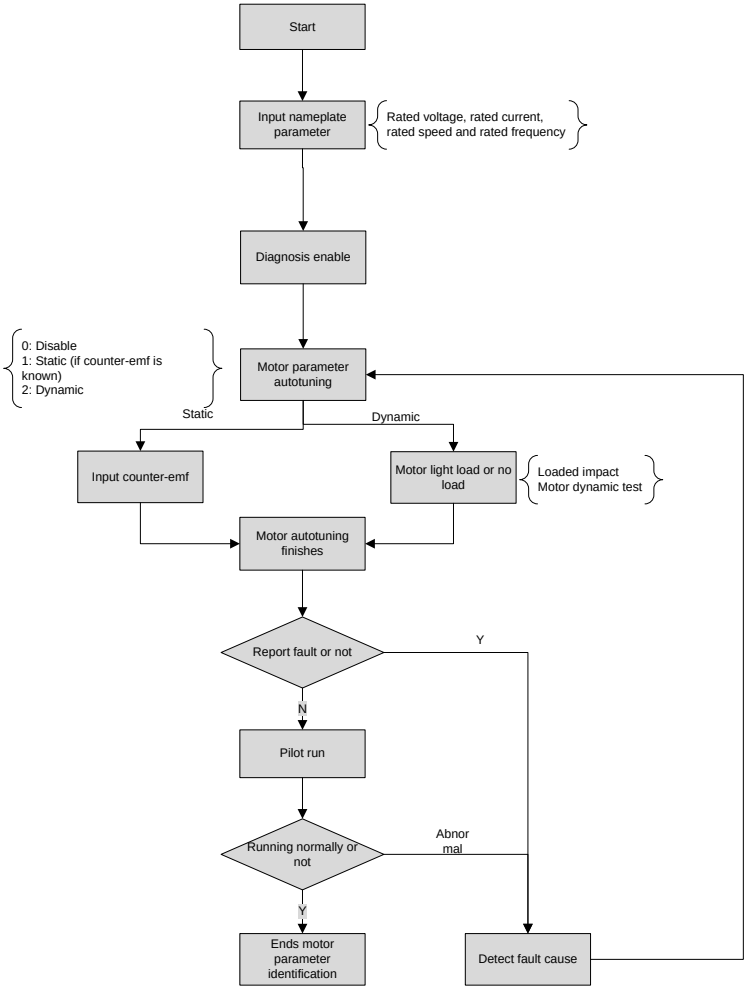
Static mode: the motor parameter value is calculated based on motor voltage equation by motor nameplate parameters, namely resistor, inductance and flux linkage. Therefore, the precision of motor parameter is based on the accuracy of nameplate parameters.

Dynamic mode: It is necessary to rotate the motor to a certain speed, the large load may impact the precision of the motor parameter test, therefore, no-load or light-load of motor is required during test.

Motor nameplate parameter and parameter autotuning mode:

| | | | |
|---|---|---|---|
| F70 | Rated motor voltage | [0,800] | V |
| F71 | Rated motor current | [0,900] | A |
| F72 | Rated motor speed | [0,6000] | rpm |
| F73 | Rated motor frequency | [0,600] | HZ |
| F74 | Motor counter-emf | [0.0,800.0] | V/Krpm |
| E12 | Diagnosis enable | 0: Disable<br>1: Enable | |
| E14 | Motor parameter autotuning (effective only after diagnosis enable is started) | 0: Disable<br>1: Static<br>2: Dynamic | |

Motor parameter autotuning test flowchart:

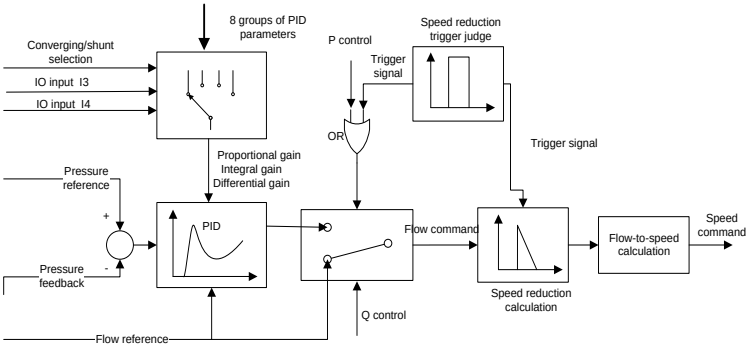


# Chapter 7 Oil Pump Control

## 7.1 Oil Pump Control Mode Overview

Servo drive oil pump control mode is to change the AC servo motor speed based on the pressure inputted from external control system, flow command and feedback signal of pressure sensor, thus controlling the output pressure and flow of the oil pump. The pressure control forms a closed-loop PID control through the pressure sensor signal installed on the oil outlet port of the oil pump, while the flow control changes the flow discharged by the pump through controlling pump speed.

The basic schematic for oil pump is as below:




## 7.2 Common Pressure Priority Control (P Control)

The oil pump performs flow control when the feedback pressure fails to reach the reference pressure to make sure the output flow of the pump can change with the flow reference quickly and accurately. The output flow of the pump is in positive proportion to the motor speed, therefore the motor speed command is determined by the flow reference. When entering pressure control, it is required the pressure feedback of the system can change with the pressure reference quickly and accurately, while pressure feedback changes with the motor speed, thus the motor speed command is determined by pressure PID regulator.

In actual hydraulic pressure system, the oil pump control needs to switch between two kinds of control frequently, which requiring small pressure overshoot, quick switching speed and small vibration during switching. Users can optimize flow control, pressure control and switching control via adjusting speed proportional gain, speed integral gain, pressure proportional gain, pressure integral gain and pressure differential gain.

Commissioning parameter table for pressure priority control:

| LED Display Code | Parameter Name | Function Instruction | Initial Value |
|---|---|---|---|
| F14 | Speed proportional gain | Increase speed proportional gain can improve the transient response of motor speed control, improve motor speed stability and control the | When selecting different |

| LED Display Code | Parameter Name | Function Instruction | Initial Value |
|---|---|---|---|
| | | interference; however, if it is set to a too large value, vibration may occur. | pumps |
| F15 | Speed integral gain | Increase speed integral gain can reduce speed regulation deviation and control overshoot; however, if it is set to a too large value, vibration may occur. | |
| F19, F22 F25, F28 | Pressure proportional gain 0_3 | Increase pressure proportional gain can improve the transient response and stability of pressure control, control the interference and reduce pressure overshoot; however, if it is set to a too large value, vibration may occur. | 13000 |
| P09, P12 P15, P18 | Multi-pump pressure proportional gain 0-3 | | 8000 |
| F20, F23 F26, F29 | Pressure integral gain 0-3 | Increase pressure integral gain can improve response speed of pressure control, reduce pressure control deviation, however, it will also increase pressure overshoot. If it is set to a too large value, vibration may occur. | 100 |
| P10, P13 P16, P19 | Multi-pump pressure integral gain 0-3 | | 88 |
| F21, F24 F27, F30 | Pressure differential gain 0-3 | The larger the differential value, the smaller the overshoot during switching to pressure control; however, if it is set to a too large value, the voltage regulation deviation characteristic will be deteriorated and vibration may occur. | 0 |
| P11, P14 P17, P20 | Multiple pressure differential gain 0-3 | | 0 |

## 7.3 Flow Priority Control (Q Control)

In cases where pressure reference is low, the rising speed of flow command will be impacted by pressure reference, in the meantime, during flow control; the pressure feedback will also make an impact on the flow command when it rises quickly to a value close to the reference pressure. Flow priority control can be applied in cases where it is required that the flow command should not be impacted by the pressure reference and pressure feedback during flow control. During flow control, flow reference acts as the flow command of the system, the condition for flow control to be switched to pressure control can be changed via parameters, during switching, users can reduce pressure overshoot via pressure trigger control.

※ The default setting of the drive is pressure priority control, while the flow priority control can be commissioned only by the SCM of the PC of our company.

Commissioning parameter table of flow priority control:

| Parameter Name | Function Instruction | Initial Value | Unit |
|---|---|---|---|
| Control mode | P mode is pressure control priority mode, Q mode is flow control priority mode | P control | |
| Trigger | When switching from flow control to pressure control, the | 200 | rpm |

| Parameter Name | Function Instruction | Initial Value | Unit |
|---|---|---|---|
| integral value | pressure trigger controls the set motor speed. | | |
| Trigger mode | Set whether to use pressure trigger control function when switching from flow control to pressure control. | No trigger | |
| Pressure differential trigger threshold | The pressure rising speed condition for entering pressure trigger state | 10 | bar\ms |
| Enter trigger coefficient 1 | The upper limit of the ratio between feedback pressure and reference pressure when entering pressure trigger state | 90 | % |
| Enter trigger coefficient 2 | The lower limit of the gap between reference pressure and feedback pressure when entering pressure trigger state | 10 | bar |
| Exit trigger coefficient 1 | The lower limit of the ratio between feedback pressure and reference pressure when exiting pressure trigger state | 80 | % |
| Exit trigger coefficient 2 | The upper limit of the gap between the reference pressure and feedback pressure when exiting pressure trigger state | 15 | bar |

## 7.4 Dual-Displacement Pump Control

Dual-displacement plunger pump can switch between big/small swash plates by switching on/off the coil, thus changing the displacement of the pump. Big swash plate dig angle is used in large flow output demand while small swash plate dip angle is used in small pressure output or pressure-hold, thus improving pressure control performance and reducing energy consumption. There are two control modes for the dual-displacement pump swash plate switching: over-pressure switching, hold pressure/over-pressure switching.

Over-pressure switching mode: When the system feedback pressure is larger than the displacement switching pressure threshold and the motor speed is smaller than the lower limit of switching speed, switch to small swash plate dig angle; when the motor speed is larger than the displacement switching speed, switch to big swash plate dip angle.

Over-pressure switching mode during holding pressure: Connect the injection input signal of upper control system to the digital input signal I6 (CN3-12) of the drive, if the input is high, it means the injection molding machine is working in injection pressure-hold state, and if in the meantime, the feedback pressure reaches pressure reference value or exceeds displacement switching pressure threshold and the motor speed is less than the lower limit of the displacement switching speed, switch to small swash plate dig angle; if the motor speed exceeds the upper limit of displacement switching speed or digital input signal I6 input is low, switch to big swash plate dip angle.

When switching to small swash plate dip angle, the drive will compensate the motor speed command according to the displacement ratio to keep the oil output flow constant.

Commissioning parameter table for dual-displacement pump control:

| LED Display | Parameter | Function Instruction | Initial Value | Unit |
|---|---|---|---|---|

| Code | Name | | | |
|---|---|---|---|---|
| F45 | Plunger pump model selection | Plunger pump model selection | 0: Single displacement | 0: Single displacement<br>1: Dual displacement |
| F46 | Plunger pump displacement ratio | Displacement ratio between small swash plate dig angle and big swash plate dip angle | 30 | % |
| F47 | Wobble plate pressure switching threshold | The feedback pressure threshold when the system switches to small swash plate dip angle | 195 | bar |
| F48 | Wobble plate pressure judging delay | The continuous time condition for the feedback pressure to be larger than wobble plate pressure switching threshold when switching to small swash plate dip angle. | 100 | ms |
| F56 | Wobble plate switching rising delay | Speed compensation delay when big swash plate dip angle switches to small swash plate dip angle | 10 | ms |
| F57 | Wobble plate switching declining delay | Speed compensation delay when big swash plate dip angle switches to big swash plate dip angle | 10 | ms |
| F58 | Upper limit of speed switching | Motor speed threshold when switching to big swash plate dip angle | 1200 | rpm |
| F59 | Lower limit of speed switching | Motor speed threshold when switching to small swash plate dip angle | 200 | rpm |
| F65 | Displacement switching mode | 0: Over-pressure<br>1: Over-pressure during pressure-hold | 0: Over-pressure | |

# Chapter 8 Multi-pump Parallel Control

The hydraulic-pressure control of the injection molding machine with large tonnage is limited by the oil pump displacement or motor power, therefore, the single pump system is far from satisfying the flow demands, it is a must to connect in parallel the oil outlets of multiple single pump systems to realize converging and obtain large flow. In converging system, in order to improve productivity and shorten the process cycle, it is necessary to complete two or more actions at the same time, which requires the hydraulic pressure system carrying single circuit to be divided into dual-circuit or three-circuit hydraulic system that can be controlled separately, and each circuit can perform flow and pressure control independently during shunt control, while during converging control, pressure control and system total flow control is performed by only one main drive, and other drives converts to the flow command of each circuit via flow distribution calculation based on the system total flow command of the main drive. The system total output flow is the flow sum of the oil pump output of each circuit system.

## 8.1 Multi-pump Mode

When the converging type of each node (single pump system) is set to multi-pump, each node can work in converging control only. The main node is used to receive the pressure and flow reference and running enable signal of the upper control system as well as the pressure sensor signal of the system oil outlet port, then carry out pressure and system total flow control. The slave node converts to speed command to perform speed control based on the system total flow command sent by CAN communication according to below flow distribution algorithm.

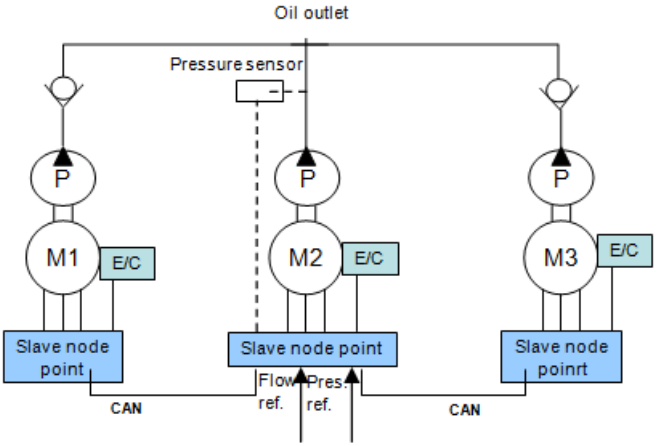
The flow distribution mode when converging type is multi-pump or composite:

Each node has its own max private flow, namely the max flow that can be withstood by the node alone.

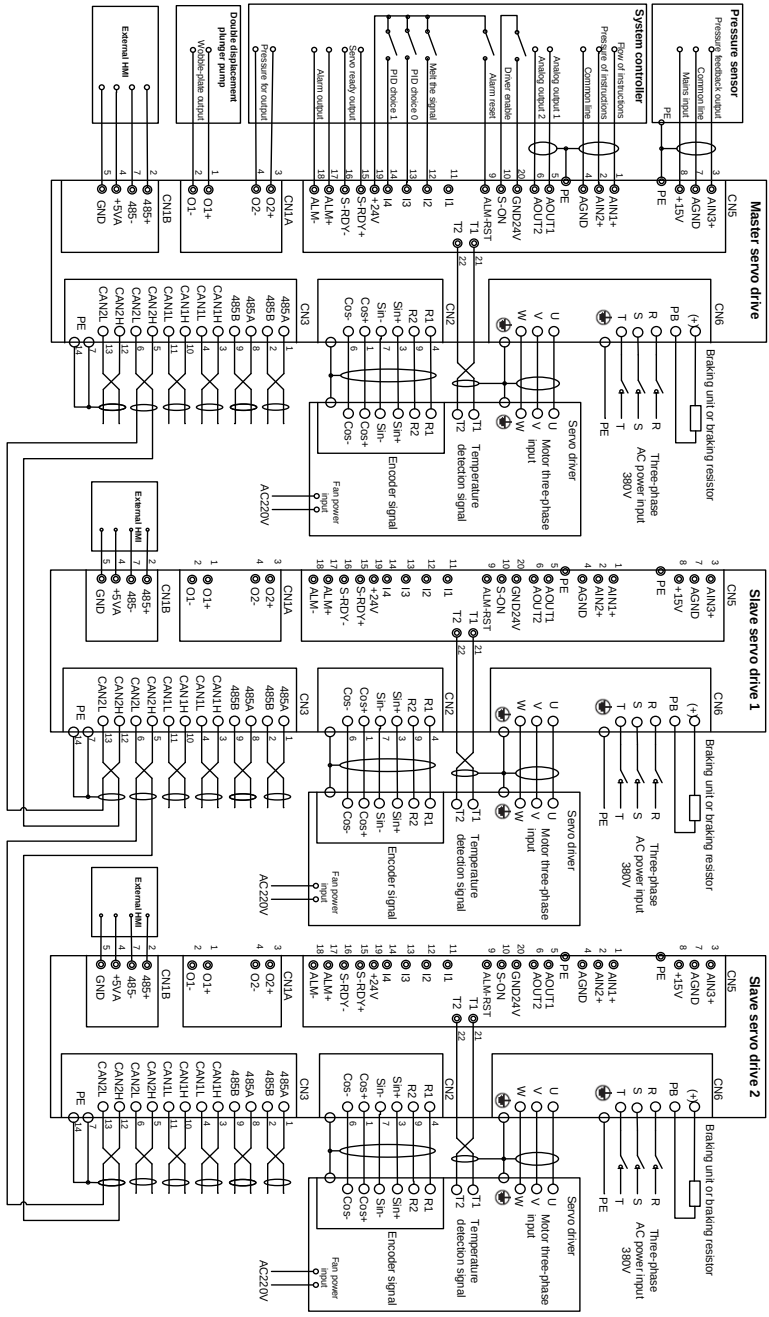
**Max private flow=max node flow*flow cut-in threshold ratio**

For total flow command of reference system, if it is less than the max private flow of main pump 0, the main pump 0 bears all the system flow needs; if it is larger than that of the main pump 0, main pump 0 provides its max private flow while the residual flow is provided by the slave pump; when the residual flow needs is less than the max private flow of slave pump 1, the slave pump 1 bears all the residual flow; when it is larger than that of the slave pump 1, slave pump 1 provides its max private flow, and the residual flow needs will be provided by the slave pump, continue by that analogy until the residual energy is fully consumed by the remaining slave pumps. If the max private flow of the last slave pump is less than the residual flow, namely the max private flow sum of all the pumps cannot fully consume the system flow needs, the system flow needs will be distributed evenly (based on the ratio) to all the pumps.

1) System diagram of multi-pump mode:



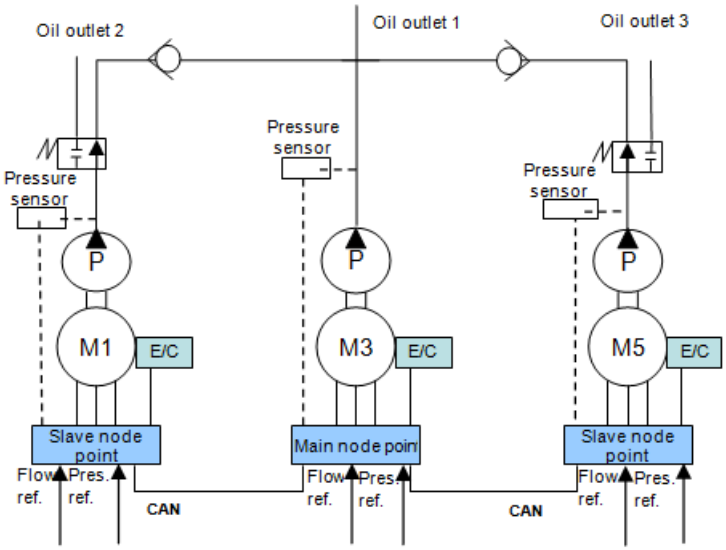

2) Multi-pump wiring diagram:


Pressure sensor
Pressure feedback output
Common line
Mates input
PE
System controller
Flow of instructions
Pressure of instructions
Common line
Analog output 1
Analog output 2
Common line
Driver enable
Alarm reset
Melt the signal
PID choice 0
PID choice 1
Servo ready output
Alarm output
Double displacement plunger pump
Wobble-plate output
Pressure for output
External HMI
Master servo drive
Slave servo drive 1
Slave servo drive 2
CN5
CN6
CN1A
CN1B
CN2
CN3
AIN3+
AGND
+15V
PE
AIN1+
AIN2+
AGND
PE
AOUT1
AOUT2
GND24V
S-ON
ALM-RST
I1
I2
I3
I4
+24V
S-RDY+
S-RDY-
ALM+
ALM-
O2+
O2-
O1+
O1-
485+
485-
+5VA
GND
Braking unit or braking resistor
Three-phase AC power input 380V
Servo driver
Motor three-phase input
Temperature detection signal
Encoder signal
Fan power input
AC220V
CAN1H
CAN1L
CAN2H
CAN2L
485A
485B

## 8.2 Composite Mode

The system has two kinds of control modes, namely converging and shunt. The control mode of each node can be switched by digital input I1 (C/D). In shunt mode, each node acts as the single-circuit hydraulic pressure system to complete flow and pressure control, while for converging mode, which is the same as multi-pump mode, the main node completes pressure control and system total flow control, and the slave node converts to speed command based on the system total flow command sent by CAN communication according to above flow distribution algorithm.

1) System diagram for composite mode



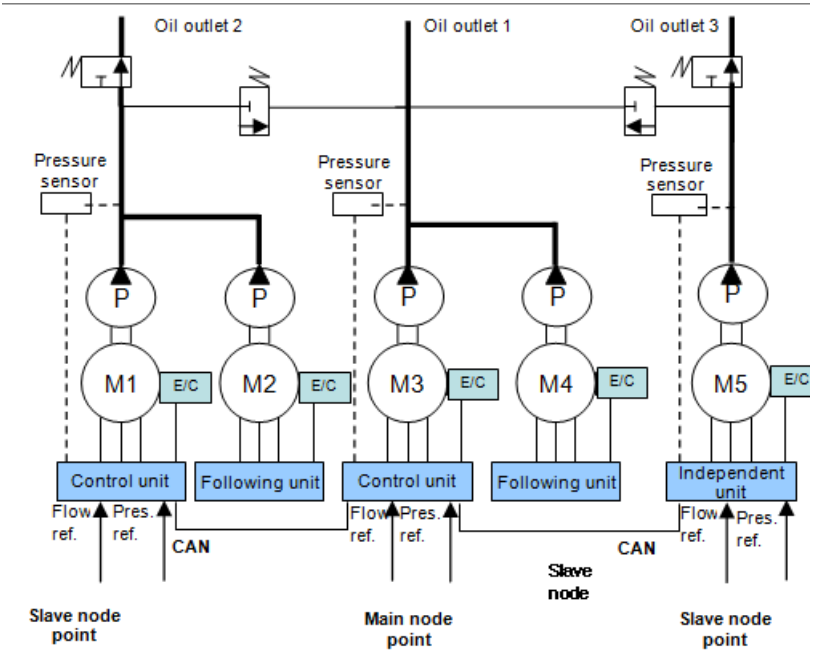

## 8.3 Multi-mode

The system is comprised of three nodes and each node is comprised of one or more single pump systems. The single pump system is called control unit and the node constituted by one control unit is an independent unit node. The multi-unit node comprised of multiple control units can be taken as a node constituted by double-pump or multiplex pump, while multi-unit mode is comprised of one control unit and one or more following units, the node carries a pressure sensor to connect to the control unit and the control unit connects to the upper control system via AIN1 and AIN2, thus receiving the pressure and flow reference signal. The two DA outputs of control unit is connected to the AIN1 and AIN2 of the following unit respectively to act as the motor speed reference signal and drive enable signal. The RDY output ports of the following unit are connected in serial with positive end connecting to 24V power and negative end connecting to I7 of control unit. The control unit obtains the running state of the following unit drive via this digital input port.

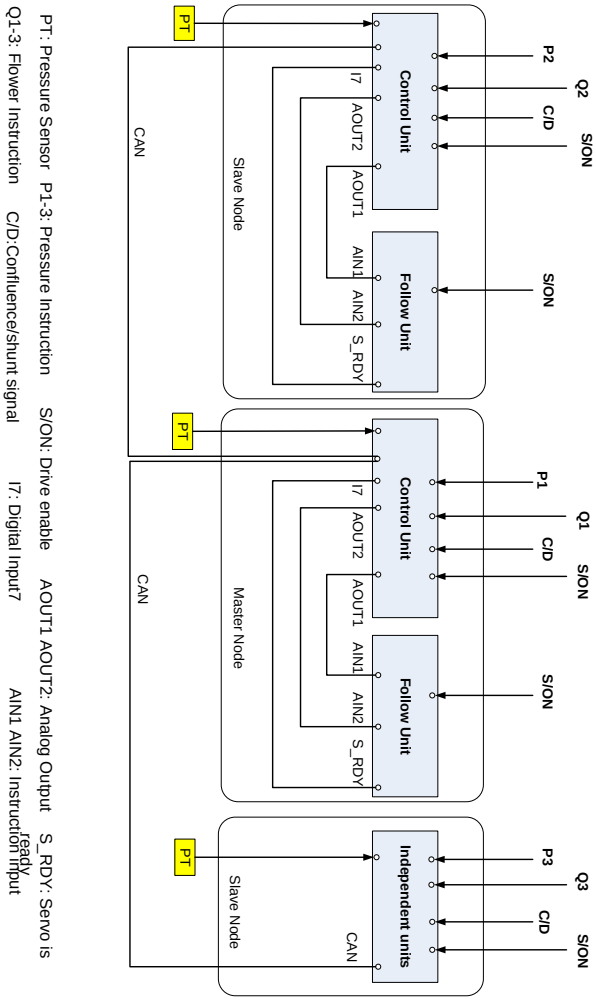
Each node uses I1 (C/D) to switch the control mode. When I1 is high, the node works in converging state and if it is low, the node works in shunt state. When the system operates in converging state, the

node number of converging can be changed, and the main node completes pressure control and system total flow. The slave node working in converging mode operates in the same speed with the main node. Above flow distribution algorithm is not used during multi-mode. The control unit of each node performs pressure control and flow control respectively in shunt mode, and the following unit and control unit keeps operating in the same speed.

System diagram for multi-mode:




Wiring diagram for composite mode and multi-mode:




Commissioning parameter table for multi-pump parallel control:

| LED Display Code | Parameter Name | Function Instruction | Initial Value | Unit |
|---|---|---|---|---|
| P00 | Network enable | Network enable control: Set properly the parameters to be used by the single pump of each node and the converging type and node number. The main node needs to be set with proper slave node number, flow cut-in threshold and | 0: Disable | |

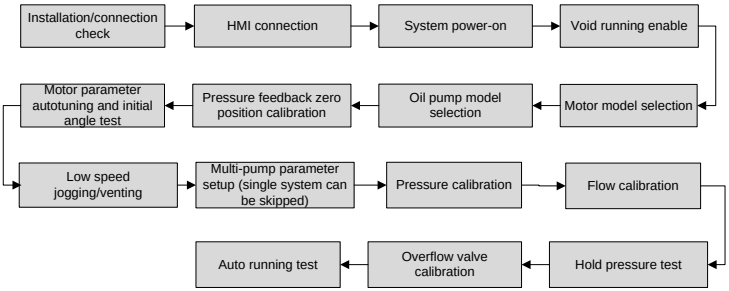
| LED Display Code | Parameter Name | Function Instruction | Initial Value | Unit |
|---|---|---|---|---|
| | | upper/lower limit of flow cut-in hysteresis. After all the settings are done, executing the network enable commands in sequence (slave node first, main node last).<br>0: Disable; 1: Enable | | |
| P01 | Drive enable on the network | Control the disable/enable of the drive of all nodes, suitable for multi-pump mode<br>0: Disable; 1: Enable | 0: Disable | |
| P02 | Converging type | Select converging type<br>0: Single pump; 1: Composite; 2: Multi-pump;<br>3: Multi-mode | 0: Single pump | |
| P03 | Node number | If node number is 0, it means master<br>If node number is 1 – 15, it means slave | 0 | |
| P04 | Slave node number | If node number is 0, the slave number means the number connected to this master | 0 | |
| P05 | Node type | Set the mode for the drive to work in the node<br>0: Independent unit; 1: Control unit 2: Following unit; 3: Flow loop unit | 0: Independent unit | |
| P06 | Flow cut-in threshold | The condition for the next pump to engage: serves to make the next pump to engage when the system flow exceeds the flow cut-in threshold of present pump, | 25 | % |
| P07 | Upper limit of flow cut-in hysteresis | The condition for the next pump to engage: serves to prevent repeated start/stop of the pump which is caused by the flow's staying in the threshold point. | 5 | % |
| P08 | Lower limit of flow cut-in hysteresis | The condition for the next pump to engage: serves to prevent repeated start/stop of the pump which is caused by the flow's staying in the threshold point. | 2.5 | % |
| P09 | Multi-pump pressure proportional gain 0 | $0^{th}$ step of the proportional parameter of multi-pump pressure PID control | 8000 | |
| P10 | Multi-pump pressure integral | $0^{th}$ step of the integral parameter of multi-pump pressure PID control | 88 | |

| LED Display Code | Parameter Name | Function Instruction | Initial Value | Unit |
|---|---|---|---|---|
| | gain 0 | | | |
| P11 | Multi-pump pressure differential gain 0 | $0^{th}$ step of the differential parameter of multi-pump pressure PID control | 0 | |
| P12 | Multi-pump pressure proportional gain 1 | $1^{st}$ step of the proportional parameter of multi-pump pressure PID control | 8000 | |
| P13 | Multi-pump pressure integral gain 1 | $1^{st}$ step of the integral parameter of multi-pump pressure PID control | 88 | |
| P14 | Multi-pump pressure differential gain 1 | $1^{st}$ step of the differential parameter of multi-pump pressure PID control | 0 | |
| P15 | Multi-pump pressure proportional gain 2 | $2^{nd}$ step of the proportional parameter of multi-pump pressure PID control | 8000 | |
| P16 | Multi-pump pressure integral gain 2 | $2^{nd}$ step of the integral parameter of multi-pump pressure PID control | 88 | |
| P17 | Multi-pump pressure differential gain 2 | $2^{nd}$ step of the differential parameter of multi-pump pressure PID control | 0 | |
| P18 | Multi-pump pressure proportional gain 3 | $3^{rd}$ step of the proportional parameter of multi-pump pressure PID control | 8000 | |
| P19 | Multi-pump pressure integral gain 3 | $3^{rd}$ step of the integral parameter of multi-pump pressure PID control | 88 | |
| P20 | Multi-pump pressure differential gain 3 | $3^{rd}$ step of the differential parameter of multi-pump pressure PID control | 0 | |

# Chapter 9 Running Commissioning

MH800 series hydraulic pressure servo system supports two kinds of commissioning modes to satisfy different customer demands: commissioning via the external HMI (optional) which adopts 5.7 inch LCD and user-friendly interface or commissioning by the built-in LED panel of the servo drive.

## 9.1 Commissioning Flowchart




## 9.2 Commissioning Procedures

The following commissioning instruction describes the operation procedures of HMI commissioning system. For commissioning via LED panel, refer to *5.4* for details.

### 9.2.1 Commissioning Preparations

1) Installation confirmation

Check the connections of each terminal, confirming all the parts needing to be fixed are fixed firmly and no loose thread occur.

2) HMI connection

MH800 series servo electro-hydraulic system supports hot-plugging of HMI. Just insert the DSUB9 terminal of HMI into the CN1B terminal on the front cover of the drive to connect the HMI to the drive. (This procedure is skipped if commissioning via LED panel).

3) Void enable

In order to ensure system safety during commissioning, it is required to void the enable of the system before powering on 3-phase AC and commissioning. There are two ways to void enable when HMI is not connected:

Method 1: Disconnect the connection wire of the drive enable terminal;

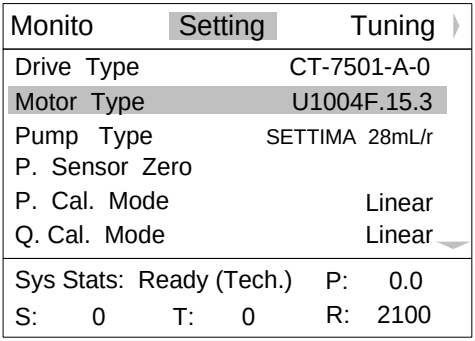
Method 2: If the upper PC of the injection molding machine carries system enable function and the enable output is connected to the enable terminal of the drive, users just need to void the system enable.

### 9.2.2 Motor Model Selection

1) Motor model selection mode

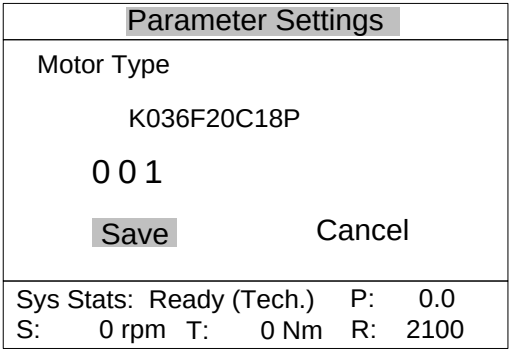
Refer to motor model list in *5.5.5* : use ◀ and ▶ key to switch to “set” mode, and stop the

highlighted cursor at “motor selection” item via ▲ and ▼ key, then press 确认 key to access.

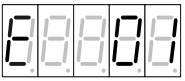



Use ◀ and ▶ key to stop the highlighted cursor at the motor model number item, and change the value to the corresponding number of the motor via ▲ and ▼ key. (See motor nameplate for detailed model, the figure above takes “K036N20A11” as an example)

Then, stop the highlighted cursor sat the “save” item via ◀ and ▶ key, and press 确认 key to save and exit to the setup menu column, HMI will transmit present motor parameter to the drive. The right side of motor selection menu will display “parameter programming”, and displays motor model “K036N20A11” after parameter programming is finished.



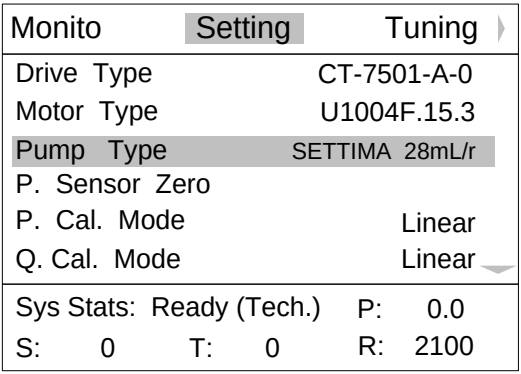

LED panel commissioning setup parameter:



### 9.2.3 Pump Model Selection

1) Pump model selection mode

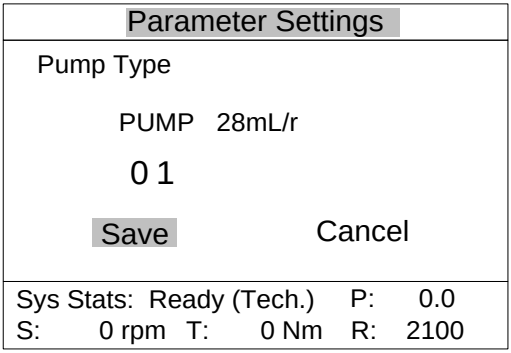
Refer to Oil pump model list in 5.5.5, stop the highlighted cursor at the “pump selection” item via ▲ and ▼, and press 确认 to enter.



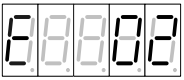

First, use ◀ and ▶ key to stop the highlighted cursor at the corresponding number, then change this number to the corresponding value of pump model via ▲ and ▼ key. (See the pump nameplate for detailed model, the figure above takes “PUMP 28mL/r” as an example)

Then, stop the highlighted cursor at “save” via ◀ and ▶, and press 确认 key to exit to the setup menu column, the HMI will transmit present pump parameters to the drive.

The right side of the “pump selection” menu will display “parameter programming”, then display pump model “PUMP 28mL/r” after parameter programming is done.




LED panel commissioning setup parameter:



If the selected pump is not in the model list, it is necessary to reset. In setup menu, adjust pump displacement (reset) [F31] and pump leakage (reset) [F32].

The following setup 9.2.3(2)→9.2.3(12)can be skipped when system configuration is the same with the default value.

2) Backpressure mode selection [F43] (the default value is manual backpressure)

a) Automatic: Storing mode is electronic backpressure

b) Manual: Storing mode is manual backpressure

3) Pressure sensor model selection [F44] (default value is 10V)

a) 5V: The drive sampling voltage range is 0 – 5V, sensor output range is 1 – 5V, measuring range is 0 – 200bar;

b) 10V: The drive sampling voltage range is 0 – 10V, sensor output range is 0 – 10V, measuring range is 0 – 250bar.

4) Plunger pump type selection [F45] (default setting is single-displacement plunger pump)

a) Dual-displacement: dual-displacement plunger pump

b) Single-displacement: single-displacement plunger pump

5) Plunger pump displacement ratio [F46] (single-displacement plunger pump is skipped)

Parameter value is the ratio between small displacement and large displacement.

6) Wobble plate switching mode [F65] (single-displacement plunger pump is skipped)

Set displacement switching mode.

7) Wobble plate switching pressure threshold [F47] (single-displacement plunger pump is skipped)

Set displacement switching pressure threshold

8) Wobble plate pressure judging delay [F48] (single-displacement plunger pump is skipped)

Set wobble plate switching pressure delay

9) Wobble plate switching rising delay [F56] (single-displacement plunger pump is skipped)

Set displacement switching rising delay

10) Wobble plate switching declining delay [F57] (single-displacement plunger pump is skipped)

Set displacement switching declining delay

11) Upper limit of speed switching [F59] (single-displacement plunger pump is skipped)

Set upper limit of speed switching

12) Lower limit of speed switching [F59] (single-displacement plunger pump is skipped)

Set lower limit of speed switching

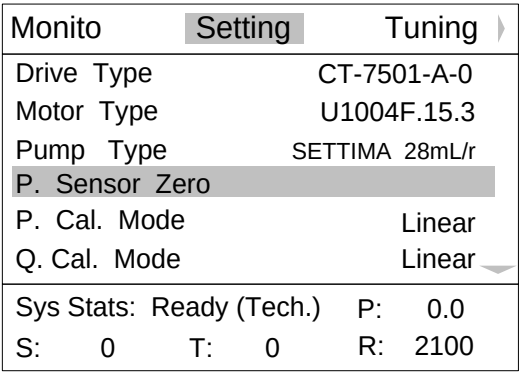
13) Multi-step pressure PID setting

If the system need to use different pressure PID parameters to perform stepwise control in different steps, first, connect I3 (CN3-9)and I4(CN3-10)and take them as the indication signals for control step, then set the PID parameter of the corresponding step (four steps in total). The relation between digital input signal and each step of pressure PID is shown below:

| **Pressure Control PID Selection during Single Pump Mode: Pressure PID Parameter** | | | | |
|---|---|---|---|---|
| I4 | I3 | KP number | KI number | KD number |
| low | low | 0 | 0 | 0 |
| low | high | 1 | 1 | 1 |
| high | low | 2 | 2 | 2 |
| high | high | 3 | 3 | 3 |

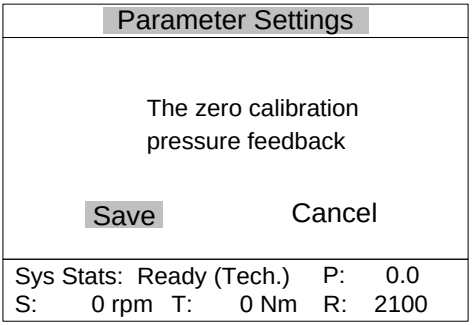
### 9.2.4 Pressure Feedback Zero Position Calibration Mode

Under setup mode, stop the highlighted cursor at “pressure feedback zero position calibration” item via ▲ and ▼ key, then press 确认 key to enter the setup interface of this item.

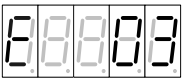



Adjust the pressure in the system oil circuit to "0" (subject to the pressure gauge of the injection molding machine) before carrying out pressure feedback zero position calibration.

Stop the highlighted cursor at "save" via ◀ and ▶ key, then press 确认 key to return to the setup menu column, and the "pressure feedback zero position calibration" item will display "calibrating", when "calibrating " disappears, it means calibration is done.




LED panel commissioning setup parameter:



### 9.2.5 Motor Parameter Autotuning and Motor Initial Angle Measurement

If the motor used is not listed in 5.5.4 motor model list, motor parameter autotuning will be required. The autotuning procedures are shown below:

1) Set motor parameters:

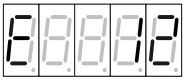
Use HMI or LED commissioning panel to set in setup menu the rated motor voltage [F70], rated motor current [F71], rated motor speed [F72], rated motor frequency [F73], motor counter-emf [F74] and motor temperature sensor [F75] .

2) Diagnosis function "Enable"

Use ◀ and ▶ key to switch to “commissioning mode”, and stop the highlighted cursor at “diagnosis function” item via ▲ and ▼ key, then press 确认 key to change the “diagnosis function” state to “enable”.

| Monitor | Setting | Tuning |
|---|---|---|
| Operating Enable | | |
| Diagnosis Enable | | Enable |
| Controller Check | | Disable |
| Measure Angle | | Disable |
| Jog Enabled | | Disable |
| Motor S.L. Way | | Disable |
| Sys Stats: Ready (Tech.) | P: | 0.0Bar |
| S: 0 rpm T: 0 Nm | R: | 2100 |

LED panel commissioning setup parameter:



3) Motor parameter autotuning

Set motor parameter autotuning [E14] parameter.

0: Disable, do not carry out motor parameter autotuning;

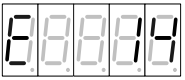
1: Static, carry out in cases where motor counter-emf is known, and the motor does not rotate during measuring; can be performed without turning on the overflow valve;

2: Dynamic, adopted in cases where motor counter-emf is unknown, and the motor runs at high speed during measuring, it is recommended to turn on the overflow valve as measuring with load may impact the precision of motor parameter measuring and the control effect, meanwhile, it may cause high voltage in the oil circuit which is a safety danger.

If LED commissioning is used, after setup, the LED will display “——————”, after measurement completes, the motor parameter autotuning [E14] parameter on the LED will revert to 0 automatically. If HMI commissioning is used, after setup is done, the right side of “motor parameter autotuning” will display “auto-measuring”; after measurement, the right side of “motor parameter autotuning” displays “succeed”, then it will be switched to “disable” state automatically.

If the drive alarms during test, users should analysis the fault cause and rule out the problem to proceed with motor parameter autotuning.

LED panel commissioning setup parameter:



4) Motor initial angle test

When motor brands other than KINWAY is adopted, it is necessary to measure the motor initial angle again.

If motor parameter autotuning is completed, motor initial angle test is not needed.

After entering commissioning interface, stop the highlighted cursor at “measuring initial angle” item via ▲ and ▼ key, and press 确认 key to make it in “enable” state.

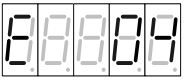
| Monitor | Setting | Tuning |
|---|---|---|
| Operating Enable | | |
| Diagnosis Enable | | Enable |
| Controller Check | | Disable |
| Measure Angle | | Disable |
| Jog Enabled | | Disable |
| Motor S.L. Way | | Disable |
| Sys Stats: Ready (Tech.) | P: | 0.0Bar |
| S: 0 rpm | T: 0 Nm | R: 2100 |

After setup, the system will measure the initial angle automatically; the right side of the “measuring initial angle” displays “auto-measuring”.

| Monitor | Setting | Tuning |
|---|---|---|
| Operating Enable | | |
| Diagnosis Enable | | Enable |
| Controller Check | | Disable |
| Measure Angle | | Self-test |
| Jog Enabled | | Disable |
| Motor S.L. Way | | Disable |
| Sys Stats: Ready (Tech.) | P: | 0.0Bar |
| S: 0 rpm | T: 0 Nm | R: 2100 |

After measurement is done, the right side of “measuring initial angle” displays “succeed” and the measurement result will be displayed in “resolver offset quantity”, then it will be switched to “disable” state.

LED panel commissioning setup parameter:



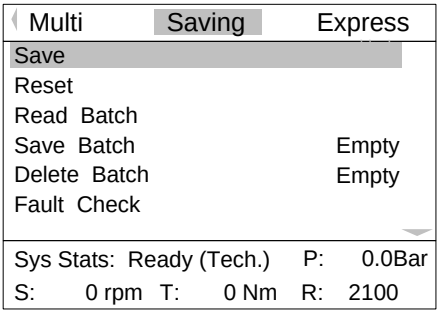
After entering “measure initial angle” menu, LED will display “READY”, press SET key to measure the initial angle automatically, LED displays " ———— " . After measuring is done, LED displays “OK”.

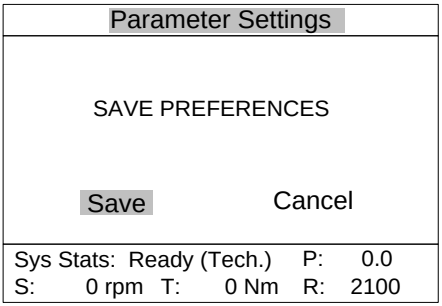
The operator should save the measurement value into EEPROM via the parameter programming function in the setup menu, and save the latest calibration state into EEPROM via “parameter programming” function in the setup menu, otherwise, the calibration state will revert to the state

before calibration.

The programming procedures are shown below:

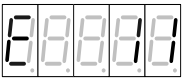
Under parameter programming mode, stop the highlighted cursor at the “parameter programming” item via ▲ and ▼ key, then press 确认 key to enter “parameter programming” setup interface”.




Stop the highlighted cursor at the “confirm” via ◀ and ▶ key, then press 确认 key to return to “parameter programming” interface, and the right side of the parameter programming item will display “in programming”. When “in programming” disappears, it means programming is completed.

LED panel commissioning setup parameter:



### 9.2.6 Low Speed Jogging and Venting

The test aims to check whether basic functions of the electro-hydraulic system operation are normal.

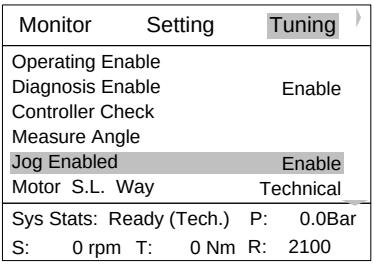
1) Inspection and preparation before operation

During running the servo system for the first time, it is a must to check the circuit connection of hydraulic pressure and electrical connection of servo system beforehand; oil pump displacement and operation pressure valve should be the same with those on the nameplate. First, adjust the system to the state where the oil discharged by the pump returns to the oil chamber directly; for instance, adjust the overflow pressure of the overflow valve to the min

value. Note: Do not start the machine when shut-off is applied to the output side of the oil pump.

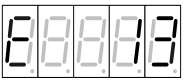
2) Low speed light-load operation

a) Turn on jogging enable to adjust the max jogging speed. After entering commissioning interface, stop the highlighted cursor at “jogging enable” item via ▲ and ▼ key, and press 确认 key to make it in “enable” state.




After adjustment is done, the operator can make the motor rotate forward or backward via 前进 and 后退 key, and keeping 前进 and 后退 pressed down can accelerate the motor to the max jogging speed in positive or negative direction (use ▲ and ▼ key for LED panel commissioning).

LED panel commissioning setup parameter:



Confirm the working condition

When motor rotates forward, confirm that the rotation direction of the pump is the same with the arrow direction on the pump label; confirm the noise and vibration is within normal range and the pump can suck oil normally.

| Error | Phenomenon | Solution |
|---|---|---|
| Error 1 | The motor does not rotate and the torque value is large. | Enter setup menu to change motor rotation direction. Perform step 8.2.5 – 8.2.6(2)(b)again |
| Error 2 | The rotation direction of the pump differs from the arrow direction on the pump label. | Enter setup menu to change motor rotation direction and resolver direction. Perform step 8.2.5 – 8.2.6(2)(b)again |

b) Venting

Confirm above-mentioned 9.2.6(2)(b)is normal and make the pump rotate forward to vent all the air inside the hydraulic pressure system.

Note: At the beginning of startup, abnormal noise may occur as there is air mixed in the hydraulic pressure oil, which is normal phenomenon; however, if the abnormal noise persists in a period of time, users must vent the air in the hydraulic pressure oil circuit.

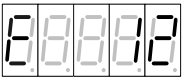
c) Void jogging enable and diagnosis enable

Refer to the modification mode in 9.2.6(2)(a)to disable the “jogging enable”, then refer to the modification mode in 9.2.5(2) to change the state of “diagnosis function” to “disable”.

| Monitor | Setting | Tuning |
|---|---|---|
| Operating Enable | | Disable |
| Diagnosis Enable | | Disable |
| Controller Check | | |
| Measure Angle | | |
| Jog Enabled | | |
| Motor S.L. Way | | Technical |
| Sys Stats: Ready (Tech.) | P: | 0.0Bar |
| S: 0 rpm T: 0 Nm | R: | 2100 |

LED panel commissioning setup parameter:

Press MODE key to make LED exit from jogging state. The exit diagnosis state needs to set the parameter below.



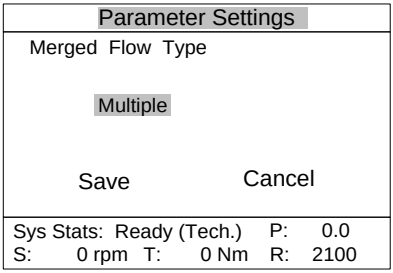
**Multi-pump parameter setup (if the system is single-pump system, this procedure can be skipped)**

1) Converging type setup

Use ◀ and ▶ key to switch to “multi-pump”, then stop the highlighted cursor at “converging type” item via ▲ and ▼ key, then press 确认 key to enter setup menu.

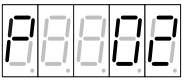
| Multi | Saving | Express |
|---|---|---|
| NET Control | | Disable |
| NET IPM Control | | Disable |
| Merged Flow Type | | Single |
| Node ID | | 0 |
| Slave Sum | | 0 |
| Node Type | | Single Unit |
| Sys Stats: Ready (Tech.) | P: | 0.0Bar |
| S: 0 rpm T: 0 Nm | R: | 2100 |

Use ◀ and ▶ key to stop the highlighted cursor at type selection, then change the converging type to the type needed via ▲ and ▼ key (in above figure, “multi-pump” is taken as an example).



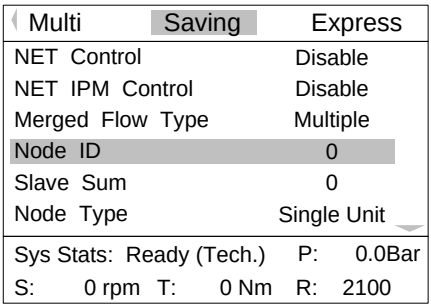

Then, stop the highlighted cursor at "save" via ◀ and ▶ key, press 确认 key to save and exit to multi-pump menu column, then the right side of converging type menu will display the selected type (in above figure, "multi-pump" is taken as an example).

LED panel commissioning setup parameter:

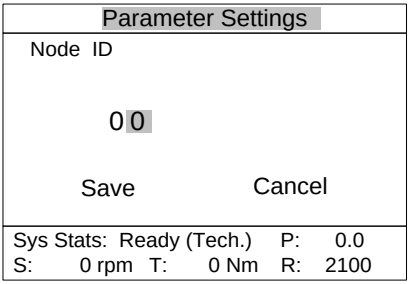


2) Node number setup

Use ◀ and ▶ key to switch to "multi-pump", then stop the highlighted cursor at "node number" item via ▲ and ▼ key, and press 确认 to enter the setup menu.

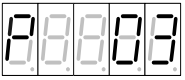



Use ◀ and ▶ key to stop the highlighted cursor at type selection, then set the node number via ▲ and ▼ key: set the main system node number to 0, set the slave system communication node number to "1", "2"…… in order based on the quantity of slave systems (the main system "0" is taken as an example in the figure).



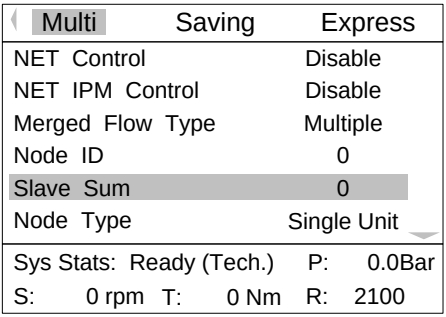

Then, stop the highlighted cursor at “save” via ◀ and ▶ key, press 确认 to save and exit to multi-pump menu column. The right side of the node number menu will display the node number of present system (“0” is taken as an example in the figure).

LED panel commissioning setup parameter:

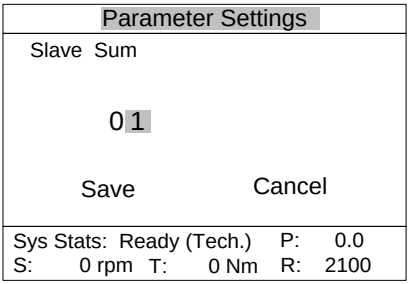



3) Slave node number setup (no. 0 node needs to be set, other nodes are skipped)

Use ◀ and ▶ key to switch to “multi-pump”, then stop the highlighted cursor at “slave node number” via ▲ and ▼ key, and press 确认 to enter setup menu.

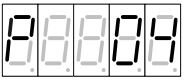



Use ◀ and ▶ key to stop the highlighted cursor at type selection, then set slave node number and the quantity of slave systems via ▲ and ▼ key (a slave system “1” is taken as an example in the figure)




Use ◀ and ▶ key to stop the highlighted cursor at “save”, press 确认 to save and exit to enter multi-pump menu column. The right side of slave node number menu will display the slave node number of present system (“1” is taken as an example in the figure).

LED panel commissioning setup parameter:




4) Multi-pump flow setup

Set “flow cut-in threshold” [P06], normally set to 25%;

Set “upper limit of flow cut-in hysteresis” [P07], normally set to 5%;

Set “lower limit of flow cut-in hysteresis” [P08], normally set to 2.5%

5) Network enable and drive enable setup

Network enable: Set “network enable/disable” [P00] respectively to perform network enable on the drive in the order of slave first and master last.

Drive enable on the network: This function is effective only when converging type is set to multi-pump mode, set “Drive enable” [P01] and perform motor enable operation on all the drives on the multi-pump parallel system.

6) Node type setup

When a certain node on the multi-pump parallel system is a multi-unit node comprised of multiple drives, it is necessary to set the “node type” [P05] parameter of all the drives on this node.

### 9.2.7 Pressure Calibration

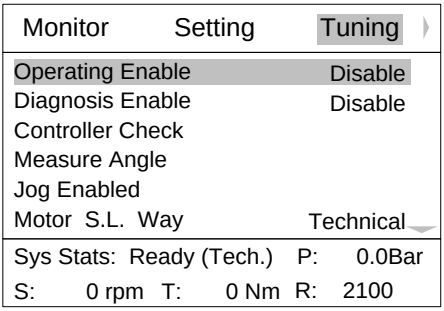
Note: The calibration for “single pump”, “composite”, “multi-mode” or “multi-pump” differs from each other slightly.

- Single pump: Calibrate directly regardless of “network enable”[P00]parameter;
- Composite and multi-mode:

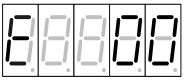
  First, disable the “network enable” [P00] under “multi-pump” menu, then calibrate each node according to the calibration mode of single pump system.
- Multi-pump:

First, disable the “network enable” [P00] under “multi-pump” menu, and set the proper “max flow” [F13]and “max pressure” [F12] of each node, then perform network enable on the multi-pump parallel system according to the mode specified in 9.2.7(5), at this moment, the max system pressure takes the min value of the “max pressure” of the master and slave nodes, then carries out calibration according to below method.

Change the “operation enable” item to “disable” state, (in multi-pump type, change “drive enable” item [P01]) to “disable” state)

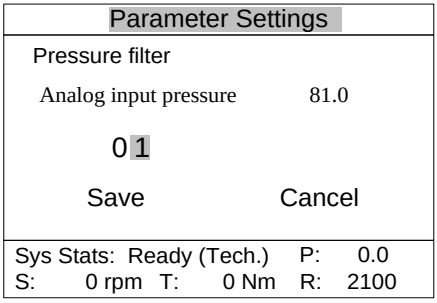



LED panel commissioning setup parameter:

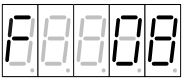


1) Filter adjustment

Use ◀ and ▶ key to switch to setup mode, and stop the highlighted cursor at “pressure filter” item via ▲ and ▼ key, then press 确认 key to enter the setup interface of pressure filter.




LED panel commissioning setup parameter:



Adjust the upper PC pressure reference to 40%, observe the change of pressure analog input.

Improve the pressure filter parameter value gradually by setting parameters until the fluctuation of pressure analog input reaches the standard listed in below table.

| | | |
|---|---|---|
| Fluctuation of pressure analog input | ≤0.2V | Measurement should be carried out during 40% of pressure reference |

2) Calibration

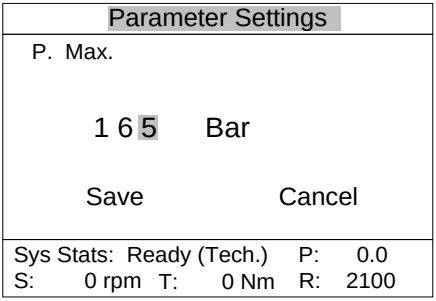
Purpose: The servo system can convert the analog reference of control system to actual requirements to carry out control only when the control system offers a reference point to the analog quantity of servo drive.

a) Set max pressure and pressure full range

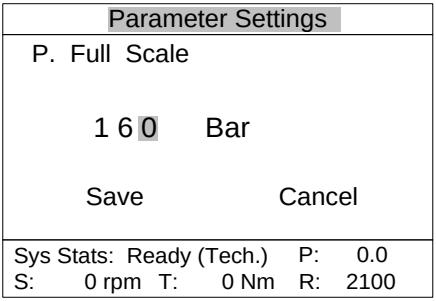
The purpose of setting the max pressure is to avoid the reference of upper PC exceeds the upper limit of the system. For multi-pump type, this parameter has been set already and need not to be set again.

Under set mode, stop the highlighted cursor at “max pressure” item via ▲ and ▼ key and press 确认 to enter its setup interface.

Modify the parameter value of the max pressure via setting value parameters. (165kg is taken as an example in the figure)

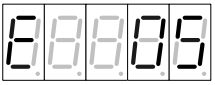



Similarly, set the “pressure full range” to the required value (set 160kg as an example in the figure)




LED panel commissioning setup parameter: Pressure full range and the max pressure can be

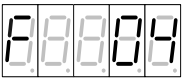
modified in LED panel by setting the pressure full range.



b) Linear calibration

Set “pressure calibration mode” to “linear calibration” via setting function parameters.

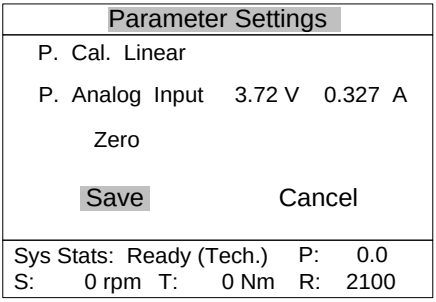
LED panel commissioning setup parameter:



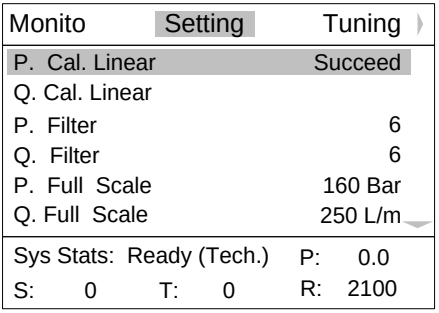
Stop the highlighted cursor at “linear pressure calibration” via ▲ and ▼ key and press 确认 to enter.

Stop highlighted cursor at linear pressure calibration point via ◀ and ▶ key, and adjust the item name to “zero position” via ▲ and ▼ key.

Stop the highlighted cursor at “save” via ◀ and ▶ key, change the pressure reference of upper PC to 0bar, and press 确认 key to return to setup mode menu.

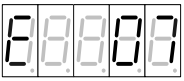



If the state column of linear pressure calibration displays “succeed”, and then disappears, it means calibration is succeeded.



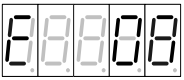
If the state of linear pressure calibration failed, the operator will need to calibrate again until succeed.

LED panel commissioning setup parameter:



The calibration of full range is the same with zero position calibration mode: change the pressure reference of upper PC to full range pressure value, and change the pressure calibration point to “full range”, then adjust the pressure of injection molding machine to the corresponding pressure of full range, finally, calibrate and confirm.

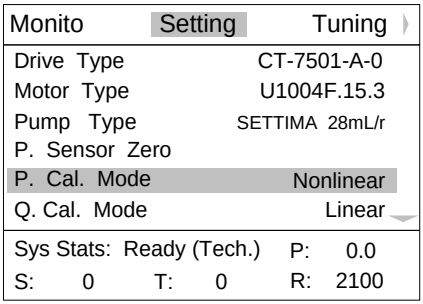
LED panel commissioning setup parameter:



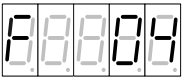
c) Polyline calibration

The polyline calibration mode is the same with linear calibration; the operator can deem the polyline calibration as the composition of multi-step linear calibration.

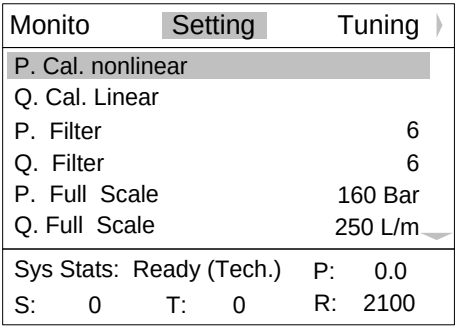
Set the “pressure calibration mode” to “polyline calibration” via setup mode of function parameters.




LED panel commissioning setup parameter:



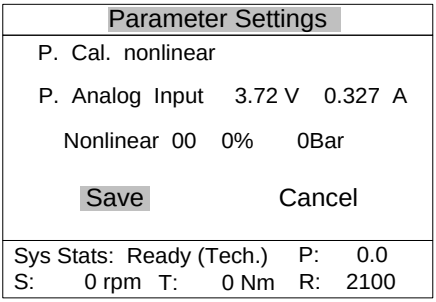
Stop the highlighted cursor at the polyline pressure calibration via ▲ and ▼ key, then press 确认 key to enter polyline pressure calibration point selection interface.



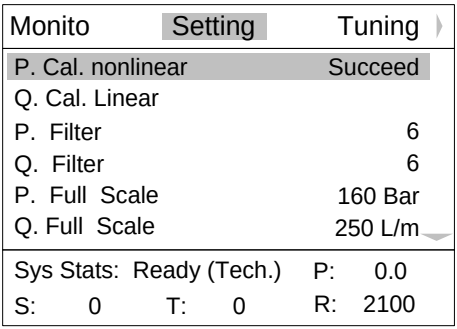

Adjust the pressure reference of injection molding machine to 0bar before performing below operations.

Stop the cursor at polyline pressure calibration point selection via ◀ and ▶ key, and adjust the item name to "00" (namely "0bar" pressure reference) via ▲ and ▼ key.

Stop the highlighted cursor at "save" via ◀ and ▶ key.

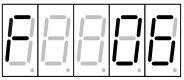



Press 确认 to return to setup mode menu, if the state column of polyline pressure calibration displays "succeed", and then disappears, it means the calibration is succeeded.




If the state of polyline pressure calibration is "failed", the operator needs to calibrate again until succeeded.

LED panel commissioning calibration setup parameter:



The calibration mode of other calibration points is the same with 0bar point calibration (refer to the table below), adjust the upper PC to the corresponding pressure reference value.

| No. | Calibration quantity (relation with full range) |
|---|---|
| 0 | 0% |
| 1 | 5% |
| 2 | 10% |
| 3 | 20% |
| 4 | 30% |
| 5 | 40% |
| 6 | 50% |
| 7 | 60% |
| 8 | 70% |
| 9 | 80% |
| 10 | 90% |
| 11 | 95% |
| 12 | 100% |

### 9.2.8 Flow Calibration

The calibration for “single pump”, “composite”, “multi-mode” and “multi-pump” differs from each other slightly:

- Single pump type: Calibrate directly regardless of “network enable” [P00] parameter.
- Composite and multi-mode type;

First, disable the “network enable” [P00] under “multi-pump” menu, then calibrate each node according to the calibration mode of single pump system.

- Multi-pump type:

  The “max flow” of each node has been set properly during 9.2.8 pressure calibration, the max system flow equals to the sum of the max flow of each node. Users do not need to set “max flow” during flow calibration.

  Modify “operation enable” [H00] item to “disable” state, (in multi-pump type, change the “drive enable” item to “disable” state)

1) Filter adjustment [F09]
   The method is the same with 9.2.8(1)
2) Calibration
   a) Set the max flow and flow full range [F13][F11]
      The method is the same with 9.2.8(2)(a)

b) Linear calibration zero position calibration[E09], full range calibration[E10]
The method is the same with 9.2.8(2)(b)

c) Polyline calibration [F07]
The method is the same with 9.2.8(2)(c)

3) Parameter programming

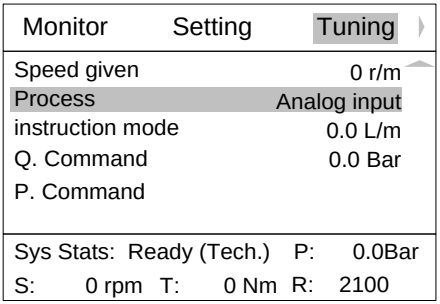
For above parameter setup, parameter programming must be executed before the drive is powered off, otherwise the drive will maintain the original parameter. The parameter programming mode is executed based on 9.2.5.

### 9.2.9 Pressure-hold Test

1) Pressure-hold test in low pressure

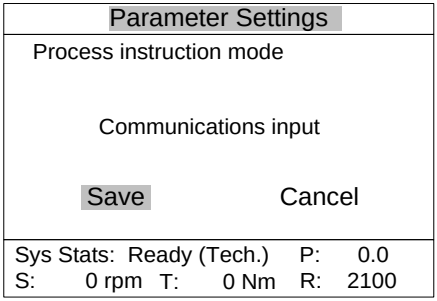
Adjust the overflow pressure of the overflow valve to the max value before performing below operations.

Under commissioning mode, when the control mode is “process mode”, stop the highlighted cursor at “process command mode” via ▲ and ▼ key, and press 确认 to enter setup interface.

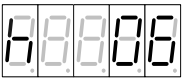



Change the name of process command mode to “communication input” via ▲ and ▼ key.

Stop the highlighted cursor at “save” via ◀ and ▶ key, then press confirm key to return to commissioning menu column, and users can read that the “process command mode” has been changed to “communication mode”.



LED panel commissioning setup parameter:



Adjust “flow reference” [H07] to 10L/m; adjust “pressure reference” [H08] to 20bar and adjust “operation enable” [H00] item to “enable” state.

Check whether oil circuit leakage occurred, and whether the pressure feedback value [d09] in HMI and the pressure gauge of injection molding machine is 20bar.

2) Pressure-hold test in high pressure

After pressure-hold test in low pressure is passed, users can carry out pressure-hold test in high pressure. When “operation enable”[H00] is in “enable” state, the “flow reference” [H07] is based on the 80% of the max flow of the injection molding machine system, “pressure reference” [H08] rises gradually to the max pressure needed by the injection molding machine, observe the system actual pressure [d09] and motor speed[d07].

If the actual system pressure cannot reach the set pressure, users need to check whether abnormal leakage occurred to the hydraulic pressure oil circuit.

If the actual system pressure reaches the set pressure but the average motor speed is higher than the value recommended in the table, users will need to figure out the leakage cause:

Situation 1: Abnormal leakage occurred to the oil pump;

Situation 2: Abnormal leakage occurred to the hydraulic pressure oil circuit;

Situation 3: Leakage occurred to the overflow valve.

| Measurement Definition | Pass The Standard (Recommended Value) |
|---|---|
| Motor speed during pressure-hold (pressure reference 100%FS, pressure-hold time is 5s) | 60-100rpm (plunger pump)<br><150rpm (screw pump)<br><300rpm (gear pump) |

After confirming the pressure and motor speed during pressure-hold fulfill requirements, check according to the data in the table whether the pressure fluctuation comply with system requirements .

| Measurement Definition | Pass The Standard (Recommended Value) |
|---|---|
| Pressure fluctuation (pressure reference 100%FS, pressure-hold time is 5s) | ≤3bar (plunger pump)<br>≤2bar (screw pump)<br>≤3bar (gear pump) |

### 9.2.10 Calibration of Overflow Valve

When “operation enable”[H00] is in “enable” state, “flow reference” [H07] is set to 30% of the max flow of injection molding machine system, “pressure reference” [H08] is overflow valve protection pressure used to adjust the overflow pressure of overflow valve. When the actual pressure is larger than the overflow valve protection pressure, confirm the overflow valve can be opened for discharge.

### 9.2.11 Calibration Review

Set the “pressure reference” [H08] of upper PC to 2bar, 10bar, 50bar, 100 bar, full range pressure -2bar and full range pressure respectively. Observe whether the read-out of pressure gauge complies with the setting, and if not, perform pressure calibration again.

Set the “flow reference” [H08] of upper PC to 2%, 50%, 98% and 100% respectively, and observe if the motor speed during operating is in proportion to the hydraulic pressure oil flow of the injection molding machine (measure by the hydraulic pressure motor speed or injection cylinder speed), if not, perform flow calibration again.

### 9.2.12 Automatic Operation and System Performance Adjustment

1) System restart

After switching off the system power, repower-on and the drive uses IO enable signal to turn on the operation enable, carry out reverse operation based on the disable mode specified in 9.2.1(3).

Restart system power and after confirming the servo system is in working state, handover the control right to the injection molding machine drive to control the servo system operation according to the injection molding machine parameters.

2) Servo performance adjustment

Servo system process control includes the following gain parameters, by which users can adjust the response features and stability precision of the servo system.

Set during single pump or shunt application:

Pressure proportional gain 0-3, [E17] [F22] [F25] [F28]

Pressure integral gain 0-3, [E18] [F23] [F26] [F29]

Set during converging application:

Multi-pump pressure proportional gain 0-3: [P09] [P12] [P15] [P18]

Multi-pump pressure integral gain 0-3: [P10] [P13] [P16] [P19]

Speed proportional gain, [E19]

Speed integral gain, [E20]

When finishing motor and pump model selection, the drive has selected the matching value of the motor and pump. If the system performance indicator cannot reach customer requirements, fine tune above parameter values until the requirements are fulfilled.

# Chapter 10 Alarm and Solution

## 10.1 Protection Display List

The servo drive carries multiple alarms and protection function including overvoltage and overcurrent. Once abnormal fault occur, the protection function acts, servo drive stops output and motor stops running. Users can cope with faults according to the contents displayed by the servo drive while referring to fault causes and solutions. The fault records will be stored in the memory of the servo drive, which can record the latest five abnormal alarms and the time of occurrence, which can be checked by users via digital LED operation panel or HMI communication.

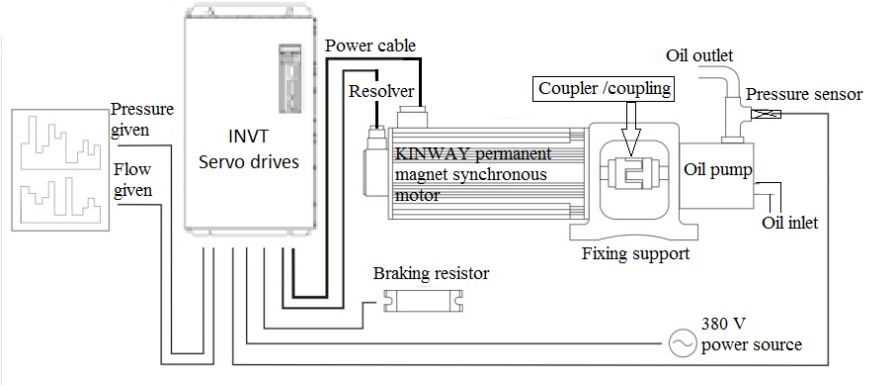
| Code | Protection Item | Meaning | Code | Protection Item | Meaning |
|---|---|---|---|---|---|
| Err01 | IPM fault | Short-circuit current passes power module transiently | Err02 | Overcurrent | Output current exceeds the allowed operating current of the drive |
| Err03 | DC overvoltage | Main circuit DC voltage is abnormally high | Err04 | DC undervoltage | When motor is powered on for operation, the main circuit DC voltage drops below the protection value |
| Err05 | FWD overspeed | The FWD speed of servo motor is abnormally high | Err06 | Module over-temperature | The cooling fin of the servo drive is too hot |
| Err07 | Motor over-temperature | Servo motor winding is too hot | Err08 | Software fault | Servo drive software operates abnormally |
| Err09 | CAN fault | When process command is CAN continuous or multi-pump parallel application, CAN communication is abnormal and the drive reports this fault | Err10 | Environment over-temperature | The air temperature inside the drive is too high |
| Err11 | Self-inspection fault | Internal hardware of the drive is abnormal | Err12 | Task re-entry | Software program calling error |
| Err13 | Over-pressure of oil pressure | The pressure of oil pressure system exceeds the allowed value | Err14 | REV overspeed | During process control mode, overspeed occurred to motor reverse rotation |
| Err15 | Pressure sensor fault | Pressure sensor is wired improperly or | Err16 | Brake resistor is damaged | Brake resistor is not connected or damaged |

| Code | Protection Item | Meaning | Code | Protection Item | Meaning |
|---|---|---|---|---|---|
| | | damaged | | | |
| Err17 | AC overvoltage | Input AC voltage is too high | Err18 | EEPROM fault | Servo unit EEPROM data abnormal |
| Err19 | Enable undervoltage | When the motor starts to power on, the main circuit DC voltage is too low | Err20 | AC undervoltage | Input AC voltage is too low |
| Err21 | Brake overload | Brake resistor overload and cause overheating | Err22 | Node fault | During multi-pump parallel application, the slave node is faulty, main drive will report this fault |
| Err23 | Rectification unit fault | The detection value of AC voltage and DC voltage does not match | Err24 | Power-on overtime | Power-on relay closing overtime |
| Err25 | 485 communication fault | When process command mode is 485 continuous, 485 communication is abnormal and the drive reports this fault | Err26 | Current feedback channel fault | Current zero drift is too large |
| Err27 | Incremental encoder zeroing interruption fault | Encoder zeroing detection is interrupted | Err28 | Incremental encoder zeroing overtime fault | Encoder zeroing detection is overtime |
| Err29 | Incremental encoder zeroing operation fault | Incremental encoder zeroing operation fault | Err30 | Motor initial angle test interruption fault | Static test on motor D axis initial angle is interrupted |
| Err31 | Resolver fault | Resolver line is not connected or resolver plate is faulty | Err33 | Resolver sampling fluctuation fault | Resolver sampling value fluctuates violently |
| Err34 | A phase current sampling fluctuation is too large | A phase current sampling fluctuation is too large | Err35 | B phase current sampling fluctuation is too large | B phase current sampling fluctuation is too large |

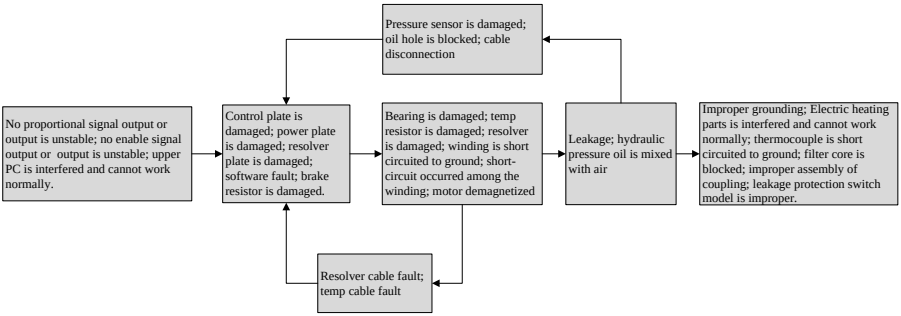
| Code | Protection Item | Meaning | Code | Protection Item | Meaning |
|---|---|---|---|---|---|
| Err36 | A phase current sampling zero drift is too large | A phase current sampling zero drift is too large | Err37 | B phase current sampling zero drift is too large | B phase current sampling zero drift is too large |
| Err38 | DC voltage sampling fluctuation is too large | DC voltage sampling fluctuation is too large | Err39 | Pressure feedback sampling fluctuation is too large | Pressure feedback sampling fluctuation is too large |
| Err40 | Pressure feedback sampling zero drift is too large | Pressure feedback sampling zero drift is too large | Err41 | Pressure reference sampling fluctuation is too large | Pressure reference sampling fluctuation is too large |
| Err42 | Flow reference sampling fluctuation is too large | Flow reference sampling fluctuation is too large | Err43 | Ambient temperature sampling fluctuation is too large | Ambient temperature sampling fluctuation is too large |
| Err44 | Module temperature sampling fluctuation is too large | Module temperature sampling fluctuation is too large | Err45 | Motor temperature sampling fluctuation is too large | Motor temperature sampling fluctuation is too large |
| Err49 | Encoder initial angle test fault | Encoder initial angle test current does not follow, overtime, etc. | Err50 | Phase sequence test fault | Motor pole pairs is calculated wrong, speed limit value is invalid, current does not follow, overtime |
| Err51 | Motor resistor test fault | Current does not follow, overtime, resistor test value is invalid | Err52 | Motor parameter dynamic test fault | Large speed error, current does not follow, large load, overtime, test value is invalid |
| Err53 | Motor parameter static test fault | The calculation result of motor parameter is invalid | Err54 | Diagnosis interruption fault | If fault occurred during executing diagnosis action, the drive will stop diagnosis and display Err54 fault |

## 10.2 Analysis on Fault Source

As shown below, the electro-hydraulic servo system of KINWAY injection molding machine is mainly comprised of permanent magnet synchronous motor, motor rotor position/speed sensor (resolver), servo drive, the oil pump which is coaxially connected to the servo motor and the pressure sensor used to detect system oil pressure.




Strictly speaking, all the parts displayed in above figure (connection cables included) can be deemed as the fault source. The figure below shows the layout of system fault:




The fault layout aims to assist users in analyzing the system in a comprehensive manner to figure out the fault source quickly and accurately.

## 10.3 Protection Causes and Solutions

If alarm code fault occurred, the panel will display the fault code which can be handled as shown below. If the problem persists, contact the distributor or the service department of our company.

The first group of fault:

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err01 | IPM fault | U, V and W is connected to the ground wire in a wrong way | Check the wiring and connect correctly |
| | | The U, V and W used by the motor main circuit is short circuited with the ground wire | Correct or replace the cable used by motor main circuit |
| | | Regenerative resistor is wired improperly | Check the wiring and connect correctly |
| | | Servo drive fault (current feedback circuit, power transistor or circuit plate fault) | Replace the drive |
| | | The U, V and W of the servo motor is short circuited with the ground wire | Replace the servo motor |
| | | The U, V and W of servo motor is short circuited with each other | |
| | | Drive parameters are set wrong | Reset parameters |
| | | The servo drive is installed in an improper way (direction and the in-between intervals are improper or affected by peripheral heating devices) | Lower the ambient temperature of the servo unit to below 45°C |

The second group of faults

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err02 | Overcurrent | Motor wiring is abnormal (improper wiring or connection) | Correct motor wiring |
| | | Position sensor wiring is abnormal (improper wiring or connection) | Correct position sensor wiring |
| | | Servo drive fault | Replace the servo drive |
| Err03<br>Err17 | DC overvoltage<br>AC overvoltage | AC power voltage is too high | Adjust the AC power voltage to normal range |
| | | Check AC power voltage ( whether there is large voltage variation) | |
| | | The speed is too high, load rotation inertia is too large (regenerative brake capacity is insufficient) | Re-discuss load conditions and operation conditions |
| | | Servo drive fault | Replace the servo drive |

The third group of fault:

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err04<br>Err20 | DC undervoltage<br>AC undervoltage | AC power voltage is low (whether there is large voltage drop) | Adjust the AC power voltage to the normal range |

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err19 | Enable undervoltage | Transient power off occurred | Restart running via reset |
| | | The cable used by motor main circuit is short circuited | Correct or replace the cable used by motor main circuit |
| | | Servo drive fault | Replace the servo drive |
| Err23 | Rectification unit fault | AC voltage and DC voltage detection is erroneous | Re-calibrate DC voltage or AC voltage |
| | | Rectification unit problem | Replace rectification drive plate or the drive |
| Err05 Err14 | FWD overspeed; REV overspeed | The U, V and W phase sequence of motor wiring is wrong | Correct motor wiring |
| | | Position sensor wiring is wrong | Correct position sensor wiring |
| | | Mal-operation occurred to position sensor due to interference | Take anti-interference measures |
| | | Servo drive circuit plate fault | Replace the servo drive |
| Err06 Err07 Err10 | Module over-temperature; Motor over-temperature; Environment over-temperature | The load exceeds rated load | Re-discuss load condition, operation condition or motor capacity |
| | | The ambient temperature of servo system exceeds 55°C | Lower the ambient temperature of the servo unit to below 55°C |
| | | Servo motor temperature sensor is wired wrong | Correct motor temperature sensor wiring |
| | | Servo drive fault | Replace servo drive |

The fourth group of fault

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err08 | Program run out fault | Interfered by static electricity lightening stroke | Reset and run again |
| Err11 | Self-inspection fault | Motor position sensor is abnormal | Replace the motor |
| | | Servo drive fault | Replace the servo drive |
| Err12 | Software fault | Servo drive fault | Replace the servo drive |
| Err13 | Overpressure of oil pressure | Pressure sensor is wired wrong | Correct pressure sensor wiring |
| | | Pressure sensor is abnormal | Replace pressure sensor |
| | | Commissioning of oil pump control and speed control parameters is improper | Adjust the control parameters to a proper value |

The fifth group of fault:

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err15 | Pressure sensor fault | Pressure sensor wiring is wrong | Correct pressure sensor wiring |
| | | Pressure sensor is abnormal | Replace pressure sensor |
| | | Servo drive fault | Replace the servo drive |
| Err16 | Brake resistor is damaged | The rotary energy when PB stops exceeds the capacity of DB resistor | Re-select the capacity of regenerative resistor or re-discuss load conditions |
| | | Check whether regenerative resistor is wired improperly, disconnected or broke | Correct the wiring of external regenerative resistor |
| | | Servo drive fault (regenerative transistor, voltage detection fault) | Replace the servo drive |
| Err18 | EEPROM is damaged | Power is off during parameter setting | Re-enter parameters after restoring to default values |
| | | Power is off during writing fault code | |
| | | Servo drive EEPROM and peripheral circuit fault | Replace the servo drive |
| Err21 | Brake resistor overload | The motor is in power generation state or starts/stops frequently in a long time | Adjust the motor running condition or replace with a power brake resistor which carries larger power |
| Err26 | Current feedback channel fault | Interference is large | Eliminate the interference |
| | | Current sensor is damaged | |
| Err31 | Resolver fault | Resolver is not connected or poorly contacted | Detect the resolver wire and resolver plate |
| | | Resolver plate fault | |

The sixth group of fault

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err33 | Resolver sampling fluctuation fault | Interference or resolver plate is damaged | Eliminate the interference and replace the resolver plate |
| Err34 | A phase current sampling fluctuation is too large | Interference | Eliminate interference, current sensor, replace control plate |
| | | Current sensor is damaged | |
| | | Control plate is damaged | |
| Err35 | B phase current sampling fluctuation is too large | Interference | Eliminate interference, current sensor, replace control plate |
| | | Current sensor is damaged | |
| | | Control plate is damaged | |
| Err36 | A phase current | The same with above | The same with above |

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| | sampling zero drift is too large | | |
| Err37 | B phase current sampling zero drift is too large | The same with above | The same with above |
| Err38 | DC voltage sampling fluctuation is too large | Interference | Eliminate interference, replace the control plate |
| | | Control plate is damaged | |
| Err39 | Pressure feedback sampling fluctuation is too large | Interference | Eliminate interference, replace pressure sensor and control plate |
| | | Pressure sensor is damaged | |
| | | Control plate is damaged | |
| Err40 | Pressure feedback sampling zero drift is too large | Interference | Eliminate interference, replace pressure sensor and control plate, system pressure discharge |
| | | Pressure sensor is damaged | |
| | | Control plate is damaged | |
| | | System has pressure | |
| Err41 | Pressure reference sampling fluctuation is too large | Interference | Eliminate interference, detect the analog signal reference of upper PC, replace the control plate |
| | | Analog signal reference of upper PC fluctuates violently | |
| | | Control plate is damaged | |
| Err42 | Flow reference sampling fluctuation is too large | The same with above | The same with above |
| Err43 | Ambient temperature sampling fluctuation is too large | Interference | Eliminate interference, replace the control plate |
| | | Control plate is damaged | |
| Err44 | Module temperature sampling fluctuation is too large | The same with above | The same with above |
| Err45 | Motor temperature sampling fluctuation is too large | The same with above | The same with above |

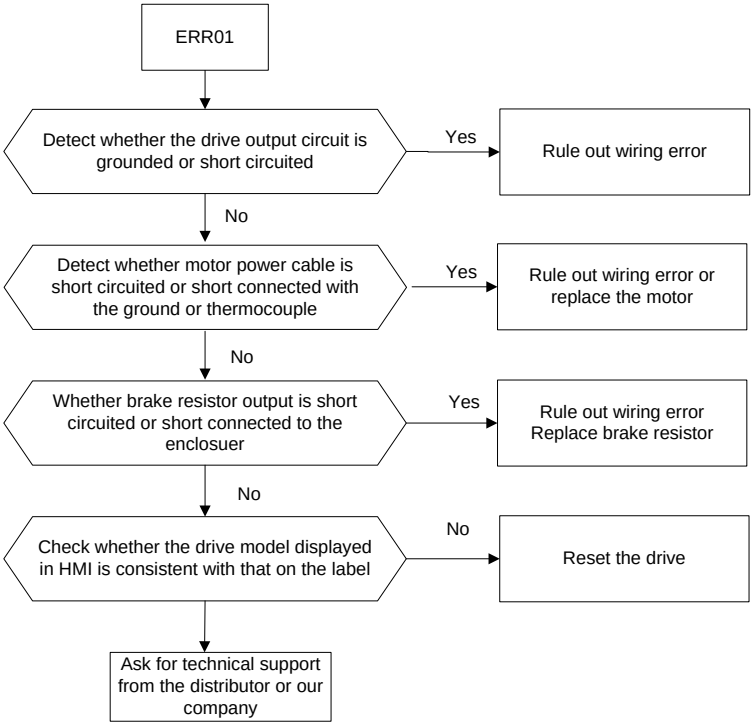
The seventh group of fault

| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| Err49 | Encoder initial angle test fault | Current sensor is damaged | Detect the drive, connect the motor |
| | | Motor is not connected | |
| Err50 | Phase sequence test fault | Current sensor is damaged | Re-enter motor nameplate parameters, detect the drive, connect the motor |
| | | Motor nameplate parameter input is erroneous | |

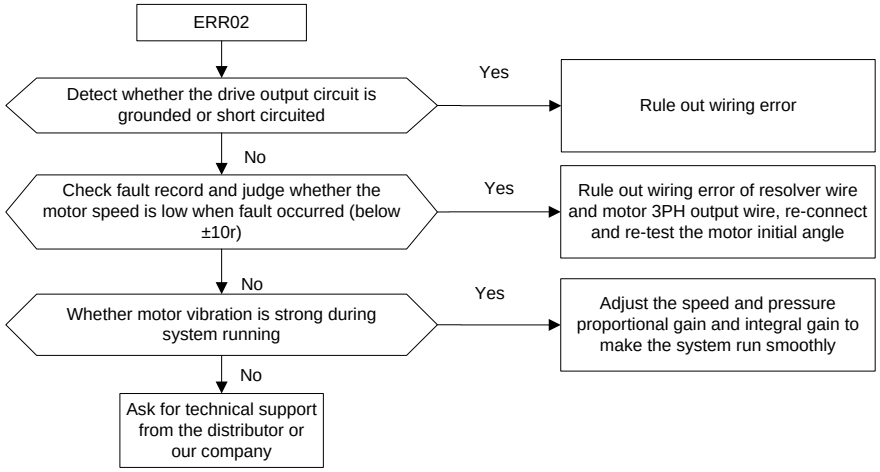
| Fault Code | Protection Item | Cause | Solution |
|---|---|---|---|
| | | Motor is not connected | |
| Err51 | Motor resistor test fault | Current sensor is damaged | Detect the drive, connect the motor |
| | | Motor is not connected | |
| Err52 | Motor parameter dynamic test fault | Current sensor is damaged | Detect the drive, re-enter motor nameplate parameter, apply no-load or light-load on the motor |
| | | Positions sensor fault | |
| | | Load is too large | |
| | | Parameter value is invalid | |
| Err53 | Motor parameter static test fault | Parameter value is invalid | Re-enter motor nameplate parameters |

## 10.4 Fault Rule-Out Flowchart

Err01: IPM fault



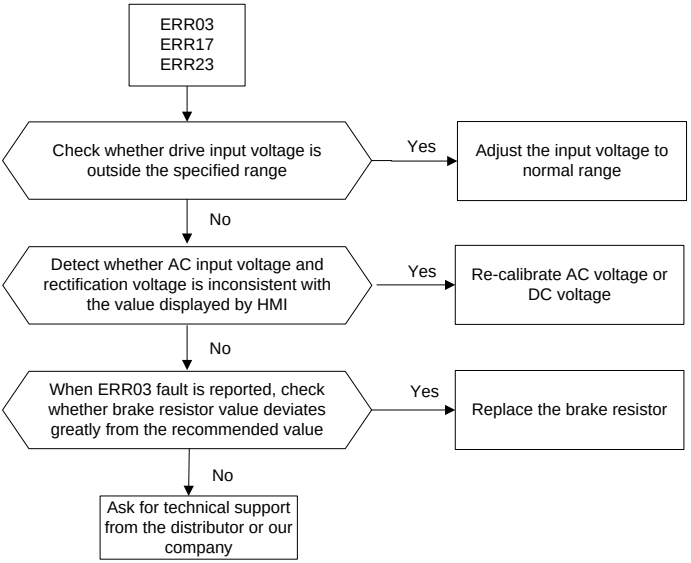
Err02: Overcurrent




Err03: DC overvoltage

Err17: AC overvoltage

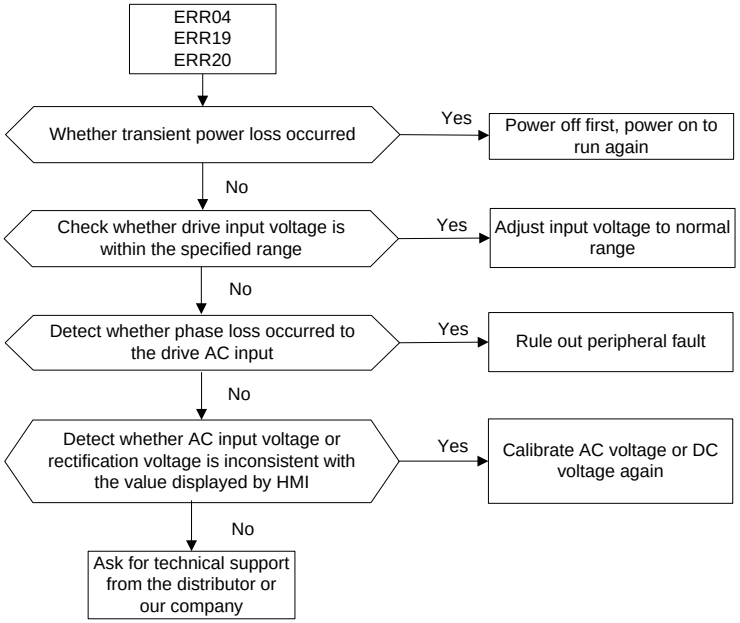
Err23: Rectification unit fault



Err04: DC undervoltage

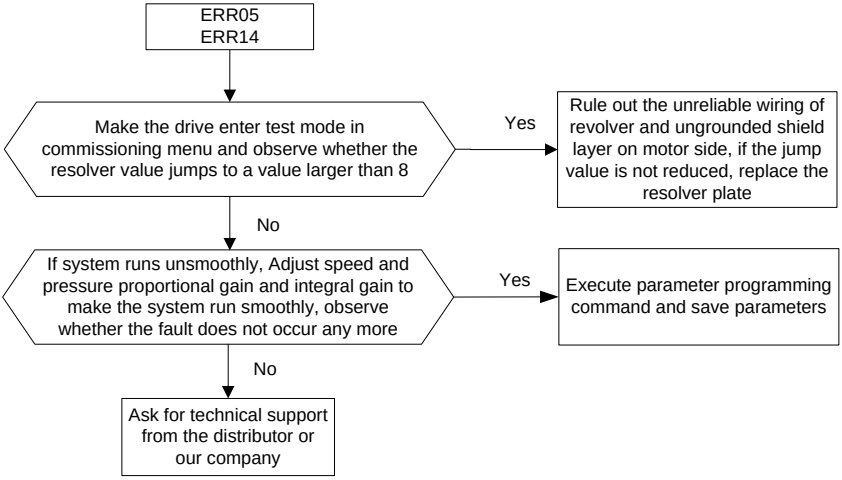
Err19: Enable undervoltage

Err20: AC undervoltage

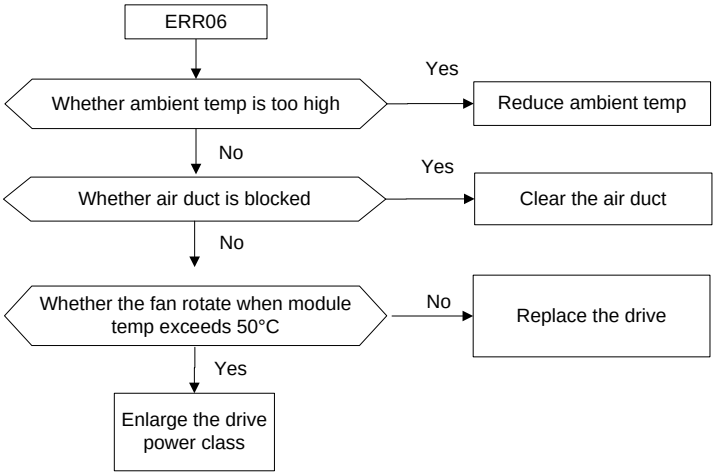



Err05: FWD overspeed

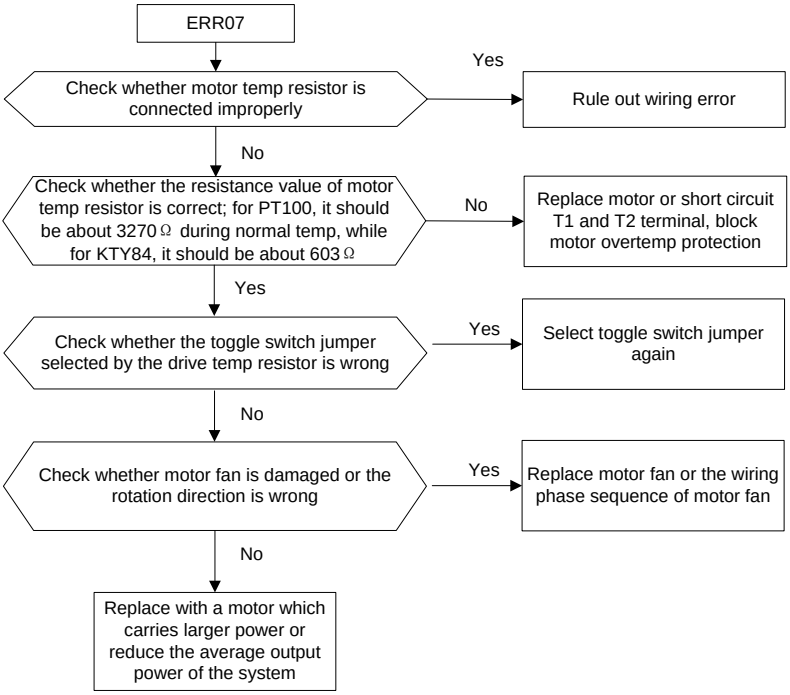
Err14: REV overspeed



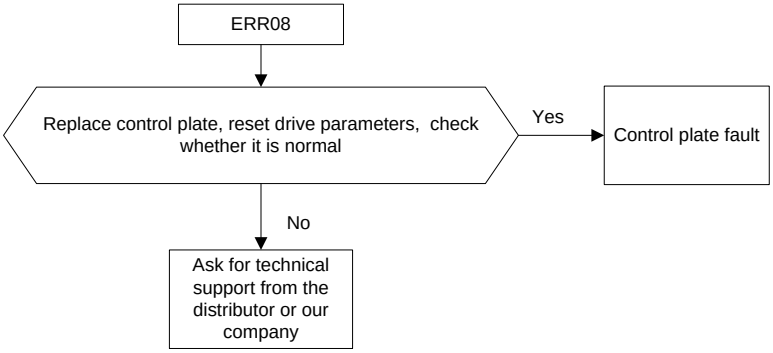
Err06: Module over-temperature



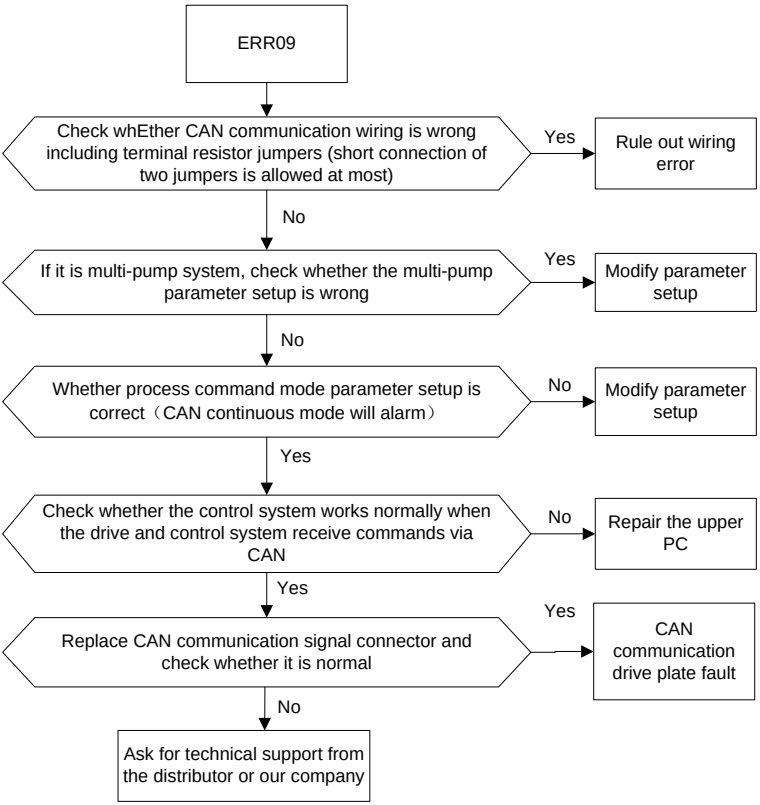

Err07: Motor over-temperature



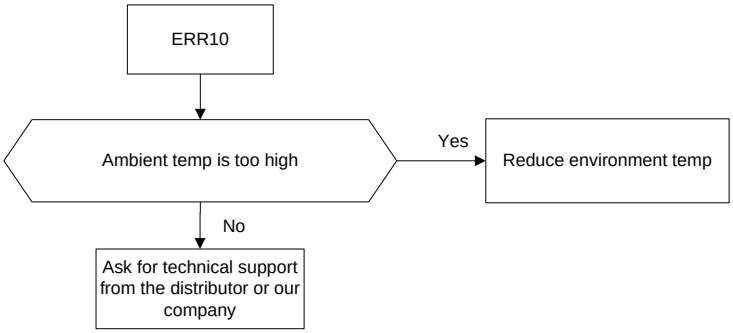
Err08: Software fault



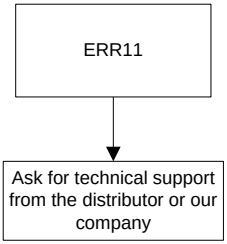

Err09: CAN fault



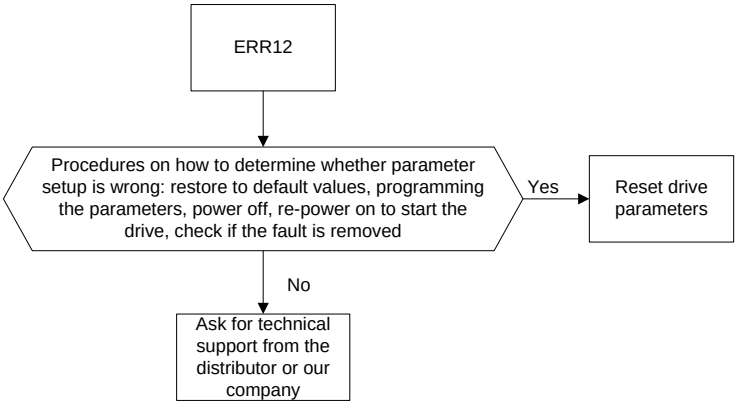
Err10: Environment over-temperature



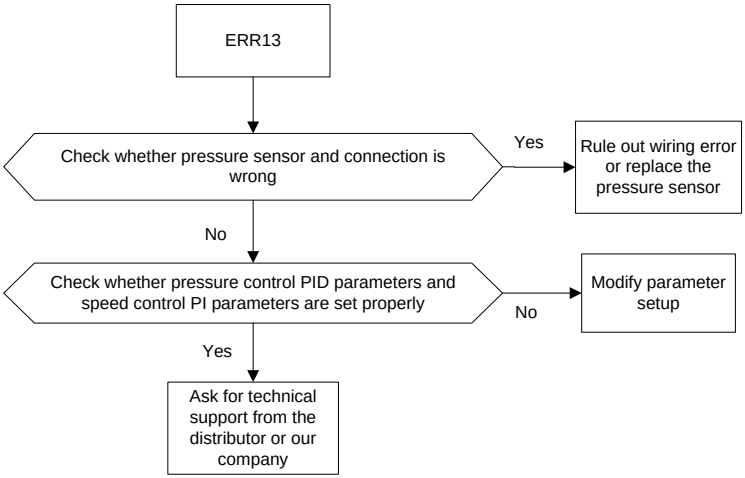

Err11: Self-inspection fault



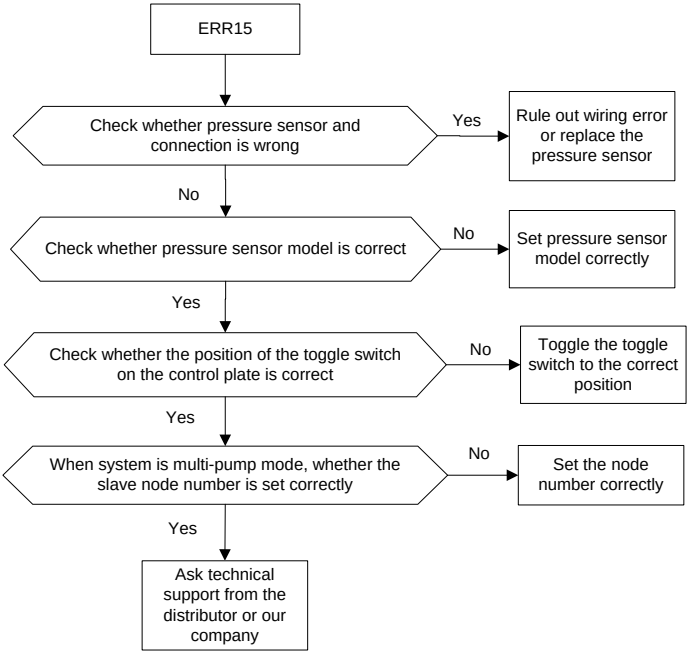

Err12: Task re-entry



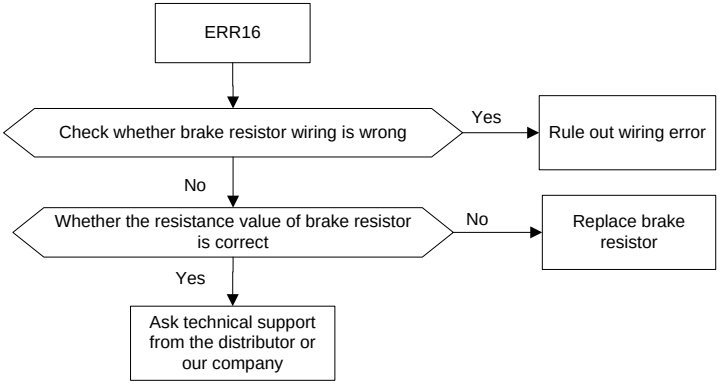
Err13: Over-pressure of oil pressure



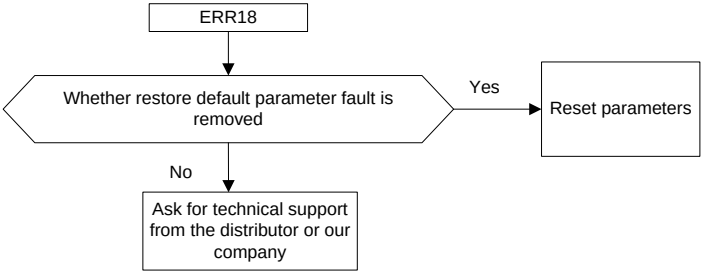

Err15: Pressure sensor fault



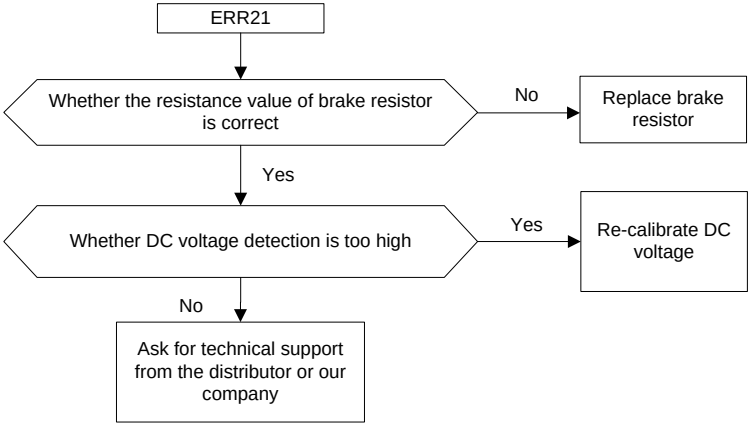
Err16: Brake resistor is damaged



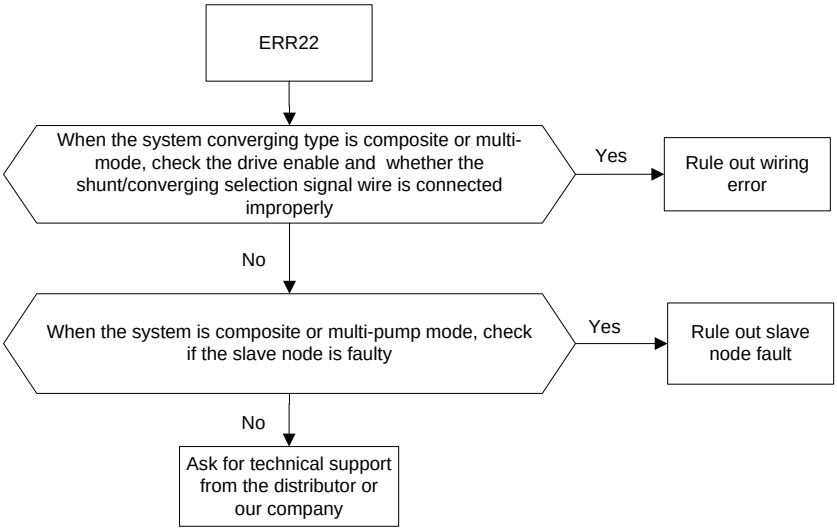

Err18: EEPROM fault



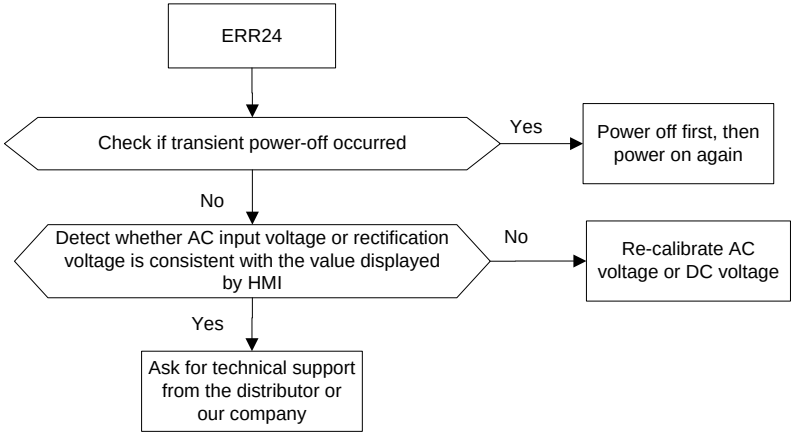

Err21: Brake overload



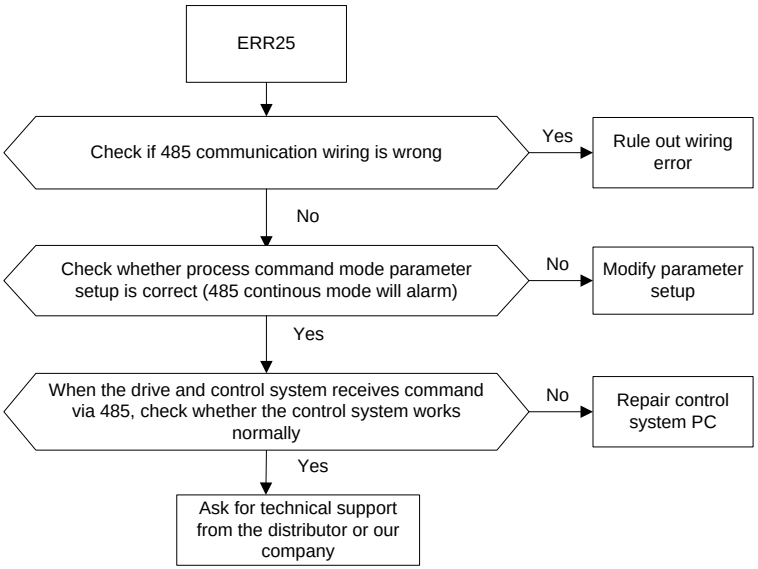
Err22: Node fault



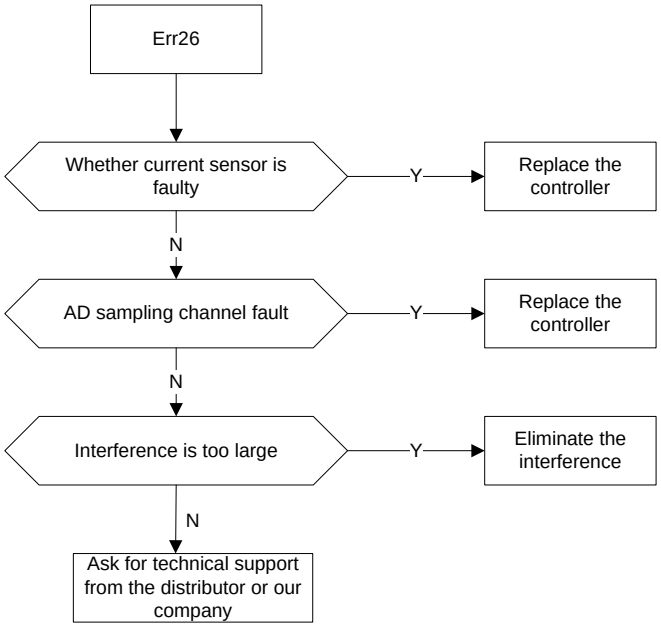

Err24: Power-on overtime



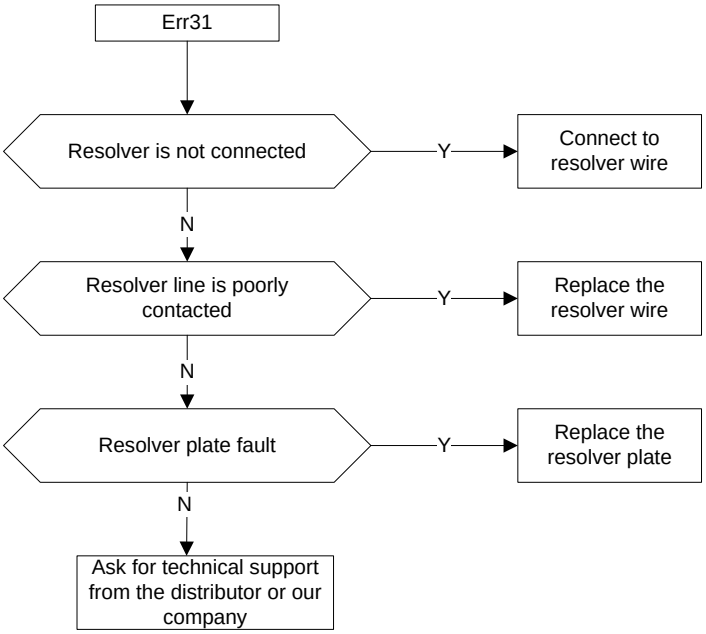
Err25: 485 communication fault



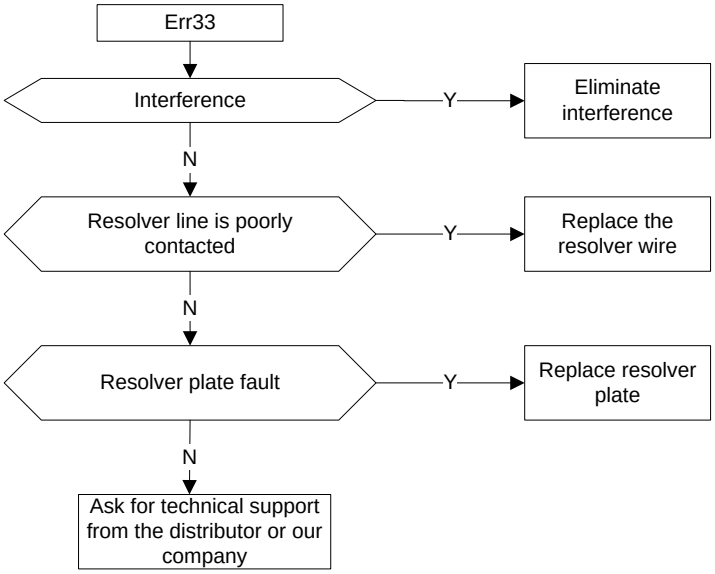

Err26: Current feedback channel fault



Err31: Resolver fault




Err33: Resolver sampling fluctuation is too large

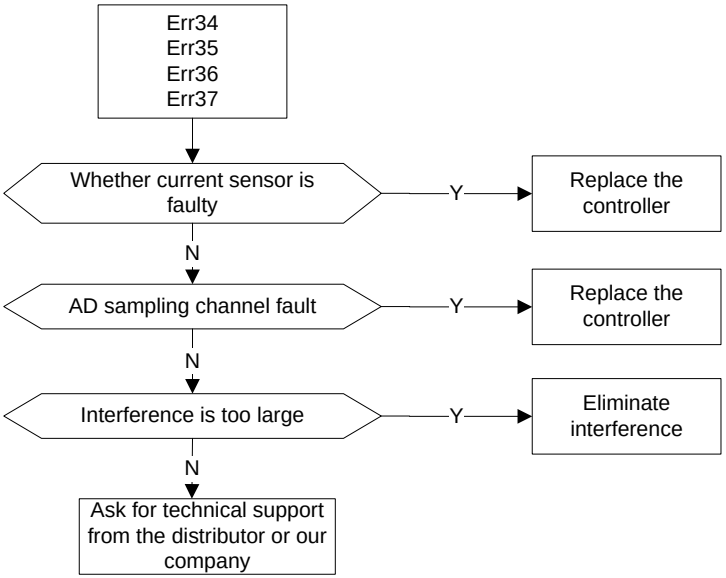


Err34: A phase current sampling fluctuation is too large

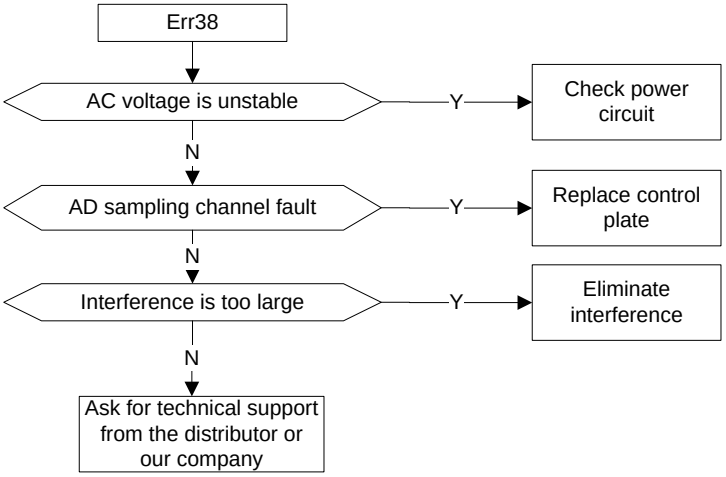
Err35: B phase current sampling fluctuation is too large

Err36: A phase current sampling zero drift is too large

Err37: B phase current sampling fluctuation is too large

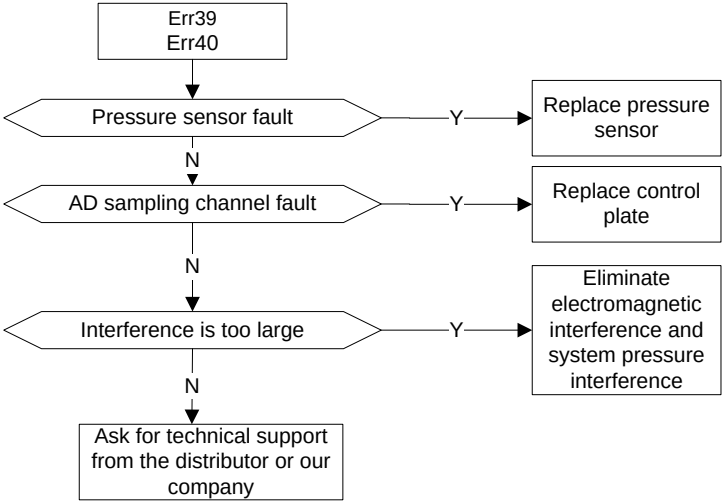



Err38: DC voltage sampling fluctuation is too large



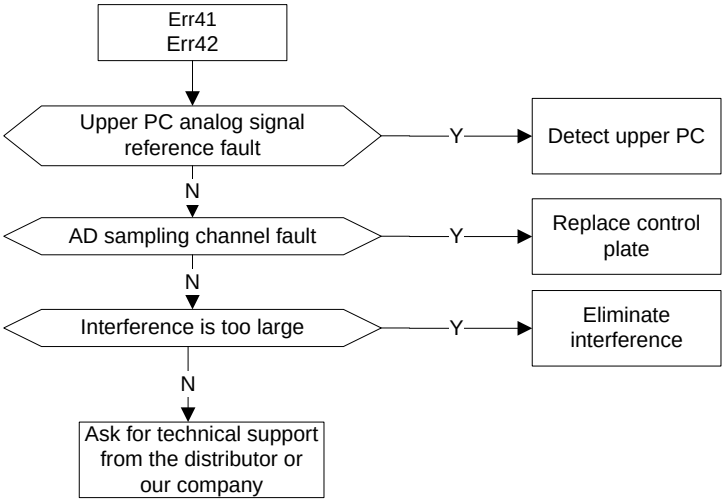
Err39: Pressure feedback sampling fluctuation is too large

Err40: Pressure feedback sampling zero drift is too large




Err41: Flow reference sampling fluctuation is too large

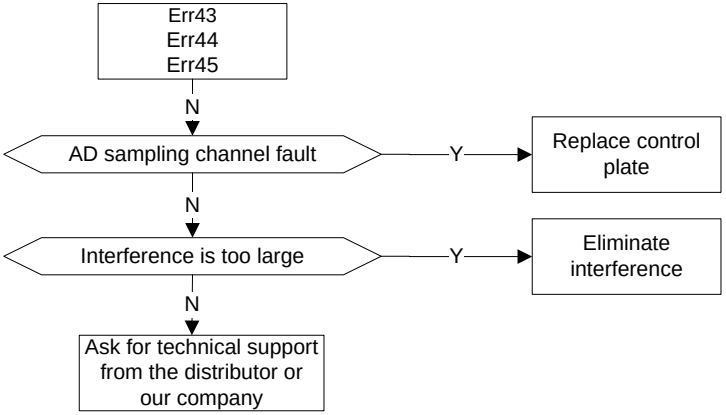
Err42: Pressure reference sampling fluctuation is too large



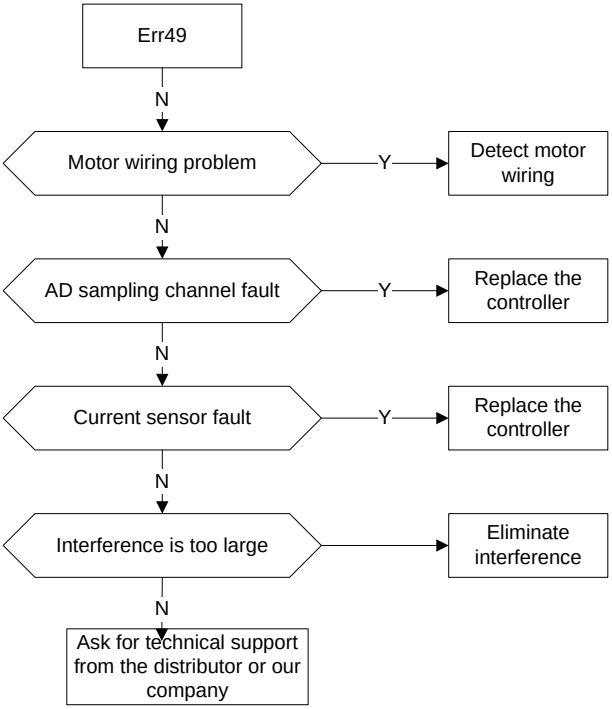
Err43: Environment temperature sampling fluctuation is too large

Err44: Module temperature sampling fluctuation is too large

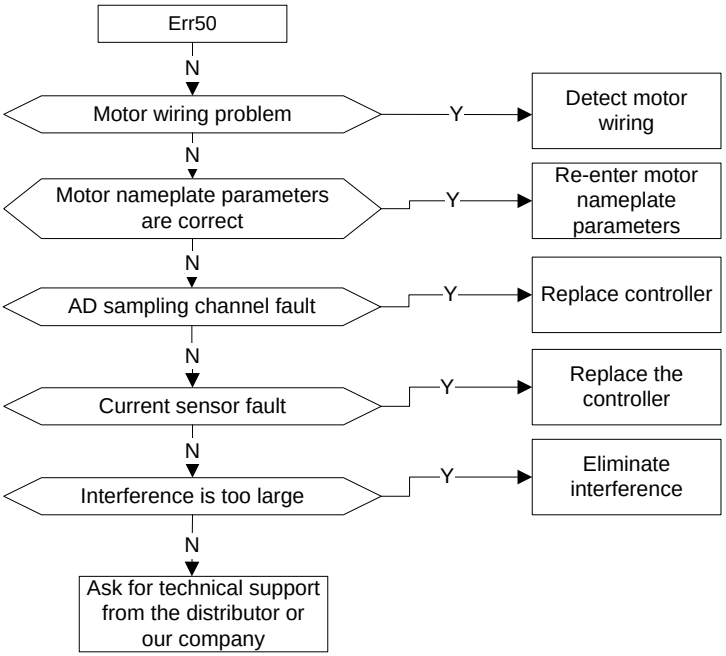
Err45: Motor temperature sampling fluctuation is too large



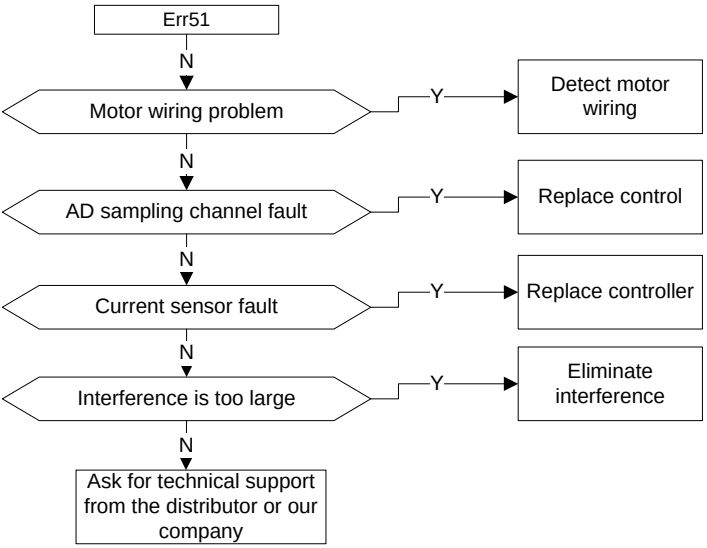

Err49: Encoder initial angle test fault



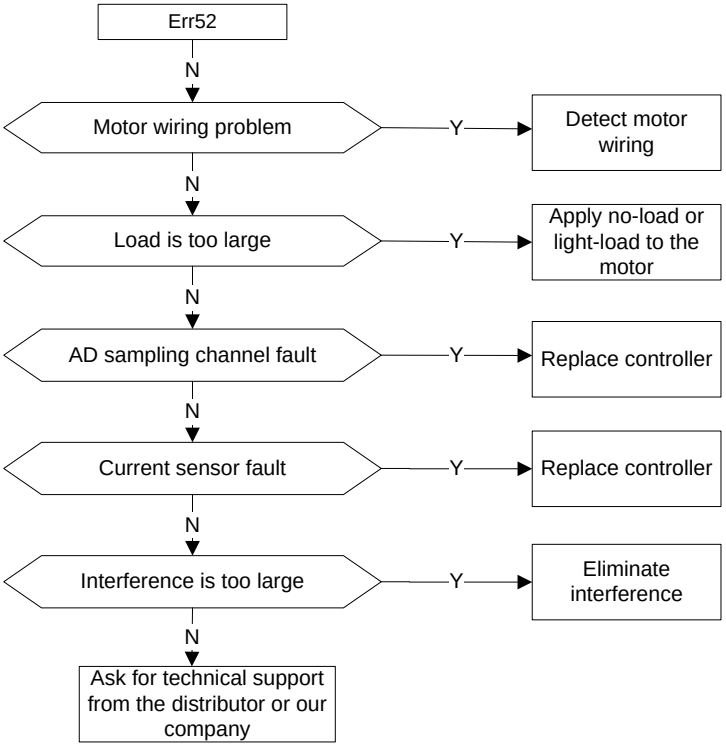
Err50: Phase sequence detection fault



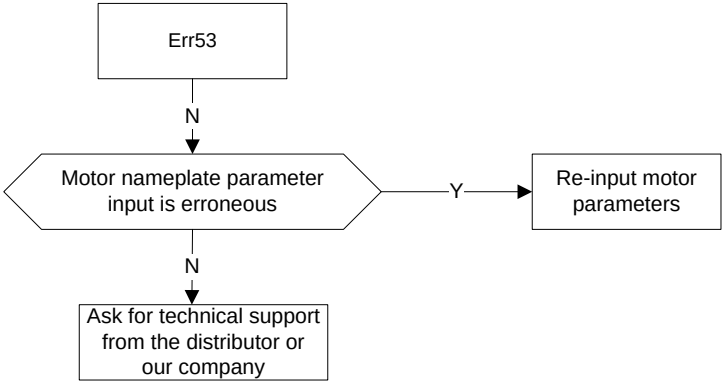

Err51: Motor resistor test fault



Err52: Motor parameter dynamic test fault




Err53: Motor parameter static test fault



# Chapter 11 Maintenance and Inspection

To avoid the danger of electric shock, only the maintenance staff who have received professional training are allowed to touch the internal circuit parts. Proper maintenance and periodic inspection is required for keeping the serve electro-hydraulic control system of injection molding machine in a good state in a long term.

## 11.1 Precautions

After cutting off all the power supplies, the capacitors inside the drive may still carry high voltage electricity during a period of time; therefore, after electric discharge, it is a must to measure with multimeter the voltage of U+ and U- terminals to ensure they are below 36V.

## 11.2 Inspection Items

The items to be inspected periodically are listed below:

| Item | Description | Method And Instruments | Criterion |
|---|---|---|---|
| Ambient environment | Ambient temperature, humidity, dust level, dust component, oil and acid and alkaline fog, etc. | Visual examination, thermometer and hygrometer | Fulfill the requirements specified in the operation manual |
| Power voltage | Whether the voltage of power supply is normal | Voltmeter, multi-meter | Fulfill the requirements specified in the operation manual |
| | Whether power-on logic action (contactor, air switch, etc.) is normal | | |
| Cosmetic and parts inspection | Whether there is abnormal vibration, noise, deformation and damage | Screw up the screws; Visual inspection; Multimeter | Abnormal |
| | Whether external brake resistor connection is loosened, resistor is aged, or resistance value is normal | | |
| Circuit inspection | No abnormal odor | Smell, listen and observe | Normal |
| | Whether cooling fan rotates normally | | |
| | Whether connectors are loosened | | |
| | Whether the lead wires are damaged | | |
| | Whether filter capacitors are deformed or there is leakage liquid | | |

## 11.3 Tramegger Test

The tramegger test can be used to test the insulation between motor winding and the enclosure only, and it must be ensured that all the connections between the motor and servo drive have been disconnected before test. 1000V tramegger should be adopted for test and the insulation resistor should be larger than 50MΩ.

Improper insulation test method may damage the servo drive, users should not perform insulation test by themselves.

## 11.4 Replacement of the Parts

The service life of the bearing of cooling fan is about 30,000h, which can sustain about 3 – 4 years during continuous usage. If abnormal noise and vibration occurred to the fan, a replacement will be required.

Service life of the aluminum electrolytic capacitor used for filter will be shortened after long-term idleness; therefore, users should power on and run the servo drive at an interval of at least half a year.

# Chapter 12 Accessories

## 12.1 Accessories Model List

| Name | Model | Application |
|---|---|---|
| Filter | DL-35EBK5 | 4R4/5R5 |
| | DL-50EBK5 | 7R5/011/015 |
| | DL-65EBK5 | 018/025 |
| | DL-100EBK5 | 030/037 |
| | DL-130EBK5 | 045/055 |
| | DL-160EBK5 | 075 |
| AC reactor | ACL2-5R5-4 | 4R4/5R5 |
| | ACL2-015-4 | 7R5/011/015 |
| | ACL2-022-4 | 018/025 |
| | ACL2-037-4 | 030/037 |
| | ACL2-055-4 | 045/055 |
| | ACL2-075-4 | 075 |
| Brake resistor | 40Ω, 500W | 4R4/5R5/7R5/011 |
| | 15Ω, 500W | 015/018/025 |
| | 10Ω, 2000W | 030/037 |
| | 10Ω, 2000W (2pcs connected in parallel) | 045/055 |
| | 30Ω, 2000W (2pcs connected in parallel) | 075 |
| Brake unit | DBU100H-060-4 | 075 |
| Pressure sensor | U5176-000005-250BG | |
| Current junction box | | During refit, if the output signal of master PC is current signal, it is necessary to convert it to voltage type with junction box |
| External HMI commissioning panel | H038-HA | Commissioning tool |

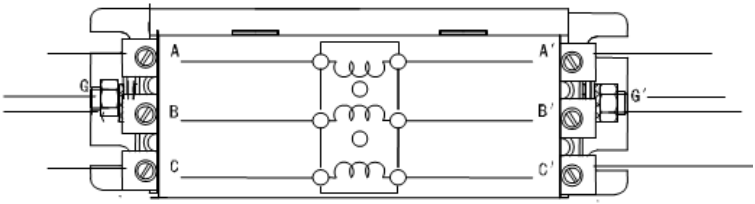
## 12.2 Noise Filter

(1) The noise filter models for each drive type

| Servo Drive Model | Noise Filter | |
|---|---|---|
| | Model | Specification |
| SV-MH800-4R4-33-S00<br>SV-MH800-5R5-33-S00 | DL-35EBK5 | 35A,200nF |

| Servo Drive Model | Noise Filter | |
|---|---|---|
| | Model | Specification |
| SV-MH800-7R5-33-S00<br>SV-MH800-011-33-S00<br>SV-MH800-015-33-S00 | DL-50EBK5 | 50A,320nF |
| SV-MH800-018-33-S00 | DL-65EBK5 | 65A,320nF |
| SV-MH800-025-33-S00 | DL-65EBK5 | 65A,320nF |
| SV-MH800-030-33-S00 | DL-100EBK5 | 100A,320nF |
| SV-MH800-037-33-S00 | DL-100EBK5 | 100A,320nF |
| SV-MH800-045-33-S00 | DL-130EBK5 | 130A,690nF |
| SV-MH800-055-33-S00 | DL-130EBK5 | 130A,690nF |
| SV-MH800-075-33-S00 | DL-160EBK5 | 160A,690nF |

(2) Filter terminal definition




| Mark | Definition |
|---|---|
| A | Input 3PH power |
| B | |
| C | |
| G | Input power ground |
| A' | Output 3PH power |
| B' | |
| C' | |
| G' | Output power ground |

(3) Filter model dimension (mm)

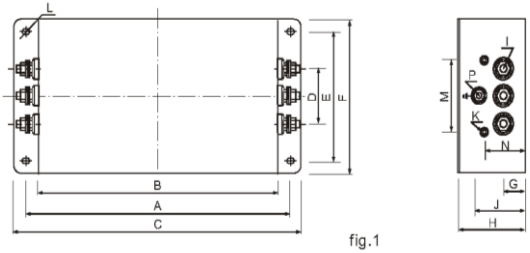



fig.1

| Model | A | B | C | D | E | F | G | H | I | J | K | M | N | P | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DL-35EBK5 | 243 | 224 | 265 | 58 | 70 | 102 | 25 | 92 | M6 | 58 | M4 | 74 | 49 | M6 | 6.4×9.4 |
| DL-50EBK5 | | | | | | | | | | | | | | | |
| DL-65EBK5 | | | | | | | | | | | | | | | |
| DL-100EBK5 | 354 | 323 | 388 | 66 | 155 | 188 | 30 | 92 | M8 | 62 | M4 | 86 | 56 | M8 | 6.4×9.4 |
| DL-130EBK5 | | | | | | | | | | | | | | | |
| DL-160EBK5 | | | | | | | | | | | | | | | |

Fix the noise filter in a well-ventilated place with bolts. The grounding terminal of input and output must be connected to the system ground in a reliable way. See 4.6.6 for connection modes.

## 12.3 Brake Resistor Model Selection and Installation

1) The reference table for brake resistor and brake unit

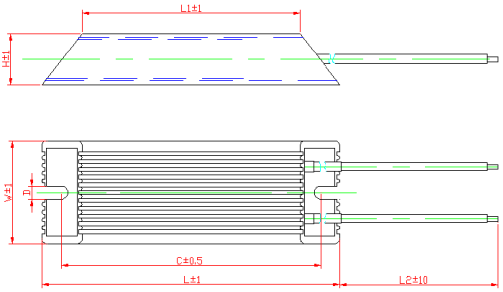
| Servo Drive Model | Brake Resistor Specification | | Brake Unit Specification |
|---|---|---|---|
| | Resistor Value Ω | Power W | |
| SV-MH800-4R4-33-S00 | 40 | 500 | Built-in brake unit |
| SV-MH800-5R5-33-S00 | 40 | 500 | |
| SV-MH800-7R5-33-S00 | 40 | 500 | |
| SV-MH800-011-33-S00 | 40 | 500 | |
| SV-MH800-015-33-S00 | 15 | 500 | |
| SV-MH800-018-33-S00 | 15 | 500 | |
| SV-MH800-025-33-S00 | 15 | 500 | |
| SV-MH800-030-33-S00 | 10 | 2000 | |
| SV-MH800-037-33-S00 | 10 | 2000 | |
| SV-MH800-045-33-S00 | 5 | 4000 (2pcs 10Ω/2000kW connected in parallel) | |
| SV-MH800-055-33-S00 | 5 | 4000 (2pcs 10Ω/2000kW connected in parallel) | |
| SV-MH800-075-33-S00 | 15 | 4000 (2pcs 30Ω/2000kW connected in parallel) | DBU100H-060-4 |

Built-in brake unit is in included for servo drives of 55kW and below; for 75kW and above models, users need to install external brake unit. As the drive does not carry brake resistor, external brake resistor is a must. If the motor brakes frequently and brake resistor of larger power is needed, users can select the brake resistor which carries small resistance value and large power during ordering. External brake resistor should be installed in a well-ventilated place and away from combustible objects and non-heat resistant parts.

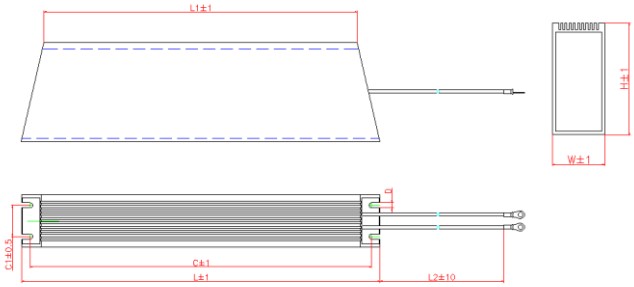
When users select the external brake resistor by themselves, note that the resistance value cannot be lower than the specified value; otherwise the drive may be damaged.

2) Brake resistor dimension (mm)

Brake resistors RXLG-500W-40R and JRXLG-500W-15RJ with aluminum case (used in 4R4/5R5/7R5/011/015 drive) are shown below:




Brake resistors RXLG-2000W-10RJ with aluminum case (used in 030/037 drive, used in 045/055 drive with 2pcs connected in parallel) and RXLG-2000W-30RJ (used in 075 drive with 2pcs connected in parallel) are shown below:




| Model | L | L1 | W | H | C | C1 | D | L2 |
|---|---|---|---|---|---|---|---|---|
| RXLG-500W-15R J<br>RXLG-500W-40R J | 335 | 290 | 60 | 30 | 315 | | 5.6 | 1000 |
| RXLG-2000W-10R J<br>RXLG-2000W-30R J | 550 | 510 | 50 | 107 | 530 | 30.5 | 5.5 | 1000 |

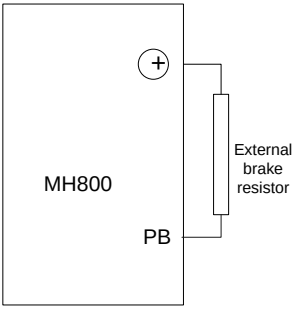
3) Installation and layout of brake resistor

All the resistors must be installed in well-cooled places.

| | |
|---|---|
|  | ✧ **The materials surrounding the brake resistor/brake unit must be fire-retardant. The surface temperature of the resistor is very high, which cause the temperature of the air flowing above the resistor to reach hundreds of centigrade; therefore, the materials must be prevented from contacting the resistor.** |

Installation of the brake resistor:

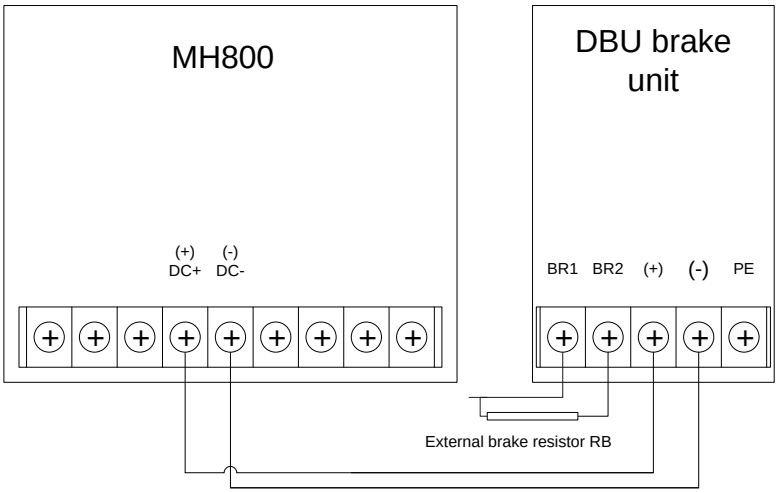
| | |
|---|---|
|  | ✧ **For 55kW and below models, only external brake resistor is needed.**<br>✧ **PB and(+) are the cable terminals of the brake resistor.** |



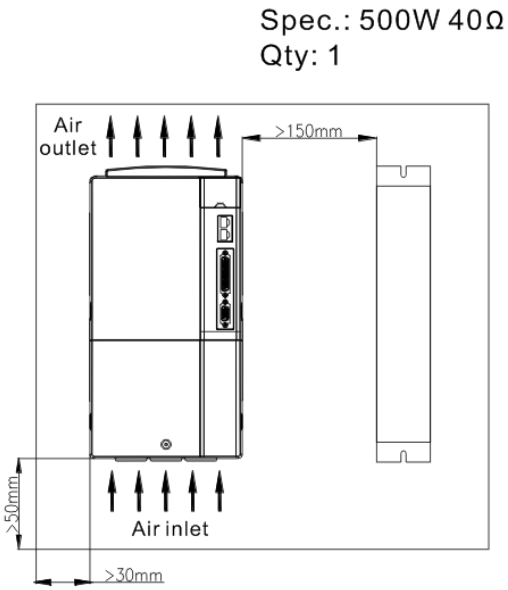

Installation of brake unit:

| | |
|---|---|
|  | ✧**For 75kW and above models, external brake unit is needed.**<br>✧**(+)and(-) are connection terminals of brake unit.**<br>✧**The length of the connection wire between (+)and(-) terminals of the inverter and (+), (-) terminals of the brake unit should be less than 5m; the wiring length of BR1 and BR2 of brake unit and the both ends of the brake resistor should be less than 10m.** |

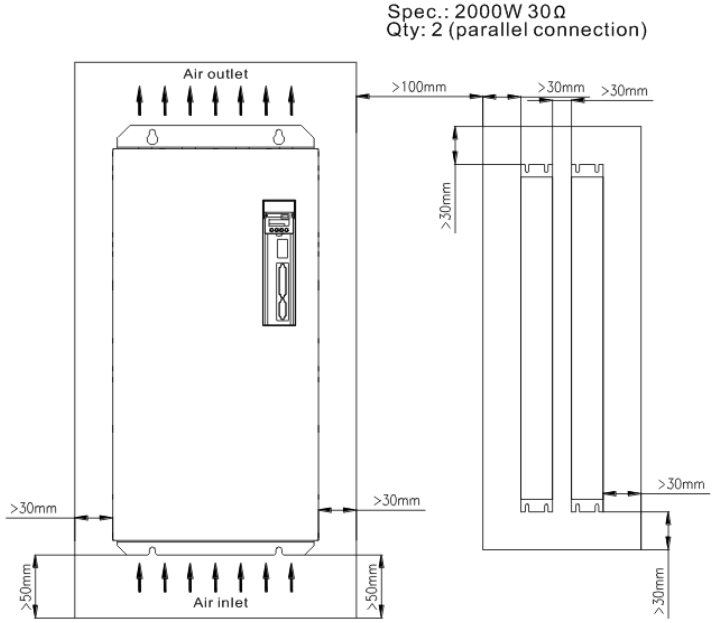
Connection of single unit is shown below:



a) SV-MH800-4R4/5R5/7R5/011/015/018/025/030/037 drive and brake resistor layout (mm)

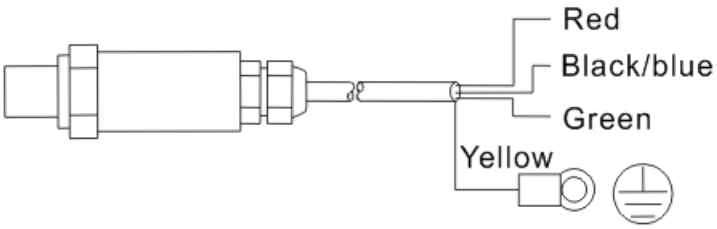



b) Layout of SV-MH800-045/055/075 drive and brake resistor (mm)



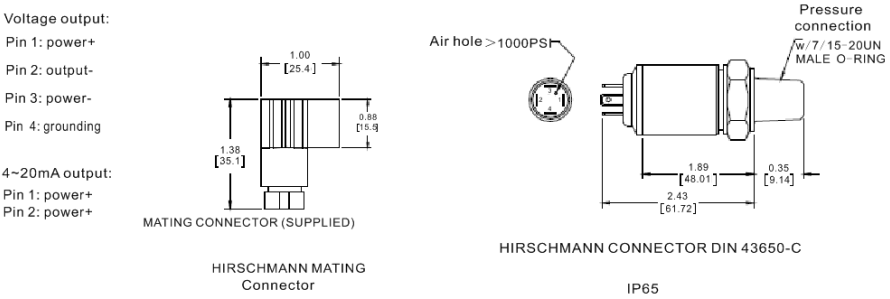
## 12.4 Pressure Sensor

1) Pressure sensor terminal




| Color | Name | Definition |
|---|---|---|
| Red | +15V | 15V power |
| Black/blue | AGND | Pressure analog signal output |
| Green | AIN3+ | |
| Yellow | PE | Connect ground line |

2) Dimension and installation of pressure sensor




Teflon tape should be used when pressure sensor is connected to oil circuit. During installation, screw tight the pressure sensor to prevent leakage.

## 12.5 External HMI Options

Refer to *5.1 External HMI Display and Operation* for details.

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