EMHEATER

User Manual

EM16-Z Hydraulic Servo Drive

China EM Technology Limited

Preface

Thank you for purchasing the EM16 series servo drive developed by China EM Technology Limited.

EM16 series servo drive is a servo drive specially developed by our electro-hydraulic servo drive for driving permanent magnet servo motor (PMSM), realising high performance vector control of permanent magnet synchronous motor, with the characteristics of energy saving, precision, high efficiency and durability. Mainly used in plastic forming, pipe extrusion, shoe making, rubber, metal die-casting and other industries

Before unpacking, please check carefully:

- Whether the nameplate model of servo drive are consistent with your order ratings. The box contains the servo drive, user manual.
- Whether the servo drive is damaged during transportation. If you find any omission or damage, please contact us or your local supplier immediately.

First-time Use

For the users who use this product for the first time, read the manual carefully. If in doubt concerning some functions or performances, contact the technical support personnel to ensure correct use.

Due to the continuous improvement of servo drive, this document will be updated without prior notice.

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1. Safety Information and Precautions

In this manual, the notices are graded based on the degree of danger:

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

Warning Indicates that failure to comply with the notice will result in personal injury or property damage.

1.1 Safety Information

Before installation		● Do not use damaged or missing components servo drive. Failure to comply will result in personal injury. ● Please use the electric motor with upper B insulation class. Failure to comply will result in personal injury.
During installation		● Install the servo drive on incombustible objects such as metal, and keep it away from combustible materials. Failure to comply may result in a fire.
		● When two servo drives are laid in the same cabinet, arrange the installation positions properly to ensure the enough cooling effect. ● Do not drop wire residue or screw into the servo drive. Failure to comply will result in damage to the servo drive.
Wiring		● Wiring must be performed only by qualified personnel under instructions described in this manual. Failure to comply may result in unexpected accidents. ● A circuit breaker must be used to isolate the power supply and the servo drive. Failure to comply may result in a fire. ● Ensure that the power supply is cut off before wiring. Failure to comply may result in electric shock. ● Connect the servo drive to ground properly by standard. Failure to comply may result in electric shock.
		● Never connect the power supply cables to the output terminals (U, V, W) of the Servo drive. Failure to comply will result in damage to the servo drive. ● Make sure that all the connecting wires comply with the requirement of EMC and the safety standard in the region. Use wire sizes recommended in the manual. Failure to comply may result in accidents. ● Never connect the braking resistor between the DC bus terminals (P+) and (P-). Failure to comply may result in a fire.
Before power-on		● Check that the following requirements comply with: The voltage class of the power supply is consistent with the rated voltage class of the servo drive. The input terminals (R, S, T) and output terminals (U, V, W) are properly connected. No short-circuit exists in the peripheral circuit. The wiring is fastened. Failure to comply will result in damage to servo drive. ● Cover the servo drive properly before power-on to prevent electric shock.
		● Do not perform the voltage resistance test on any part of the servo drive because such test has been done in the factory. Failure to comply will result in accidents. ● All peripheral devices must be connected properly under the instructions described in this manual. Failure to comply will result in accidents.

After power-on		● Do not open the servo drive's cover after power-on to prevent from electric shock. ● Do not touch the servo drive with wet hand and its peripheral circuit to prevent from electric shock. ● Do not touch the terminals of the servo drive (including the control terminals). Failure to comply may result in electric shock. ● Do not touch the U, V, W terminal or motor connecting terminals when servo drive automatically does safety testing for the external high-voltage electrical circuit. Failure to comply may result in electric shock.
		● Note the danger during the rotary running of motor when check the parameters. Failure to comply will result in accidents. ● Do not change the factory default settings of the servo drive. Failure to comply will result in damage to the servo drive.
During operation		● Do not go close to the equipment when selected the restart function. Failure to comply may result in personal injury. ● Do not touch the fan or the discharging resistor to check the temperature. Failure to comply will result in personal injury. ● Signal detection must be performed only by qualified personal during operation
		● Avoid objects falling into the servo drive when it is running. Failure to comply will result in damage to servo drive. ● Do not start/stop the servo drive by turning the contactor ON/OFF. Failure to comply will result in damage to the servo drive.
Maintenance		● Do not repair or maintain the servo drive at power-on. Failure to comply will result in electric shock. ● Repair or maintain the servo drive only after the charge light on servo drive is powered off. This allows for the residual voltage in the capacitor to discharge to a safe value. Failure to comply will result in personal injury. ● Repair or maintenance of the servo drive may be performed only by qualified personnel. Failure to comply will result in personal injury or damage to the servo drive.

1.2 General Precautions

Motor insulation test

Perform the insulation test when the motor is used for the first time, or when it is reused after being stored for a long time, or in a regular check-up, in order to prevent the poor insulation of motor windings from damaging the servo drive. The motor must be disconnected from the servo drive during the insulation test. A 500-V mega-Ohm meter is recommended for the test. The insulation resistance must not be less than 5 MΩ.

Thermal protection of motor

If the rated capacity of the motor selected does not match that of the servo drive, especially when the servo drive's rated power is greater than the motor's, adjust the motor protection parameters on the operation panel of the servo drive or install a thermal relay in the motor circuit for protection.

Motor heat and noise

The output of the servo drive is pulse width modulation (PWM) wave with certain harmonic frequencies, and therefore, the motor temperature, noise, and vibration are slightly greater than those motor runs at grid power frequency (50 Hz).

Voltage-sensitive device or capacitor at output side of the servo drive

Do not install the capacitor for improving power factor or lightning protection voltage-sensitive resistor at the output side of the servo drive because the output of the servo drive is PWM wave. Otherwise, the servo drive may suffer transient over current and even to be damaged.

Contactor at the Input or Output side of the servo drive

When contactor is installed between the input side of the servo drive for the power supplying, the servo drive must not be started or stopped by the contactor switching on or off. If the servo drive has to be operated by the contactor, ensure that the time interval between switching is at least one hour. Since frequently charge and discharge will shorten the service life of the capacitor inside of the servo drive.

When a contactor is installed between the output side of the servo drive and the motor, do not turn off the contactor when the servo drive is running. Otherwise, IGBT modules inside of servo drive may be damaged.

When input voltage is over rated voltage range

Do not change the three-phase power input of the servo drive to two-phase input. Otherwise, servo drive will be damaged.

Prohibition of three-phase input changed into two-phase input

Do not change the three-phase power input of the servo drive to two-phase input. Otherwise, servo drive will be damaged.

Surge suppressor

The servo drive has a built-in voltage sensitive resistor for suppressing the surge voltage. Using frequently surge place, please add extra surge voltage protection device at input side of servo drive.

Note: Do not add the surge suppressor at the output side of the servo drive.

Some special application

If wiring that is not described in this manual such as shared DC bus is applied, please contact the agent or our company for technical supporting.

Scrap disposition

The electrolytic capacitors on the main circuit and PCB board may explode when they are burning. Poisonous gas is generated when the plastic parts are burning. Please treat them as industrial waste by special way.

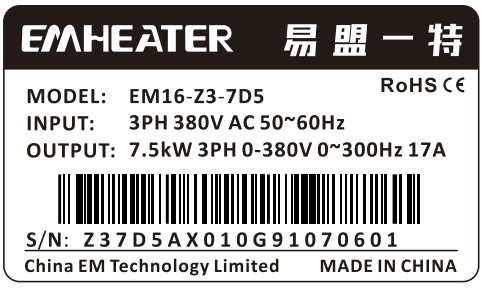
Matched Motor

- The standard matched motor is suitable permanent magnet synchronous servo motor.
- The common standard parameters of the matched motor have been configured inside the servo drive. It is still necessary to perform motor auto-tuning or modify the default values based on actual application. Otherwise, the running result and protection performance will be weaken.
- The servo drive may alarm and even be damaged when short-circuit exists on cables or inside the motor. Therefore, perform insulation test when the motor and cables are newly installed or during routine maintenance. During the test, make sure the servo drive is disconnected from the tested parts

2. Product Information

2.1 Products Label and Model Designation

EM16 - Z 3 - 7d5
❶ ❷ ❸ ❹



❶	EM16 Series Servo drive
❷	Products Type: Z: Electro-hydraulic servo drive
❸	Voltage range:

Symbol	Input	Output
2	3 phase 220V	3 phase 220V
3	3 phase 380V	3 phase 380V

❹	Adaptable motor: 7d5: 7.5KW ;011: 11KW

Diagram 2-1 Products Label and Designation rules

Product appearance

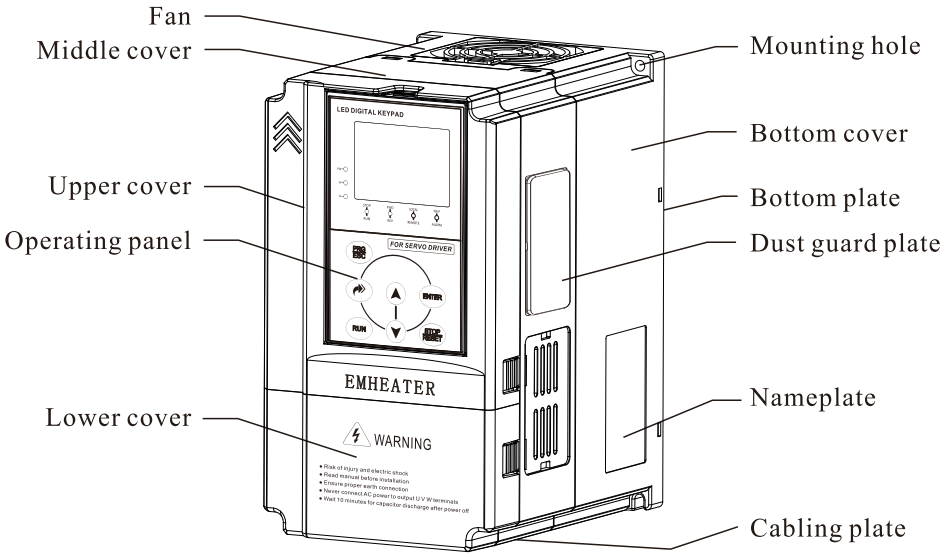


Diagram 2-2 Structural appearance

The housing types of the EM16 models are listed in the following table:

Type	Plastic	Sheet metal
3PH 220V	4kW~11kW	15kW~45kW
3PH 380V	7.5kW~22kW	30kW~90kW

2.2 Technical Specifications

Input &Output	● **Input Voltage:** 220V/380V±15% ● **Input Frequency:** 47~63Hz ● **Input Frequency Resolution:** 0.01Hz (Digital setting); maximum frequency×0.025% (Analog setting) ● **Output Voltage:**0~Rated input voltage ● **Output Frequency:** 0~320Hz(FVC) ● **Carrier Frequency:** 1kHz~16kHz

Technical Performance	● **Control Mode:** Closed-loop vector control (FVC); Voltage/Frequency (V/F) control ● **Startup Torque:** 0.5Hz/150% (FVC); 0Hz/180%(FVC) ● **Speed Range:** 1:1000(FVC) ● **Speed Stability Accuracy:** ±0.02%(FVC) ● **Torque Control Accuracy:** ±5%(FVC) ● **Overload Capacity:** 150% rated current 60s; 180% rated current 3s
Individualized Functions	● **Auto voltage regulation (AVR):** It can keep constant output voltage automatically when the mains voltage fluctuation ● **Overvoltage/ Overcurrent Stall Control:** The current and voltage are limited automatically during the running process so as to avoid frequently tripping due to overvoltage / over current. ● **Rapid Current Limit:** To avoid frequently over current faults of the servo drive. ● **High Performance:** Control of asynchronous motor is implemented through the high-performance current vector control technology. ● **Motor Overheat Protection:** The optional I/O extension card enables AI3 to receive the motor temperature sensor input (PT100, PT1000) so as to realize motor overheat protection. ● **Multiple Encoder Types:** It supports differential encoder, open-collector encoder ● **Protection Mode:** Motor short-circuit detection after power-on, input/output phase loss protection, over current and overvoltage protection, less voltage protection, overheat protection and overload protection,etc
External Interface	● **Programmable Digital Input:** 5 digital input (DI) terminals ● **Programmable Analog Input:** 3 analog input (AI) terminals, AI1 support 0V~10V or 0mA~20mA input, AI2/AI3 support -10V~+10V ● **Programmable Analog Output:**2 analog output (AO) terminals, AO1/AO2 both of them supports 0mA~20mA and 0V~10V. ● **Relay Output:** 2 relay output terminal ● **Programmable Digital Output:** 1 digital output terminal
Environment	● **Installation Location:** Indoor, no direct sunlight, dust, corrosive gas, combustible gas, oil smoke, vapour, drip or salt. ● **Altitude:** Lower than 1000m ● **Ambient Temperature:** -10°C~ +40°C (de-rated if the ambient temperature is between 40°C and 50°C) ● **Humidity:** Less than 95%RH, without condensing ● **Vibration:** Less than 5.9 m/s2 (0.6 g) ● **Storage Temperature:** -20°C ~ +60°C

2.3 Model and Technical data

Model	Power Capacity (KVA)	Input Current (A)	Output Current (A)	Adaptable Motor	
				KW	HP
Three phase 220V 50/60Hz					
EM16-Z2-004	8.9	14.6	13	3.7	5
EM16-Z2-5d5	17	26	25	5.5	7.5
EM16-Z2-7d5	21	35	32	7.5	10
EM16-Z2-011	30	46.5	45	11	15
EM16-Z2-015	40	62	60	15	20
EM16-Z2-018	57	76	75	18.5	25
EM16-Z2-022	69	92	91	22	30
EM16-Z2-030	85	113	112	30	40
EM16-Z2-037	114	157	150	37	50
EM16-Z2-045	134	180	176	45	60
Three phase 380V 50/60Hz					
EM16-Z3-7d5	11	20.5	17	7.5	10
EM16-Z3-011	17	26	25	11	15
EM16-Z3-015	21	35	32	15	20

Model	Power Capacity (KVA)	Input Current (A)	Output Current (A)	Adaptable Motor	
				KW	HP
EM16-Z3-018	23	36.5	35	18.5	25
EM16-Z3-022	30	46.5	45	22	30
EM16-Z3-030	40	62	60	30	40
EM16-Z3-037	57	76	75	37	50
EM16-Z3-045	69	92	91	45	60
EM16-Z3-055	85	113	112	55	75
EM16-Z3-075	114	157	150	75	100
EM16-Z3-090	134	180	176	90	125

2.4 Product appearance and installation dimension

EM16 appearance and Installation Hole Dimension (mm)

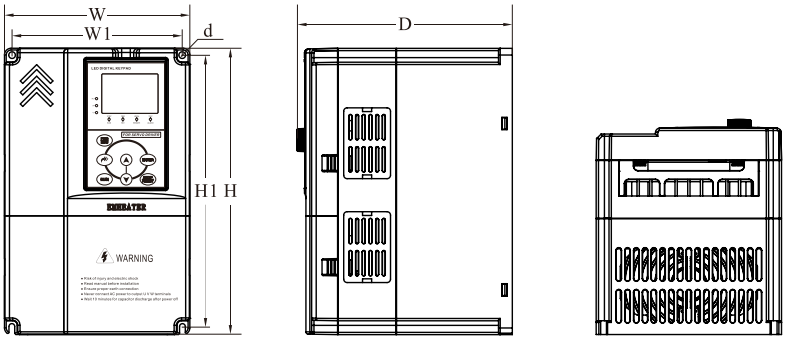


Diagram 2-3 Single phase 4~22KW Wall-mounted installation dimensions

Matching inverter		Appearance and installing dimension (Unit: mm)					
Voltege	Power Range	W	W1	H	H1	D	d
3PH 220V	4~5.5kW	162	148	250	238	191	Φ5.5
3PH 380V	7.5~11kW						
3PH 220V	7.5~11kW	223	207	323	307	207	Φ5.5
3PH 380V	15~22kW						

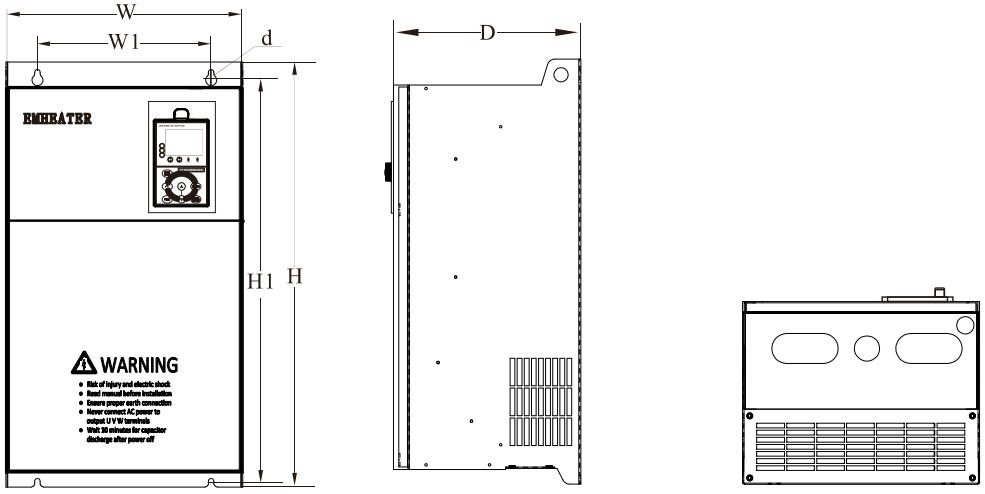


Diagram 2-4 Three phase 30~90kW Wall-mounted installation dimensions

Matching inverter		Appearance and installing dimension (Unit: mm)					
Voltege	Power Range	W	W1	H	H1	D	d
3PH 220V	15~18.5kW	300	220	540	500	240	Φ7
3PH 380V	30~37kW						
3PH 220V	22~30kW	340	260	580	540	270	Φ10
3PH 380V	45~55kW						
3PH 220V	37~45kW	410	260	610	575	280	Φ12
3PH 380V	75~90kW						

2.5 Daily maintenance of servo drives

2.5.1 Daily maintenance

Due to the influence of temperature, humidity, dust and vibration, it will lead to poor heat dissipation and component aging of servo drive, and results in potential failure or reducing the service life of servo drive. Therefore, it is necessary to do daily and regular maintenance of the servo drive.

Daily check items:Daily check items:

1. Check if the servo drive sound is normal during the running of the motor;
2. Check if there is a vibration during the running of the motor;
3. Check whether the installation environment of servo drive has changed;
4. Check if the cooling fan of servo drive is working correctly, the cooling air duct is clear;
5. Check if the servo drive is overheating;
6. Make sure that the servo drive should always be kept in a clean state;
7. Clear up effectively the dust on the surface of the servo drive, prevent the dust from entering into the inside of the servo drive, especially for the metal dust;
8. Clear up effectively the oil and dust on the cooling fan of servo drive.

2.5.2 Regular inspection

Please regularly check servo drive, especially for the difficult checking place during running.

Regular inspection items:

1. Check the air duct and clear up regularly;
2. Check if there are any loose screws;
3. Check if the inverter has been corroded;
4. Check whether the wiring terminals show signs of arcing.

Note: When using the megger(please use the DC 500V meg ohm meter) to measure the insulation resistance, you shall disconnect the main circuit to the servo drive. Do not use the insulation resistance meter to test the control circuit. Do not to do the high voltage test (It has been done when the servo drive producing in factory.)

2.5.3 Replacement of wearing parts

The vulnerable parts of servo drive include the cooling fan and filter electrolytic capacitor, its service life is closely related to the using environment and maintenance status. The general service life is:

Part Name	Service Life
Fan	3 to 4 Years
Electrolytic capacitor	5 to 6 Years

The user can confirm the replace time according to the running time.

1. Possible reasons for the damage of cooling fan: bearing wear and blade aging. Distinguish standard: Any cracks in the fan blade, any abnormal vibration sound during the starting of servo drive.

2. Possible reasons for the damage of filting electrolytic capacitor: poor quality of the input power supply, the environment temperature is higher, the load change frequently and the electrolyte aging. Distinguish standard: Any leakage of its liquid, if the safety valve is protruding, please test capacitor electrostatic capacitance and insulation resistance.

2.5.4 Storage of the servo drive

After buying the servo drive, users shall pay attention to the temporary and long-term storage as following:

1. Store the servo drive in the original packaging;
2. Long-term storage can lead to the degradation of electrolytic capacitors, and must ensure to power on for once within 2 years. And the power-on time is at least 5 hours. The input voltage must slowly rise to the rating by using the voltage regulator.

2.6 Selection Guide of braking component

Table 2-5 is the recommended value of braking resistor, users can select the different resistance value and power according to the actual situation,(but the resistance value must not be less than the recommended value in the table, and the power can be bigger.) The selection of braking resistance need to be confirmed according to the power that the motor generated in the practical application systems, and is relevant to the system inertia, deceleration time, the energy of the potential energy load, needs customers to choose according to actual situation. The greater the inertia and the shorter deceleration time is needed more frequently braking, so the braking resistor needs the one with bigger power but smaller resistance value.

2.6.1 Selection of braking resistance value

When braking, almost all the regenerated energy of motor is consumed by the braking resistor.

According to the formula: U * U/R = Pb

In the formula:

U --- The braking voltage when the system brake stably (different system is different, for the 380VAC system generally take 700V)

R - Braking resistor value

Pb – Power of braking(W)

2.6.2 Selection power of braking resistor

In theory the power of braking resistor is consistent with the braking power, but it need to be taken into consideration that the braking resistor power will derate to 70%.

According to the formula: 0.7*Pr=Pb*D

In this formula:

Pr----Power of resistor

D---- Braking proportion (the proportion that the regeneration process accounts for the whole process)

Table 2-5 EM16 servo drive braking components selection table

Inverter Power	Recommend power of braking resistor	Recommend resistance value of braking resistor	Braking unit	Remarks
Three phase 220V				
EM16-Z2-004	400W	≥ 45Ω	Built-in as standard	No special instructions
EM16-Z2-5d5	800W	≥ 22Ω		
EM16-Z2-7d5	1000W	≥ 16Ω		

Inverter Power	Recommend power of braking resistor	Recommend resistance value of braking resistor	Braking unit	Remarks
EM16-Z2-011	1500W	≥ 11Ω		
EM16-Z2-015	2500W	≥ 8Ω		
EM16-Z2-018	3.7 kW	≥ 8Ω		
EM16-Z2-022	4.5 kW	≥ 8Ω		
EM16-Z2-030	5.5 kW	≥ 4Ω		
EM16-Z2-037	7.5 kW	≥ 4Ω		
EM16-Z2-045	9kW	≥ 4Ω		
Three phase 380V				
EM16-Z3-7d5	500W	≥ 65Ω	Built-in as standard	No special instructions
EM16-Z3-011	800W	≥ 43Ω		
EM16-Z3-015	1000W	≥ 32Ω		
EM16-Z3-018	1300W	≥ 25Ω		
EM16-Z3-022	1500W	≥ 22Ω		
EM16-Z3-030	2500W	≥ 16Ω		
EM16-Z3-037	3.7 kW	≥ 16Ω		
EM16-Z3-045	4.5 kW	≥ 16Ω		
EM16-Z3-055	5.5 kW	≥ 16Ω		
EM16-Z3-075	7.5 kW	≥ 12Ω		
EM16-Z3-090	9kW	≥ 8Ω		

2.6.3 Braking resistor connection description

The braking resistor connection of EM16 series servo drive is showed as below:

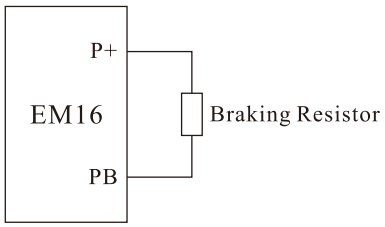


Diagram 2-5 Braking resistor connection scheme

3. Installation of Servo Drive

3.1 Installation environment

1. The place with indoor vents or ventilation devices.
2. The environment temperature shall be -10℃~40℃. If the temperature is over 40℃but less than 50℃, better to take down the cover of servo drive or open the front door of cabinet to facilitate heat dissipation.
3. Try to avoid high temperature and wet place; the humidity shall be less than 90% without frost deposit.
4. Avoid direct sunlight.
5. Keep away from flammable, explosive and corrosive gas and liquid.
6. No dust, floating fiber and metal particles.
7. Install on the place without strongly vibration. And the vibration should be not over 0.6G, please pay attention to far away from the punching machine, etc.
8. Keep away from electromagnetic interference source.

3.2 Installation direction and space

In order to not affect the service life of servo drive and reduce its performance, note for its installation direction and space and correctly fasten it.

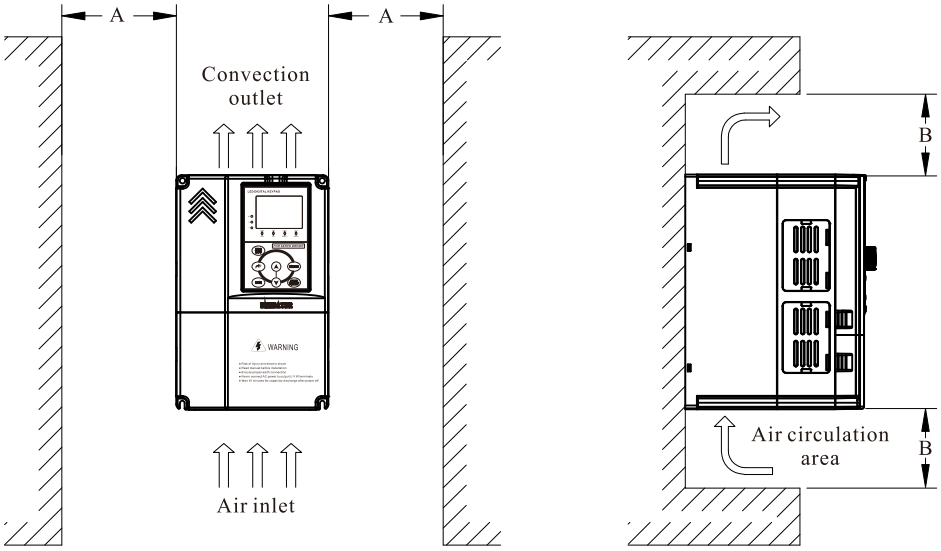


Diagram3-1 Ventilating duct installation dimension diagram of servo drive

Power class	Installation dimension	
	A	B
≤7.5kW	≥ 20mm	≥ 100mm
11kW~30kW	≥ 50mm	≥ 200mm
≥ 37kW	≥ 50mm	≥ 300mm

Note:

Please install the servo drive vertically, to dissipate heat upward, and pay attention to direction of servo drive to avoid inversion.

If there are several units of servo drive installed in one cabinet, please install them side by side, do not to install up and down.

3.3 Peripheral Devices Connection Diagram

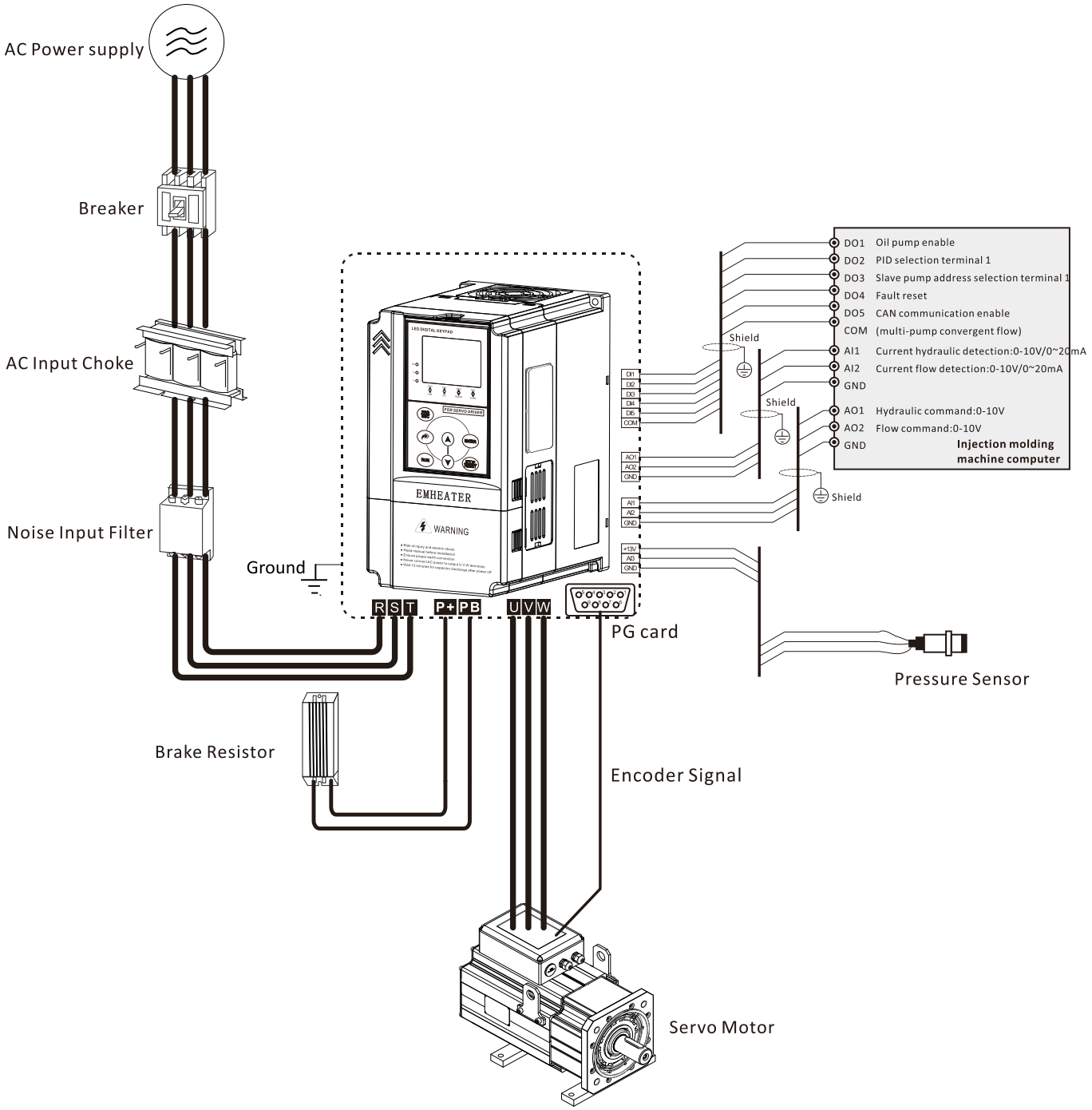


Diagram 3-2 Peripheral Devices Connection

3.4 Model Selection of Main Circuit Peripheral Devices

Table 3-1 Model Selection Diagram of Main Circuit Peripheral Devices (Recommended)

Model	MCCB (A)	Contactor (A)	Cable of Input Side Main Circuit (mm^2)	Cable of Output Side Main Circuit (mm^2)	Cable of Control Circuit (mm^2)
Three-phase 220V					
EM16-Z2-004	32	25	4.0	4.0	1.0

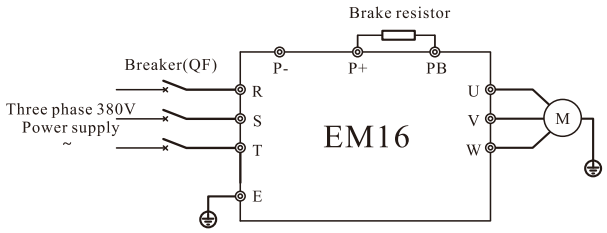
Model	MCCB (A)	Contactor (A)	Cable of Input Side Main Circuit (mm^2)	Cable of Output Side Main Circuit (mm^2)	Cable of Control Circuit (mm^2)
EM16-Z2-5d5	63	40	4.0	4.0	1.0
EM16-Z2-7d5	63	40	6.0	6.0	1.0
EM16-Z2-011	100	100	10	10	1.0
EM16-Z2-015	125	125	16	10	1.0
EM16-Z2-018	160	160	16	16	1.0
EM16-Z2-022	200	200	25	25	1.0
EM16-Z2-030	200	200	35	35	1.0
EM16-Z2-037	250	250	50	50	1.0
EM16-Z2-045	250	250	70	70	1.0
Three-phase 380V					
EM16-Z3-7d5	40	40	4.0	4.0	1.0
EM16-Z3-011	63	63	4.0	4.0	1.0
EM16-Z3-015	63	63	6.0	6.0	1.0
EM16-Z3-018	100	100	6	6	1.0
EM16-Z3-022	100	100	10	10	1.0
EM16-Z3-030	125	125	16	16	1.0
EM16-Z3-037	160	160	16	16	1.0
EM16-Z3-045	200	200	25	25	1.0
EM16-Z3-055	250	250	35	35	1.0
EM16-Z3-075	250	250	50	50	1.0
EM16-Z3-090	350	350	70	70	1.0

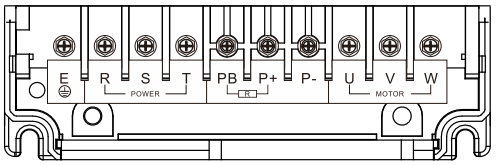
3.5 Sketch and Description of Main Circuit Terminals

Function and description of Main Circuit Terminals

Three phase 220V: EM16-Z2-004 ~ EM16-Z2-011

Three phase 380V: EM16-Z3-004 ~ EM16-Z3-022

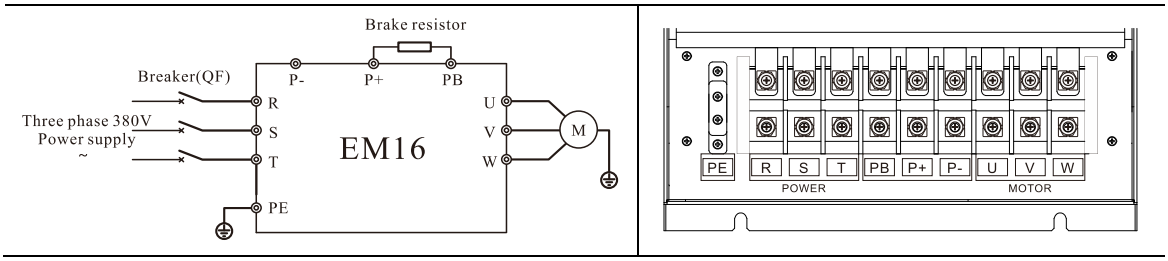




Note: P + and P- are DC input, prohibit external braking unit

Three phase 220V: EM16-Z2-015 ~ EM16-Z2-045

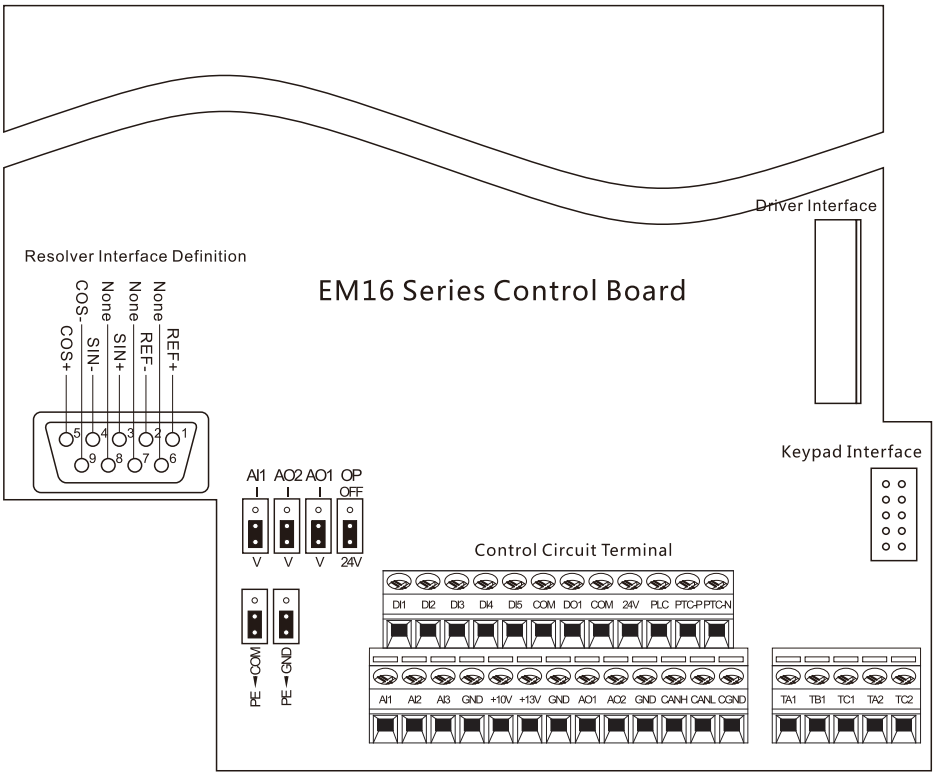
Three phase 380V: EM16-Z3-030~ EM16-Z3-090



Terminal symbol	Function description
R、S、T	Three-phase AC power input terminals
P+、PB	Braking resistor connection
P、P+	External DC reactor connecting terminals-shorted by bronze before delivery
⏚ or E/PE	Grounding terminal
U,V,W	Three-phase AC power output terminals

3.6 Control Circuit and Main Circuit Terminals Description

3.6.1 Control Circuit and Main Circuit Wiring



3-11 EM16 Control Circuit Terminal Sketch Map

3.6.2 Description of control circuit terminals

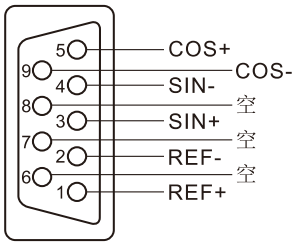
Table 3-2 Description of control circuit terminals

Type	Terminal Symbol	Terminal Name	Terminal function description
Power	+10V-GND	External +10V power supply	Provide +10V power supply to external unit. Maximum output current:10mA

Type	Terminal Symbol	Terminal Name	Terminal function description
Supply			Generally, it provides power supply to external potentiometer with resistance range of 1 kΩ~5kΩ
	+13V-GND	Pressure sensor power supply	Supplied externally with 13V±10% power supply, maximum output current: 10mA Generally used as a power supply for pressure sensors.
	+24V-COM	External +24V power supply	Provide +24 V power supply to external unit. Generally, it provides power supply to DI/DO terminals and external sensors. Maximum output current: 200 mA
	PLC	External power supply input terminals	It connect with +24V terminal by default
Analog input	AI1-GND	Analog input 1	1. Input range: AI1: DC 0V~10V/0mA~20mA；AI2/AI3: DC -10V~+10V。 2. Impedance: 22 kΩ (voltage input), 500 Ω (analog current input)
	AI2-GND	Analog input 2	
	AI3-GND	Analog input 3	
Digital input	DI1-COM	Digital input 1	1. Optical coupling isolation, option dual polarity input 2. Input Impedance: 2.4 kΩ 3. Voltage range of level input: 9V~30 V
	DI2-COM	Digital input 2	
	DI3-COM	Digital input 3	
	DI4-COM	Digital input 4	
	DI5-COM	Digital input 5	
	PTCP-PTCN	Motor overheat protection input	Motor temperature overheating protection PTC sensor. Support: PTC130, PTC150, etc.
Digital output	DO1-COM	Digital output	Optocoupler isolated, open collector output. Output current range: 0-50mA
Analog output	AO1-GND	Analog output 1	Voltage or current output type is decided by jumper AO1/AO2. Output voltage range: 0V~10 V Output current range: 0mA~20 mA
	AO2-GND	Analog output 2	
Relay output	TA1-TB1	NC terminal	Contact driving capacity: 250 Vac, 3 A, COSø = 0.4 30 Vdc, 1 A
	TA1-TC1	NO terminal	
	TA2-TC2	NO terminal	
CAN output	CANH/CANL	CAN communicationg	Maximum communication speed 1Mbps
	CGND		
Jumper	PE-COM		COM grounding PE selection, default connected. In the meeting of interference, connecting PE to COM can improve anti-interference
	PE-GND		GND grounding PE selection, default connected. In the meeting of interference, connecting PE to COM can improve anti-interference ability.
	AI1		AI1 output type selection. Voltage or Current output, voltage output by default.
	AO1		AO1 output type selection.

Type	Terminal Symbol	Terminal Name	Terminal function description
			Voltage or Current output, voltage output by default.
	AO2		AO2 output type selection. Voltage or Current output, voltage output by default.
	OP		Internal power supply drives DI1 to DI5 input terminals; external power supply needs to be shorted to OFF

3.6.3 Description of the function of the PG card terminals of the servo drive

No.	Terminal Name	Terminal Symbol	Pin definitions
1	REF+	Excitation signal	
2	REF-		
3	SIN+	Sine feedback signal	
4	SIN-		
5	COS+	Cosine feedback signal	
9	COS-		
6~8	-	Reserved	

4. Operation and Display

4.1 Instruction of operation and display

The operation panel can modify the function parameters of the servo drive, monitor the working status of the servo drive and control the operation of the servo drive (start, stop), etc. Its appearance and functions are shown in the figure below:

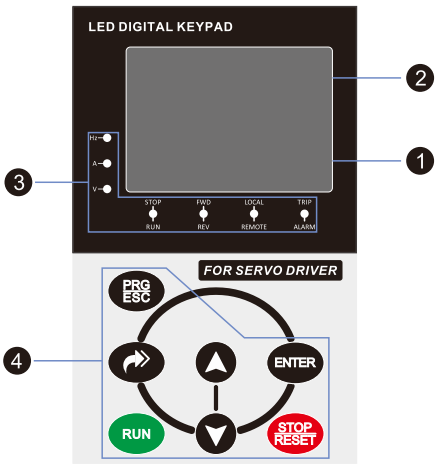


Diagram 4-1 Operating Keypad

No.	Name	Function	
❶	Main LED display area	The 5-digit LED display is able to display the setting frequency, output frequency, monitoring data and Error codes.	
❷	Auxiliary LED display area	The 5-digit LED display is able to display various operating status information, such as the running frequency, the setting frequency, output voltage and so on.	
❸	Unit / Status Indicator area	Hz	Frequency unit
		A	Current unit
		V	Voltage unit
		STOP/RUN	OFF indicates that the servo drive is in the stop state and ON indicates that the servo drive is in the running state.
		FWD/REV	It is Forward/Reverse indicator, ON indicates reverse rotation.
		LOCAL /REMOTE	It indicates whether the servo drive is operated by operation keypad, terminals or communication. OFF indicates keypad operation control state; ON indicates terminals operation control state; Blinking indicates communication operation control state.
		TRIP /ALARM	Tunning/ Torque Control/Fault indicator When the indicator is ON, it indicates torque control mode. When the indicator is blinking slowly, it indicates the auto-tuning state. When the indicator is blinking quickly, it indicates the error state.
❹	Operation key area	PRG ESC	Programming key: Enter or exit menu level I.
		ENTER	Confirmation key: Enter the menu interfaces level by level, and confirm the parameter setting.
			Multi-function key: Perform function switchover according to the setting of b9-01
			Shift key: Select the displayed parameters in turn in the stop or running state, and select the digit to be modified when modifying parameters.
			Increment key: Increase data or function code.
		RUN	Decrement key: Decrease data or function code.
		STOP RESET	Stop/Reset key: Stop the servo drive when it is in the running state and perform the reset operation when it is in the error state.

4.2 Viewing and Modifying Function Codes

The operation panel of the EM16 adopts three-level menu.

The three-level menu consists of function code group (Level I), function code (Level II), and function code setting value (level III), as shown in the following figure.

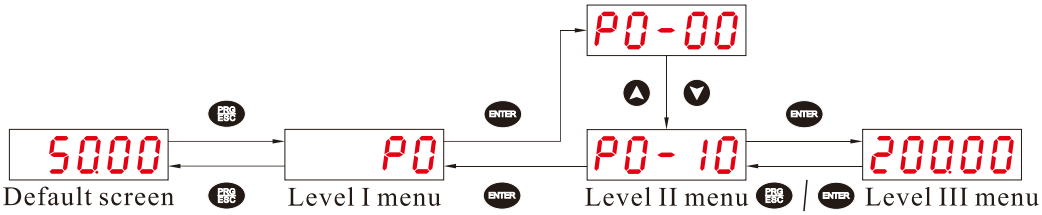


Diagram 4-2 Operation procedure on the operation panel

Instruction: We can return to level II menu from Level III menu by pressing "PRG/ESC" or "ENTER".

The difference between them is:

After you press "ENTER", the system saves the parameter setting first, and then goes back to Level II menu and shifts to the next function code.

After you press "PRG/ESC", the system does not save the parameter setting, but directly returns to Level II menu and remains at the present function code.

Under the Level III state, if there is no blinking digit of this parameter, then it indicates that the parameter can not to be modified. The possible reasons are:

1. This function code is a non-modifiable parameter, such as the actual testing parameters, operation records, etc.
2. This function code cannot be modified under the running state, but can modify after stopping.

4.3 Table of parameters

The parameter function tables are described below:

Group P0: Basic Function Parameters

Code	Parameter Name	Functional description	Default
P0-00	Model type	1: Heavy load	1
P0-01	Control mode	0: Reserved 1: Closed-loop vector control(FVC) 2: V/F control	1
P0-02	Command source selection	0: Keypad control (LED off) 1: Terminal control (LED on) 2: Communication control (LED blinking)	0
P0-03	Main frequency source X selection	0: Digital setting (UP/DOWN modifiable, no-record after power off) 1: Digital setting (UP/DOWN modifiable, record after power off) 2: AI1 3: AI2 4: AI3 6: Multi-function 9: Communication setting	1
P0-04	Auxiliary frequency source Y selection	The same as P0-03 (Main frequency source X selection)	0
P0-05	Selection of auxiliary frequency Y range	0: Relative to maximum frequency 1: Relative to main frequency X	0
P0-06	Range of auxiliary frequency Y	0%~150%	100%

Code	Parameter Name	Functional description	Default
P0-07	Frequency source selection	0: Main frequency source X 1: X and Y calculation	0
P0-08	Preset frequency	0.00Hz~maximum frequency(P0-10)	50.00Hz
P0-09	Rotating direction	0: Same direction 1: Reverse direction	0
P0-10	Maximum frequency	50.00Hz~300.00Hz	200.00Hz
P0-11	Source of frequency upper limit	0: Set by F0-12 1: AI1 2: AI2 3: AI3 4: Reserved 5: Communication setting	0
P0-12	Frequency upper limit	Frequency lower limit(P0-14) ~ maximum frequency (P0-10)	200.00Hz
P0-13	Frequency upper limit offset	0.00Hz~maximum frequency(P0-10)	0.00H
P0-14	Frequency lower limit	0.00Hz~Frequency upper limit(P0-12)	0.00H
P0-15	Carrier frequency	1kHz~16.0kHz	Model dependent
P0-16	Carrier frequency adjustment selection	0: Carrier frequency temperature adjustment invalid 1: Carrier frequency temperature adjustment valid	1
P0-17	Acceleration time 1	0.0s~6500.0s	20.0s
P0-18	Deceleration time 1	0.0s~6500.0s	20.0s

Group P1: Motor Parameters

Code	Parameter Name	Functional description	Default
P1-00	Motor type selection	0: Common asynchronous motor 1: Variable frequency asynchronous motor 2: Permanent magnet synchronous motor	2
P1-01	Rated motor power	0.4kW~1000.0kW	Model dependent
P1-02	Rated motor voltage	0V~440V	Model dependent
P1-03	Rated motor current	0.01A~655.35A	Model dependent
P1-04	Rated motor frequency	0.00~maximum frequency	Model dependent
P1-05	Rated motor speed	0rpm~30000rpm	Model dependent
P1-11	Shaft D inductance	0~65535	Model dependent
P1-12	Shaft Q inductance	0~65535	Model dependent
P1-13	Stator resistance	0~65535	Model dependent
P1-14	Unit	00~12	Model dependent
P1-15	Back electromotive force	0~65535V	Model dependent
P1-16	Auto tuning selection	0: No action 1: Static auto-tuning	0

		2: Dynamic auto-tuning without load, reverse high speed rotation 3: Static auto-tuning with load 4: Fast dynamic auto-tuning without load, reverse high speed rotation. 5: Dynamic auto-tuning without load, forward high speed rotation 6: Fast dynamic auto-tuning without load, forward high speed rotation.	

Group P2: Vector Control Parameters

Code	Parameter Name	Functional description	Default
P2-00	Speed loop proportional gain 1	0~400	60
P2-01	Speed loop integration time 1	0.01s~10.00s	0.30s
P2-02	Switchover frequency 1	0.00~P2-05	5.00Hz
P2-03	Speed loop proportional gain 2	0~400	60
P2-04	Speed loop integration time 2	0.01s~10.00s	0.30s
P2-05	Switchover frequency 2	P2-02~ maximum frequency	10.00Hz
P2-06	Slip compensation coefficient	50%~200%	100%
P2-07	Time constant of speed loop filter	0.5~10.0ms	1.0ms
P2-08	Torque control	0: Invalid 1: Valid	0
P2-09	Torque upper limit source	0: P2-10 1: AI1 2: AI2 3: AI3 4: Reversed 5: Communication setting Analog input range corresponding to P2-10	0
P2-10	Torque upper limit	0.0%~250.0%	200.0%
P2-11	Torque command filter frequency	0Hz~1500Hz	500Hz
P2-13	Shaft D current loop Kp	0.2~5.0	1.0
P2-14	Shaft D current loop Ki	0.2~5.0	1.0
P2-15	Shaft Q current loop Kp	0.2~5.0	1.0
P2-16	Shaft Q current loop Ki	0.2~5.0	1.0
P2-27	Automatic phase sequence adjustment selection according to model	0: No adjust 1: Adjust phase sequence according to model	1

Group P4: Input Terminals

Code	Parameter Name	Functional description	Default
P4-00	DI1 function selection	0: No function 1: Forward RUN(FWD, pump enaled) 2: Reverse RUN(REV) 3: Three line control 4: Forward JOG 5: Reverse JOG 8: Free stop 9: Fault reset(RESET) 11: External fault NO input 12: Multi-function terminal 1 13: Multi-function terminal 2 14: Multi-function terminal 3 15: Multi-function terminal 4 33: External fault NC input	1
P4-01	DI2 function selection		0
P4-02	DI3 function selection		9

Code	Parameter Name	Functional description	Default
P4-03	DI4 function selection	48: Servo pump PID selection terminal 1 49: Servo pump PID selection terminal 2 50: CAN communication enabled 51: Slave pump terminal enabled 52: Switchover from pressure mode to speed mode 53: Slave pump address selection terminal 1 54: Slave pump address selection terminal 2 55: Switchover from injection to pressure holding 56: Fault reset (Overcurrent cannot be reset)	0
P4-04	DI5 function selection		0
P4-15	DI filter time	1~10	4
P4-16	Terminal command mode	0: Two-line mode 1 1: Two-line mode 2 2: Three-line mode 1 3: Three-line mode 2	0
P4-18	AI1 minimum input	-11.00V~11.00V	0.02V
P4-19	Corresponding setting of AI1 minimum input	-100.0%~100.0%	0.0%
P4-20	AI1 maximum input	-11.00V~11.00V	10.00V
P4-21	Corresponding setting of AI1 maximum input	-100.0%~100.0%	100.0%
P4-22	AI1 filter time	0.000s~10.000s	0.010s
P4-23	AI2 minimum input	-11.00V~11.00V	0.02V
P4-24	Corresponding setting of AI2 minimum input	-100.0%~100.0%	0.0%
P4-25	AI2 maximum input	-11.00V~11.00V	10.00V
P4-26	Corresponding setting of AI2 maximum input	-100.0%~100.0%	100.0%
P4-27	AI2 filter time	0.000s~10.000s	0.005s
P4-28	AI3 minimum input	-11.00V~11.00V	0.02V
P4-29	Corresponding setting of AI3 minimum input	-100.0%~100.0%	0.0%
P4-30	AI3 maximum input	-11.00V~11.00V	10.00V
P4-31	Corresponding setting of AI3 maximum input	-100.0%~100.0%	100.0%
P4-32	AI3 filter time	0.000s~10.000s	0.000s
P4-43	AI1 sampling voltage 1	-9.999V~9.999V	2.000V
P4-44	AI1 corrected voltage 1	-9.999V~9.999V	2.000V
P4-45	AI1 sampling voltage 2	-9.999V~9.999V	8.000V
P4-46	AI1 corrected voltage 2	-9.999V~9.999V	8.000V
P4-47	AI2 sampling voltage 1	-9.999V~9.999V	2.000V
P4-48	AI2 corrected voltage 1	-9.999V~9.999V	2.000V
P4-49	AI2 sampling voltage 2	-9.999V~9.999V	8.000V
P4-50	AI2 corrected voltage 2	-9.999V~9.999V	8.000V
P4-51	AI3 sampling voltage 1	-9.999V~9.999V	2.000V
P4-52	AI3 corrected voltage 1	-9.999V~9.999V	2.000V
P4-53	AI3 sampling voltage 2	-9.999V~9.999V	8.000V
P4-54	AI3 corrected voltage 2	-9.999V~9.999V	8.000V

Group P5: Output terminals

Code	Parameter Name	Functional description	Default
P5-01	Relay (TA1-TB1-TC1) function selection	0: No output 1: Servo drive running 2: Fault output 6: Motor overload pre-warning	2

Code	Parameter Name	Functional description	Default
P5-02	Relay (TA2-TC2) function selection	7: Servo drive overload pre-warning 19: Undervoltage status output 20: Communication setting 23: Double-discharge plunger pump sloping switchover (NO) 24: Hydraulic control NC output 25: Slave pump alarm 26: Injection slop switchover 28: Business running time reached 29: Business running time not reaching 24 hours	1
P5-03	DO1 function selection		0
P5-10	AO1 output selection	0: Running frequency 1: Set frequency 2: Output current 3: Output torque 4: Output power 5: Output voltage 6: Reserved 7: AI1 8: AI2 9: AI3 10: Feedback rotational speed (hydraulic control mode) 11: Feedback pressure (hydraulic control mode) 12–16: Reserved	10
P5-11	AO2 output selection		11
P5-14	AO1 offset coefficient	-100.0%~100.0%	0.0%
P5-15	AO1 gain	-10.00~10.00	1.00
P5-16	AO2 offset coefficient	-100.0%~100.0%	0.0%
P5-17	AO2 gain	-10.00~10.00	1.00

Group P7: Keypad and Display parameters

Code	Parameter Name	Functional description	Default
P7-02	STOP/RESET key terminal	0: Valid only in operation panel control 1: Stop function valid in terminal control 2: Reset function valid in terminal control 3: Both stop and reset functions valid in terminal control	2
P7-06	Load speed display coefficient	0.0001~6.5000	1.0000
P7-07	Heatsink temperature	0.0℃~100℃	-
P7-09	Accumulative running time	0h~65535h	-
P7-10	Software version 1	-	-
P7-11	Software version 2	-	-

Group P8: Auxiliary function

Code	Parameter Name	Functional description	Default
P8-17	Set accumulative running time	0~65535h	0
P8-18	Startup protection selection	0: Disabled 1: Enabled	0
P8-22	Detection of shortcircuit to ground upon power-on	0: Disabled 1: Enabled	1
P8-23	Action selection upon running time reached	0: Continue to run 1: Stop and report Err26	0
P8-24	Software undervoltage threshold	100.0–380.0 V (AC voltage input, multiplied by 1.414 when converted to bus voltage)	-
P8-25	Allowed opening time of the brake unit	0.1s～3600.0s	5.0s

Group P9: Fault and Protection

Code	Parameter Name	Functional description	Default
P9-00	Motor overload protection selection	0: Disabled 1: Enabled	1
P9-01	Motor overload protection gain	0.20~10.00	1.00
P9-04	Braking voltage threshold	120%~150%(100% corresponding to 530V)	130%
P9-12	Input phase loss protection	0: Disabled 1: Enabled	1
P9-13	Output phase loss protection	0: Disabled 1: Enabled	1
P9-14	Runaway speed deviation	0.50Hz~50.00Hz	10.00Hz
P9-15	Detection time of runaway fault	0.1s~20.0S	10.0s
P9-16	Motor temperature protection	0: Disabled 1: Enabled	1
P9-18	1st fault type	0: No fault 1: Reserved 2: Overcurrent during acceleration (Err02) 3: Overcurrent during deceleration (Err03) 4: Overcurrent at constant speed (Err04) 5: Overvoltage during acceleration (Err05) 6: Overvoltage during deceleration (Err06) 7: Overvoltage at constant speed (Err07) 8: Reserved 9: Undervoltage (Err09) 10: Servo drive overload (Err10) 11: Motor overload (Err11) 12: Input phase loss (Err12) 13: Output phase loss (Err13) 14: Module overheat (Err14) 15: External device fault (Err15) 16: Communication fault (Err16) 17: Contactor fault (Err17) 18: Current detection fault (Err18) 19: Motor auto-tuning fault (Err19) 20: Reserved 21: Data overflow (Err21) 22: Reserved 23: Short circuit to ground (Err23) 24–25: Reserved 26: Running time reached(Err26) 27: Business running time reached (Err27) 42: CAN communication fault(Err42) 43: Encoder fault during motor auto-tuning (Err43) 44: Speed deviation protection fault (Err44) 45: Motor overheat (Err45) 46: Pressure sensor fault (Err46) 47: Slave pump fault pre-warning(Err47) 48: CAN address conflict (Err48) 49: Encoder signal fault (Err49) 52: Main fault in multi-pump combining flow (Err52) 58: User parameter recovery fault (Err58) 59: Abnormal back electromotive force fault (Err59) 61: Excessive brake control time protection (Err61) 63: Reverse running time reached (Err63)	0
P9-19	2nd fault type		0
P9-20	Latest fault type		0
P9-21	Frequency upon fault	—	—
P9-22	Current upon fault	—	—
P9-23	Bus voltage upon fault	—	—
P9-24	Input terminal state upon fault	—	—

Code	Parameter Name	Functional description	Default
P9-25	Output terminal state upon fault	—	—
P9-26	Fault type	—	—

Group PA: Business Timing Function

Code	Parameter Name	Functional description	Default
PA-00	1st runtime protection password	0~65535	0
PA-01	1st timed running time	0h~PA-03	0
PA-02	2nd runtime protection password	0~65535	0
PA-03	2nd timed running time	PA-01~PA-05	0
PA-04	3rd runtime protection password	0~65535	0
PA-05	3rd timed running time	PA-03~PA-07	0
PA-06	4th runtime protection password	0~65535	0
PA-07	4th timed running time	PA-05~65535h	0
PA-08	Accumulative business running time (hour)	0h~65535h	0
PA-09	Accumulative business running time (second)	0h~65535s	0
A maximum of 4-segment timed running is supported. The relationship among these segments of timed running is: FA-01 < FA-03 < FA-05 < FA-07. Each segment has a protection password. If the timed running time is set to 0, the timing function is disabled. After the timed running time of all segments is reached, the servo drive reports Err27, indicating that the business timing is reached. In this case, you need to disable the timing function or increase the timing time. The set timed running time can be viewed in FA-08 without a password.			

Group PP: User Password

Code	Parameter Name	Functional description	Default
PP-00	User password	0~65535	0
PP-01	Restore default setting	0: No operation 1: Restore default settings 2: Clear fault records 3: Restore user backup parameters	0
PP-02	Motor model selection	0~65535	0
PP-03	Injection moulding machine tonnage selection	0~65535	0
PP-04	Password for user storage operation	0~65535	0
PP-05	User storage mode	0: No operation 1: Store user parameters	0

Group H0: Field Weakening and SVC Control Parameters

Code	Parameter Name	Functional description	Default
H0-00	Field weakening control mode	0: Direct calculation 1: Automatic adjustment	1
H0-01	Field weakening current coefficient	0~500	5
H0-02	Synchronous motor field weakening depth	0~50%	5%
H0-03	Synchronous motor maximum output adjustment coefficient	20~300%	100%
H0-04	Synchronous motor excitation current calculation adjustment factor	40~200%	100%

Group H1: PG Card Parameters

Code	Parameter Name	Functional description	Default
H1-00	PG card type	0: Resolver 1: Reserved 2: ABZ encoder	0

Code	Parameter Name	Functional description	Default
H1-02	Encoder installation angle	0.0°~359.9°	0.0°
H1-03	Inversion of feedback speed	0: Same 1: Different	0
H1-04	Number of pole pairs of resolver	1~50	1
H1-05	Resolver signal fault detection time	0.000: Detection invalid 0.001s~60.000s	2.000s
H1-06	Number of encoder lines	0~65535	1024

Group H2: CAN Communication Parameters

Code	Parameter Name	Functional description	Default
H2-00	Baud rate selection	0: 20k 1: 50k 2: 125k 3: 250k 4: 500k 5: 1M	5
H2-01	CAN local address	1~255	1
H2-02	Communication timeout	0.0s (Invalid) 0.1s~600.0s	0.3s
H2-03	CAN multi-pump mode	0: Multi pump mode 1 (Old mode) 1: Multi pump mode 2 (New mode)	0
H2-04	CAN slave address 1	0~65535	32766
H2-05	CAN slave address 2	0~65535	0
H2-06	CAN slave address 3	0~65535	0
H2-07	CAN slave address 4	0~65535	0

Group H3: Pump Control Parameters

Code	Parameter Name	Functional description	Default
H3-00	Hydraulic control mode	0: Non-hydraulic control mode 1: Hydraulic control mode 1 (CAN given) 2: Hydraulic control mode 2 (AI given) 3: CAN hydraulic control mode (for special use)	0
H3-01	Maximum rotational speed	Rotational speed corresponding to lower limit of maximum frequency~30000rpm	2000rpm
H3-02	System hydraulic pressure	0.0kg/cm2~maximum hydraulic pressure (H3-03)	175.0kg/cm2
H3-03	Maximum hydraulic pressure	System hydraulic pressure (H3-02)~500.0kg/cm2	250.0kg/cm2
H3-04	1st Hydraulic pressure command rise time	0.000s~2.000s	0.020s
H3-05	Hydraulic pressure control Kp1	0.0~800.0	210.0
H3-06	Hydraulic pressure control Ti1	0.001s~10.000s	0.100s
H3-07	Hydraulic pressure control Td1	0.000s~1.000s	0.000s
H3-08	Maximum reverse rotational speed	0.0%~100.0%	20.0%
H3-09	Minimum flow	0.0%~50.0%	0.5%
H3-10	Minimum pressure	0.0 kg/cm2~50.0 kg/cm2	0.5kg/cm2
H3-11	Hydraulic pressure control Kp2	0.0~800.0	210.0
H3-12	Hydraulic pressure control Ti2	0.001s~10.000s	0.100s
H3-13	Hydraulic pressure control Td2	0.000s~1.000s	0.000s
H3-14	Hydraulic pressure control Kp3	0.0~800.0	210.0
H3-15	Hydraulic pressure control Ti3	0.001s~10.000s	0.100s
H3-16	Hydraulic pressure control Td3	0.000s~1.000s	0.000s
H3-17	Hydraulic pressure control Kp4	0.0~800.0	210.0
H3-18	Hydraulic pressure control Ti4	0.001s~10.000s	0.100s
H3-19	Hydraulic pressure control Td4	0.000s~1.000s	0.000s
H3-20	AI zero drift auto correction	0: Disabled	0

Code	Parameter Name	Functional description	Default
		1: Enabled	
H3-21	Fault detection time of hydraulic pressure sensor	0.000s: Detection invalid 0.001s~60.000s	0.500s
H3-22	Setting of maximum rotational speed in pressure control	0.0%~100.0%	10.0%
H3-23	Setting of minimum hydraulic pressure in pressure control	0.0%~100.0%	60.0%
H3-24	Output delay time in pressure control	0.000s~10.000s	0.100s
H3-25	1st set hydraulic pressure S-curve rise filter time	0.000s~1.000s	0.030s
H3-26	1st set hydraulic pressure S-curve fall filter time	0.000s~1.000s	0.030s
H3-27	1st set hydraulic pressure overshoot suppression detection level	0~2000	100
H3-28	1st set hydraulic pressure overshoot suppression coefficient	0~3.000	0.200
H3-29	Pressure loop gain coefficient	0.20~5.00	1.00
H3-30	Torque upper limit for switchover from pressure mode to speed mode	50.0%~250.0%	160.0%
H3-31	1st set hydraulic pressure pressure command delay time	0.000s~0.500s	0.000s
H3-32	Slave minimum input	0.0%~H3-34	0.0%
H3-33	Corresponding setting of slave minimum input	-100.0%~100.0%	0.0%
H3-34	Slave medium input	H3-32~H3-36	0.0%
H3-35	Corresponding setting of slave medium input	-100.0%~100.0%	0.0%
H3-36	Slave maximum input	H3-34~100.0%	100.0%
H3-37	Corresponding setting of slave maximum input	-100.0%~100.0%	100.0%
H3-38	Multi-pump master giving slave speed enable	0: Disabled 1: Enabled	0
H3-39	Multi-pump combining flow holding pressure control gain	20~800	100
H3-40	Multi-pump injection reduces PI to eliminate-shake pressure deviation	0.0~50.0kg	5.0kg
H3-41	Multi-pump injection reduces PI to eliminate-shake flow lower limit	0~30000rpm	0rpm
H3-42	Multi-pump injection reduces PI to eliminate-shake flow detection time	0.200~2.000s	0.400s
H3-43	Pressure deviation of slave pump not working in multi-pump CAN mode	0~50.0kg	5.0kg
H3-44	Flow lower limit of of slave pump not working in multi-pump CAN mode	-100.0%~100.0%	0
H3-45	Judgement time from slave pump no speed command stop	0.100~5.000s	1.000s

Code	Parameter Name	Functional description	Default
H3-46	Deceleration time from slave pump no speed command stop	0.001~5.000s	0.200s
H3-47	Start valve unloading delay	0.001~5.000s	0.100s
H3-48	Exit valve unloading delay	0.001~5.000s	0.100s
H3-49	Start valve unloading differential pressure lower limit	0.0~H3-02(System hydraulic pressure）	0.0kg
H3-50	Start valve unloading pressure setting lower limit	0.0~H3-02(System hydraulic pressure）	0.0kg
H3-51	Pressure sensor fault detection time lower limit	0%~300%（Motor rated current P1-03）	100%
H3-52	Pressure sensor fault detection speed upper limit	0%~100%（Maximum speed H3-01）	50%

Group H4: Hydraulic Control Optimization Parameters

Code	Parameter Name	Functional description	Default
H4-00	Rotational speed filter time	0~5.000s	0.005s
H4-01	Current filter time	0~5.000s	0.010s
H4-02	1st set hydraulic pressure command decline time	0.000s~2.000s	0.020s
H4-03	1st set flow command rise time	0~1.000s	0.100s
H4-04	1st set flow command decline time	0~1.000s	0.100s
H4-06	Flow leakage compensation value	0.0%~50.0%	0.0%
H4-08	Minimum pressure for reversing unloading	0.0kg/cm2~H3-02	0.0kg/ cm2
H4-09	Long Runtime protection for reversing unloading	0.001s~5.000s	0.000s
H4-10	2nd set hydraulic pressure command rise S filter time	0.001s~1.000s	0.030s
H4-11	2nd set hydraulic pressure command decline S filter time	0.001s~1.000s	0.030s
H4-12	2nd set flow command rise time	0~5.000s	0.100s
H4-13	2nd set flow command decline time	0~5.000s	0.100s
H4-14	2nd set hydraulic pressure command rise time	0~2.000s	0.020s
H4-15	2nd set hydraulic pressure command decline time	0~2.000s	0.020s
H4-16	2nd set hydraulic pressure overshoot suppression detection level	0~2000	200
H4-17	2nd set hydraulic pressure overshoot suppression coefficient	0~3.000s	0.050s
H4-18	2nd set hydraulic pressure command delay	0.000s~0.500s	0.000s
H4-22	Hydraulic pressure suppression cancels hydraulic pressure deviations	0.0kg/cm2~H3-02	10.0kg/ cm2
H4-23	Maximum deviation from the integral limit	0.0kg/cm2~H3-02	25.0kg/ cm2
H4-24	Integral limit mode selection	0~1	0
H4-25	Increase in pressure ring output limit	0~50.0	2. 0

Code	Parameter Name	Functional description	Default
H4-26	Hydraulic PID algorithm selection	0~3	0
H4-29	1st hydraulic pressure impact overshoot suppression pressure judgement thresholds	0~100.0% (Bigger than this value enters overshoot suppression)	70.0%
H4-30	1st hydraulic pressure impact overshoot suppression coefficient Kd1	0~1.00 (Enhanced suppression by increasing parameter values)	0.40
H4-31	2nd hydraulic pressure impact overshoot suppression pressure judgement thresholds	0~100.0% (Bigger than this value enters overshoot suppression)	70.0%
H4-32	2nd hydraulic pressure impact overshoot suppression coefficient Kd2	0~1.00 (Enhanced suppression by increasing parameter values)	0.40

Group U0: Viewed Servo Drive Parameters

Code	Parameter Name	Functional description	Default
U0-00	Running frequency	0.00 Hz ~ maximum frequency (P0-10)	—
U0-01	Set frequency	0.00 Hz ~ maximum frequency (P0-10)	—
U0-02	Bus voltage	0V~830V	—
U0-03	Output voltage	0 V ~ rated motor voltage (P1-02)	—
U0-04	Output current	0.01A~6553.5A	—
U0-05	Output power	0.4kW~1000.0kW	—
U0-06	Output torque	0.0% ~ torque upper limit(P2-10)	—
U0-07	Local DI/DO state		—
U0-09	AI1 voltage (After correction)	-10.00V~10.000V	—
U0-10	AI2 voltage (After correction)	-10.00V~10.000V	—
U0-11	AI3 voltage (After correction)	-10.00V~10.000V	—
U0-28	Overcurrent threshold	0.01A~655.35A	—
U0-29	Overcurrent type	1: Hardware overcurrent 2: Software overcurrent	—
U0-30	AI1 voltage (Before correction)	-10.00V~10.000V	—
U0-31	AI2 voltage (Before correction)	-10.00V~10.000V	—
U0-32	AI3 voltage (Before correction)	-10.00V~10.000V	—
U0-34	AO1 output voltage	0.000V~10.000V	—
U0-35	AO2 output voltage	0.000V~10.000V	—

Group U1: Viewed Servo Pump Parameters

Code	Parameter Name	Functional description	Default
U1-00	Real-time angle	0.0°~359.9°	—
U1-01	Set hydraulic pressure	0.0kg~ system hydraulic pressure (H3-02)	—
U1-02	Feedback hydraulic pressure	0.0kg ~ maximum hydraulic pressure(H3-03)	—
U1-03	Motor rotational speed	-9999rpm~30000rpm	—
U1-04	AI1 voltage	-10.00V~10.000V	—
U1-05	AI2 voltage	-10.00V~10.000V	—
U1-06	AI3 voltage	-10.00V~10.000V	—
U1-07	AI1 zero drift	-10.00V~10.000V	—
U1-08	AI2 zero drift	-10.00V~10.000V	—
U1-09	AI3 zero drift	-10.00V~10.000V	—
U1-10	Reference flow	0.00Hz~ maximum frequency (P0-10)	—
U1-11	Resolver signal interference degree	0~1000 (wire breaking)	—
U1-12	Hydraulic pressure reference of host computer	0.0kg~ system hydraulic pressure (H3-02)	—

Code	Parameter Name	Functional description	Default
U1-13	CAN communication interference status	0~128 (128: Disconnection)	—
U1-14	Number of CAN messages sent	0~65535	—
U1-15	Number of CAN messages received	0~65535	—
U1-16	CAN buffer use ratio	0~1.00%	—

4.4 Faults and Solutions

The EM16 servo drive has a number of warning messages and protection functions. Once a fault occurs, the protection functions act, the servo drive stops output, the servo drive fault relay contacts act, and the fault code is displayed on the servo drive control panel. Before seeking service, the user can can first find out for themselves according to this section to analyse the cause of the fault and find a solution.

In the warning message Err22 is the hardware over-current or over-voltage signal, in most cases the hardware over-voltage fault causes Err22.

Fault Type	Display	Possible Causes	Solutions
Inverter unit protection	Err01	1: The output circuit is grounded or short circuited. 2: The connecting cable of the motor is too long. 3: The IGBT overheat. 4: The internal connections become loose. 5: The main control board is faulty. 6: The drive board is faulty. 7: The inverter IGBT is faulty.	1: Eliminate external faults. 2: Install a reactor or an output filter. 3: Check the air filter and the cooling fan. 4: Connect all cables properly. 5: Ask for technical support 6: Ask for technical support 7: Ask for technical support
Over current during acceleration	Err02	1: The output circuit is grounded or short circuited. 2: Motor auto-tuning is not performed. 3: The acceleration time is too short. 4: Manual torque boost or V/F curve is not appropriate. 5: The voltage is too low. 6: The startup operation is performed on the rotating motor. 7: A sudden load is added during acceleration. 8: The servo drive model is of too small power class.	1: Eliminate external faults. 2: Perform the motor auto- tuning. 3: Increase the acceleration time. 4: Adjust the manual torque boost or V/F curve. 5: Adjust the voltage to normal range. 6: Select rotational speed tracking restart or start the motor after it stops. 7: Remove the added load. 8: Select a servo drive of higher power class.
Over current during deceleration	Err03	1: The output circuit is grounded or short circuited. 2: Motor auto-tuning is not performed. 3: The deceleration time is too short. 4: The voltage is too low. 5: A sudden load is added during deceleration. 6: The braking unit and braking resistor are not installed.	1: Eliminate external faults. 2: Perform the motor auto-tuning. 3: Increase the deceleration time. 4: Adjust the voltage to normal range. 5: Remove the added load. 6: Install the braking unit and braking resistor.
Over current at constant speed	Err04	1: The output circuit is grounded or short circuited. 2: Motor auto-tuning is not performed. 3: The voltage is too low. 4: A sudden load is added during operation.	1: Eliminate external faults. 2: Perform the motor auto-tuning. 3: Adjust the voltage to normal range. 4: Remove the added load.

Fault Type	Display	Possible Causes	Solutions
		5: The servo drive model is of too small power class.	5: Select an Servo drive of higher power class.
Overvoltage during acceleration	Err05	1: The input voltage is too high. 2: An external force drives the motor during acceleration. 3: The acceleration time is too short. 4: The braking unit and braking resistor are not installed.	1: Adjust the voltage to normal range. 2: Cancel the external force or install a braking resistor. 3: Increase the acceleration time. 4: Install the braking unit and braking resistor.
Overvoltage during deceleration	Err06	1: The input voltage is too high. 2: An external force drives the motor during deceleration. 3: The deceleration time is too short. 4: The braking unit and braking resistor are not installed.	1: Adjust the voltage to normal range. 2: Cancel the external force or install the braking resistor. 3: Increase the deceleration time. 4: Install the braking unit and braking resistor.
Overvoltage at constant speed	Err07	1: The input voltage is too high. 2: An external force drives the motor during deceleration.	1: Adjust the voltage to normal range. 2: Cancel the external force or install the braking resistor.
Control power supply fault	Err08	The input voltage is not within the allowable range.	Adjust the input voltage to the allowable range.
Low voltage	Err09	1: Instantaneous power failure occurs on the input power supply. 2: The servo drive's input voltage is not within the allowable range. 3: The DC bus voltage is abnormal. 4: The rectifier bridge and buffer resistor are faulty. 5: The drive board is faulty. 6: The main control board is faulty.	1: Reset the fault. 2: Adjust the voltage to normal range. 3: Ask for technical support 4: Ask for technical support 5: Ask for technical support 6: Ask for technical support
Servo drive overload	Err10	1: The load is too heavy or locked- rotor occurs on the motor. 2: The servo drive model is of too small power class.	1: Reduce the load and check the motor and mechanical condition. 2: Select a servo drive of higher power class.
Motor overload	Err11	1: bb-02 is set improperly. 2: The load is too heavy or locked- rotor occurs on the motor. 3: The servo drive model is of too small power class.	1: Set bb-02 correctly. 2: Reduce the load and check the motor and the mechanical condition. 3: Select a servo drive of higher power class.
Power input phase loss	Err12	1: The three-phase power input is abnormal. 2: The drive board is faulty. 3: The lightningproof board is faulty. 4: The main control board is faulty.	1: Eliminate external faults. 2: Ask for technical support. 3: Ask for technical support. 4: Ask for technical support.
Power output phase loss	Err13	1: The cable connecting the servo drive and the motor is faulty. 2: The servo drive's three-phase outputs are unbalanced when the motor is running. 3: The drive board is faulty. 4: The IGBT module is faulty.	1: Eliminate external faults. 2: Check whether the motor three phase winding is normal. 3: Ask for technical support. 4: Ask for technical support.
IGBT Module	Err14	1: The ambient temperature is too high. 2: The air filter is blocked.	1: Lower the ambient temperature. 2: Clean the air filter.

Fault Type	Display	Possible Causes	Solutions
overheat		3: The fan is damaged. 4: The thermally sensitive resistor of the IGBT module is damaged. 5: The inverter IGBT module is damaged.	3: Replace the damaged fan. 4: Replace the damaged thermally sensitive resistor. 5: Replace the inverter module.
External equipment fault	Err15	1: External fault signal is input via DI. 2: External fault signal is input via virtual I/O.	1: Reset the operation. 2: Reset the operation.
Communication fault	Err16	1: The host computer is in abnormal state. 2: The communication cable is faulty. 3: The communication extension card is set improperly. 4: The communication parameters in group bA are set improperly.	1: Check the cabling of host computer. 2: Check the communication cabling. 3: Set the communication extension card correctly. 4: Set the communication parameters properly.
Contactor fault	Err17	1: The drive board and power supply are faulty. 2: The contactor is faulty.	1: Replace the faulty drive board or power supply board. 2: Replace the faulty contactor.
Current detection fault	Err18	1: The HALL device is faulty. 2: The drive board is faulty.	1: Replace the faulty HALL device. 2: Replace the faulty drive board.
Motor auto-tuning fault	Err19	1: The motor parameters are not set according to the nameplate. 2: The motor auto-tuning times out.	1: Set the motor parameters according to the nameplate properly. 2: Check the cable connecting the Servo drive and the motor.
Encoder fault	Err20	1: The encoder type is incorrect. 2: The cable connection of the encoder is incorrect. 3: The encoder is damaged. 4: The PG card is faulty.	1: Set the encoder type correctly based on the actual situation. 2: Eliminate external faults. 3: Replace the damaged encoder. 4: Replace the faulty PG card.
EEPROM read- write fault	Err21	The EEPROM chip is damaged.	Replace the main control board.
Servo drive hardware fault	Err22	1: Overvoltage exists. 2: Over current exists.	1: Handle based on over voltage. 2: Handle based on over current.
Short circuit to ground	Err23	The motor is short circuited to the ground.	Replace the cable or motor.
Accumulative running time reached	Err26	The accumulative running time reaches the setting value.	Clear the record through parameter A0-09
Business running time reached	Err27	1. Check if PA-08 is greater than or equal to PA-01/03/05/07	1. Ask the supplier for runtime protection code PA-00/02/04/06 and increase PA-01/03/05/07
By wave current limiting fault	Err40	1: The load is too heavy or locked- rotor occurs on the motor. 2: The servo drive model is of too small power class.	1: Reduce the load and check the motor and mechanical condition. 2: Select a servo drive of higher power class.
Motor switchover fault during running	Err41	Change the selection of the motor via terminal during running of the servo drive.	Perform motor switchover after the servo drive stops.
CAN	Err42	1. Check if the CAN communication	1. Set the correct communication parameters

Fault Type	Display	Possible Causes	Solutions
communication fault		parameters are set correctly (H2-00, H2-01) 2. Check if the CAN communication line contact is good 3. Is the CAN+/CAN- connection reversed?	2. Strengthen the CAN communication cable 3. Correct the wrong wiring
Encoder Fault During Motor Auto-tuning	Err43	1. Check whether the encoder model matches the servo drive. 2. Check whether the encoder wiring is correct. 3. Check whether the encoder installation is correct. 4. PG card fault	1. Select the adapted encoder. 2. Eliminate the wiring fault. 3. Install the encoder correctly. 4. Change the PG card
Speed Deviation Too Large	Err44	1. Check whether the encoder installation and wiring become loose. 2. Check whether the power cables of the motor become loose. 3. PG card fault	1. Fix the encoder. 2. Fasten the power cables 3. Change the PG card
Motor overheat	Err45	1. Check whether wiring of the PTC sensor for motor overheat protection is correct 2. Check whether the motor temperature is too high. 3. Check whether fault is reported after PTC-P and PTC-N are shorted.	1. Eliminate the wiring fault. 2. Reduce the load of the motor, add cooling fans and increase the motor capacity. 3. The PTC signal is wrong.
Pressure Sensor Fault	Err46	1. Check whether wiring of the PTC sensor for motor overheat protection is correct. 2. Check whether the motor temperature is too high. 3. Check whether fault is reported after PTC-P and PTC-N are shorted. 4. Check whether it is normal after the I/O board is replaced.	1. Eliminate the wiring fault. 2. Reduce the load of the motor, add cooling fans or increase the motor capacity 3. The PTC signal is wrong. 4. Change I/O board.
Encoder Signal Fault	Err49	1. Check whether the connection joint between the PG card and the encoder becomes loose. 2. Check whether wiring between the PG card and the encoder is proper. 3. Check whether it it normal after the PG card is replaced.	1. Eliminate the wiring fault. 2. Eliminate the wiring fault. 3. Change the PG card board.
Parameter recovery error fault	Err58	1. User parameters have not been stored	1. User parameter storage after correct parameter setting (PP-04 enter password, PP-05 = 1 to save user parameters)
Back electromotive force tuning fault	Err59	1. Check whether the P1 group motor parameters are set correctly 2. Replace the same type of motor for testing to confirm whether the motor is demagnetized	1. Set the correct motor parameters 2. Replace the motor and contact the manufacturer to help find the cause of demagnetization
Brake pipe prolonged brake protection fault	Err61	1. Whether the bus voltage is higher than the braking voltage for a long time 2. Whether the brake protection time setting is too small	1. Use brake unit for braking 2. Increase the braking protection time and observe whether there is overheating of the braking resistor, if overheating, need to change the higher power braking resistor

Fault Type	Display	Possible Causes	Solutions
Reverse run time reached	Err63		

4.5 Common Faults and Solutions

The following fault situations may be encountered during the use of the servo drive, please refer to the following methods for simple fault analysis:

No.	Failure phenomena	Reason	Solution
1	No display upon power-on	1. There is no power supply to the servo drive. 2. The 8-core cable connecting the drive board and the control board is in poor contact. 3. Components inside the servo drive are damaged.	1. Check the power input. 2. Connect the 8-core cable again. 3. Ask for technical support.
2	"Err23" is displayed upon power-on.	1. The motor or the motor output cable is short circuited to the ground. 2. The servo drive is damaged.	1. Check the insulation status of the motor and the output cable with a megger. 2. Ask for technical support.
3	Err14 (module overheat) fault is reported frequently.	1. The setting of carrier frequency is too high. 2. The cooling fan is damaged, or the air filter is blocked. 3. Components inside the servo drive are damaged (thermal coupler or others).	1. Reduce the carrier frequency. 2. Replace the fan and clean the air filter. 3. Ask for technical support.
4	The motor does not rotate after the servo drive runs.	1. Check the motor and the motor cables. 2. The motor is damaged or lockedrotor occurs. 3. The motor parameters in group F1 are set improperly.	1. Ensure the cable between the Servo drive and the motor is normal. 2. Replace the motor or rectify mechanical faults. 3. Check and set the motor parameters again.
5	The DI terminals are disabled.	1. The related parameters are set incorrectly. 2. The jumper across OP and +24V becomes loose. 3. The control board is faulty.	1. Check and set the parameters in group F4 again. 2. Re-connect the cable. 3. Ask for technical support.
6	The motor speed is always low in VC mode.	1. The encoder is damaged or the encoder wiring is incorrect. 2. Components inside the servo drive are damaged.	1. Replace the encoder and correct the wiring. 2. Ask for technical support.
7	The servo drive reports overcurrent and overvoltage faults frequently.	1. The motor parameters in group F1 are set improperly. 2. The acceleration/deceleration time is improper. 3. The load fluctuates.	1. Set the motor parameters or perform motor auto-tuning again. 2. Set proper acceleration/deceleration time. 3. Ask for technical support.
8	Err17 is reported upon	The soft startup contactor is not picked	1: Check whether the contactor cable is

No.	Failure phenomena	Reason	Solution
	power-on or running.	up.	loose. 2: Check whether the contactor is faulty. 3: Check whether 24 V power supply of the contactor is faulty. 4: Ask for technical support.

Appendix I Multi-pump model for injection moulding machines

1. Servo oil pump and pump control solution

The multi-pump control is divided into two options: "multi-pump combining flow" and "multi-pump splitting flow".

Multi-pump combining flow: One set of servo drives is used as the master drive, the remaining servo drives work in parallel as slave drives and the system computer outputs a set of flow and pressure analog signals.

In the flow control state (feedback pressure is less than the command pressure) the master and slave drives can have the same speed.

In the pressure control state (feedback pressure is greater than or equal to the command pressure), the slave pump automatically stops working and is controlled by the master drive alone.

Multi-pump splitting flow: Multiple servo drives can operate in both multi-pump combining flow and multi-pump splitting flow (separate oil pressure PID control) modes, and the system computer outputs multiple flow and pressure analog signals.

Multi-pump combining flow structure diagram

A diagram of the multi-pump combining flow control structure is shown below.

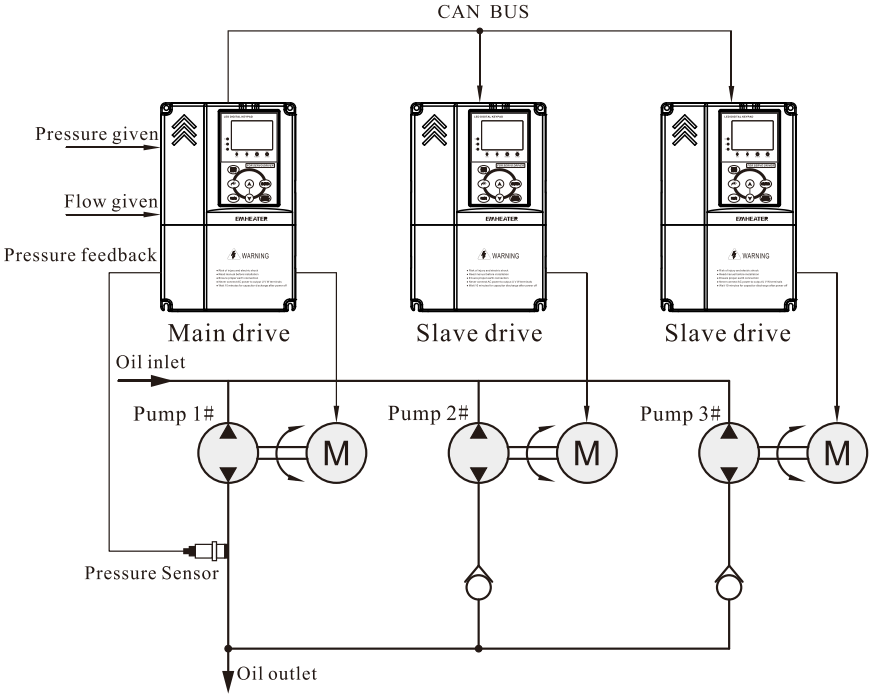


Diagram I-1 Multi-pump combining flow structure diagram

Note: For detailed wiring and CAN communication wiring, please refer to the "Wiring", and for function code adjustment, please refer to the "Function code setting".

The same motor speed can be guaranteed by communication.

Multi-pump splitting flow structure diagram

A diagram of the multi-pump splitting flow control structure is shown below.

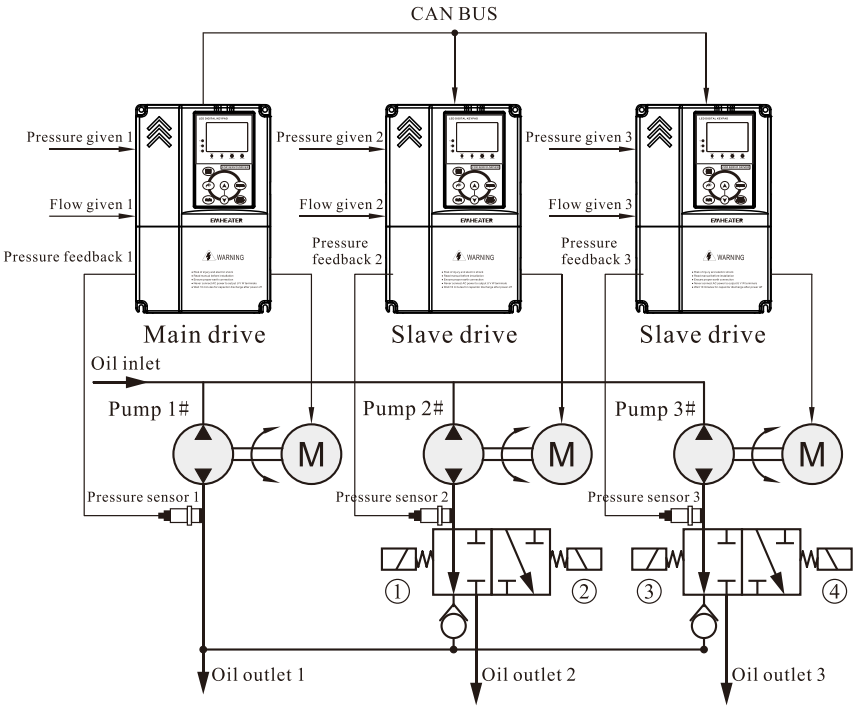


Diagram I-2 Multi-pump splitting flow structure diagram

Note: For detailed wiring and CAN communication wiring, please refer to the "Wiring", and for function code adjustment, please refer to the "Function code setting".

The same motor speed can be guaranteed by communication.

The state of the solenoid valves ①, ②, ③ and ④ can be achieved separately the control of pump 2# combining flow and splitting flow, and pump 3# combining flow and splitting flow.

Pressure and flow commands and pressure feedback signals received from the drive are invalid during combining flow control.

CAN communication command is invalid during split follow control.

Multi-pump control mode description:

H2-03	CAN multi-pump mode	0	Multi pump mode 1 (Old mode)
		1	Multi pump mode 2 (New mode)

EM16 Supports two multi-pump modes:

Multi-pump mode 1: That is old mode and suitable for simple multi-pump control;

- Slave pump cannot be controlled when slave pump switching to master pump
- Multi-pump mode when 50#DI terminal is enabled
- Disconnect the 50# DI terminal of the slave pump and slave pump switching to the master pump

Multi-pump mode 2: That is new mode, in order to meet more complex multi-pump combining flow and splitting flow mode, supports up to 4 multi-pump splitting flow combinations control of two modes with different wiring and applications, details as follows.

a) Wiring

Wiring descreption for parallel pump operation.

Multi-pump combining flow:

In the case of multi-pump combining flow, the "slave alarm output" (function code set to "25") signal is connected to the system computer for alarm display.

Note: One-way valve leakage is larger and at the same time from the pump's internal leakage is smaller, it will cause the pressure control state from the pump oil circuit appear unexplained high pressure phenomenon, in order to release the high pressure state of this oil section, the following ways can be taken.

- Reducing the slave pump flow to a reasonable range.
- Reducing the upper torque setting of the slave drive to a reasonable range.
- The slave speed response curve is set according to the maximum leaking speed of the master pump to ensure automatic unloading from the slave drive at low speed holding pressure.
- For detailed function code setting, please refer to "Slave pump response to master pump function code setting" .

Multi-pump combining flow:

The "slave alarm output" (function code set to "25") signal is connected to the system computer for alarm display.

In this control state, the pressure feedback signal 2 from the pressure sensor mounted on the slave pump circuit is received independently by the slave drive, so there is no unexplained high pressure phenomenon in the slave pump oil circuit under pressure control.

Communication connection:

The CAN BUS of all pumps are connected as shown in the diagram below.

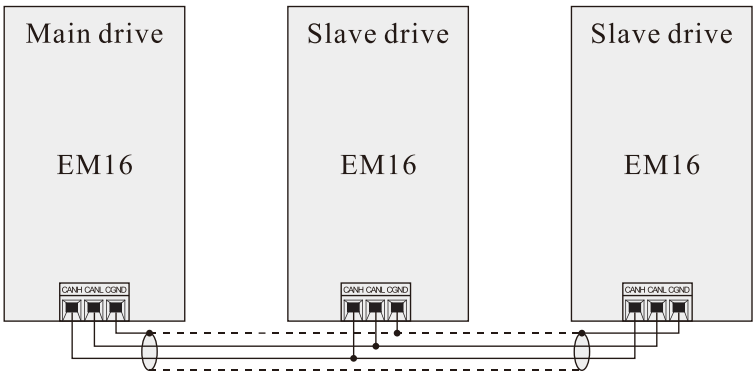


Diagram I-3 CAN bus connection diagram

Note: Please use a twisted shielded cable for the connection. The CANH and CANL signal terminals on all drive control boards are connected together and the ground terminal CGND is connected together by means of a shield.

Function setting for slave pumps to respond to master pump commands.

Code	Parameter Name	Default	Description
H3-32	Slave minimum input	0.0%	Slave pump driver setting
H3-33	Corresponding setting of slave minimum input	0.0%	
H3-34	Slave medium input	0.0%	
H3-35	Corresponding setting of slave medium input	0.0%	
H3-36	Slave maximum input	100.0%	
H3-37	Corresponding setting of slave maximum input	100.0%	

Setting the H3-32~H3-37 function can realize the automatic unloading of the slave pump under the low speed holding pressure of the main pump to avoid the high pressure phenomenon of the slave pump, and ensure the linearity of the flow of the whole system.

Example:

Condition 1: If maximum holding pressure speed is 50rpm/min for the main pump and maximum speed is

2000rpm/min, maximum speed is 2000rpm/min for slave pump.

Condition 2: When holding pressure, only the main pump is engaged and the slave pumps are completely stopped.

Condition 3: To ensure the linearity of the flow, the main pump is 100rpm or more and the same speed for the slave and master pumps.

The above means that the slave pump stops working when the main pump is below 50rpm/min, and The running speed of the slave pump and the main pump is the same when the main pump is above 100rpm/min. The speed command of the main pump is 0%~100%, and the slave pump responds to the speed command of the main pump by setting the 3-point curve as follows:

(H3-32, H3-33)=(Input command from slave pump: 50rpm/min, Response command from slave pump: 0rmp/min) =(2.5%, 0.0%)

(H3-34,H3-35)= (Input command from slave pump: 100rpm/min, Response command from slave pump: 100rmp/min) =(5.0%，5.0%)

(H3-36,H3-37)= (Input command from slave pump: 2000rpm/min, Response command from slave pump:2000rmp/min) =(100%,100%)

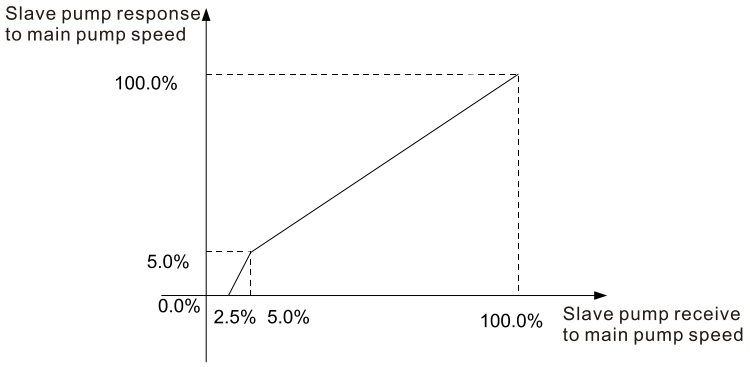


Diagram I-4 Slave pump response to main pump speed command diagram

Note: The slave pump response to the main pump speed command is set exactly the same for two multi-pump modes.

Main drive setting

Multi-pump mode 1(H2-03＝0):

All drives must enable the 50# multi-pump control enable DI terminal.

Code	Parameter Name	Default	Description
H2-01	CAN communication address	1	
H2-03	Multi pump mode 1	0	
P4-**	Multi pump control enable	50	DI5 and COM shorted directly
P5-02	Relay(T/H2-T/C2)output selection	25	Slave alarm output (NO)

Multi-pump 2(H2-03＝1):

Function code setting: The drive at address 1 is the absolute main pump and cannot be a slave pump. Up to 4 combinations of splitting flow control can be set as follows:

Code	Parameter Name	Default	Description
P4-**	Slave pump address selection terminal 1	53	In the case of multi-pump splitting flow, for setting the main pump to select which slave pumps are to be combining flow together.
P4-**	Slave pump address selection terminal 2	54	
P5-02	Relay (TA2-TC2) function selection	25	Slave pump alarm (NO)
H2-01	CAN local address	1	
H2-03	Multi pump mode 2	1	

H2-04	CAN slave address 1	0	Through input terminals 53 and 54, 4 kinds of combined splitting flow and combining flow control of slave pumps can be realized.
H2-05	CAN slave address 2	0	
H2-06	CAN slave address 3	0	
H2-07	CAN slave address 4	0	

Slave pump address DI input selection:

54#DI input	53#DI input	CAN slave drive address selection
0	0	H2-04: CAN slave address 1
0	1	H2-05: CAN slave address 2
1	0	H2-06: CAN slave address 3
1	1	H2-07: CAN slave address 4

Instructions for setting slave pump address:

The screen for setting the LED function code from the pump address is shown below:

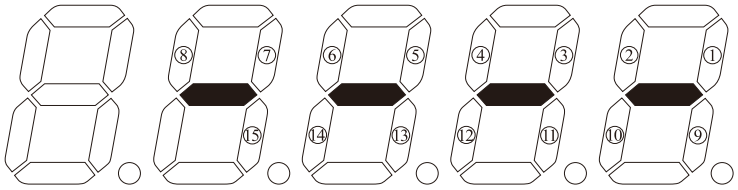


Diagram I-5 Initial diagram of slave pump address setting

The number in the digital tube indicates the corresponding slave pump address.

The digital tube corresponding to the number is ON that the slave pump with that numbered address is enabled to participate in control.

A total of 15 slave pump address settings are supported.

For example, for the 1# main pump, H2-04 sets the slave pump address as shown below, means that 1# is the main pump and works in combining flow with the 2#, 3# and 4# slave pumps.

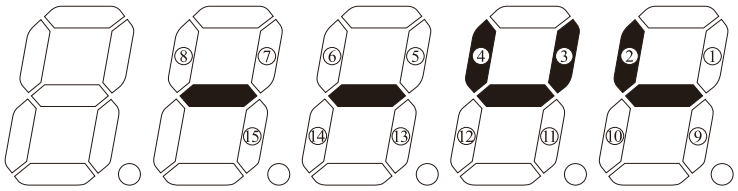


Diagram I-6 Slave pump address setting

Instructions for operating the keys from the slave pump address:

1#~15# pump address selecttion through  and  Combination settings.

Slave drive setting

Multi-pump 1(H2-03=0):

The following shows the slave drive function code settings. Other function codes are set according to the general method for servo oil pumps.

Code	Parameter Name	Default	Description
H2-01	CAN local address	>1	Slave drive
P4-**	Multi pump enable	50	Slave pump or switch to main pump control

To switch from the slave pump to the main pump, disconnect the 50# DI terminal from the slave pump

Multi-pump 2(H2-03=1)

The following shows the slave drive function code settings. Other function codes are set according to the general method for servo oil pumps.

Code	Parameter Name	Default	Description
H2-01	CAN local address	> 1	Slave drive
P4-**	Slave pump address selection terminal 1	53	When the slave pump acts as the master pump, terminal triggering is required. Refer to "main pump drive settings" for slave pump address settings.
P4-**	Slave pump address selection terminal 2	54	

Instructions for multi-pump combining and splitting flow control applications

Multi-pump 1(H2-03=0):

For example: The injection moulding machine oil pump system has a total of 3 pumps with addresses set to 1#, 2# and 3#, because of the multi-pump mode 1 slave pump without slave pump, there are the following 2 combinations.

Combination 1: 3 pumps combining flow.

Combination 2: 2+1 combined splitting flow control, 1# main pump with 2# slave pump, 3# pump switched to work as main pump

The following are wiring and setting instructions for the above two combinations:

1) Combination 1: 3 pumps combining flow:

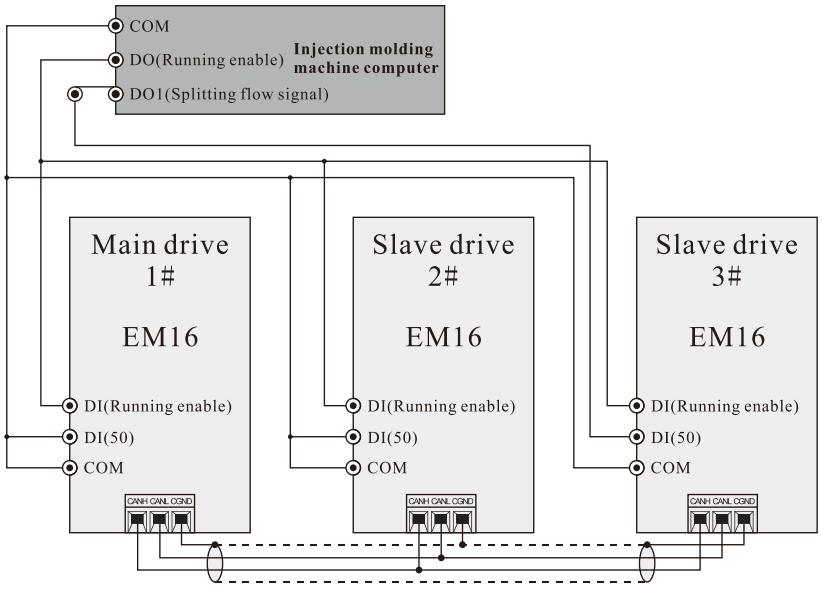


Diagram I-7 3 pumps combining flow

Wiring instructions:

Because 1# main pump has always been the master pump, 2# main pump has always been the slave pump, 50# DI terminal directly shorted.

3# salve pump will switch to main pump in the second combination, and need for external signal switching, so the upper computer to give a closing signal to 50# DI terminal of 3# slave pump closed to deal with multi-pump combining flow state.

2) Combination 2: 2+1 combined splitting flow control, 1# main pump work with 2# slave pump, 3# pump switched to work as main pump:

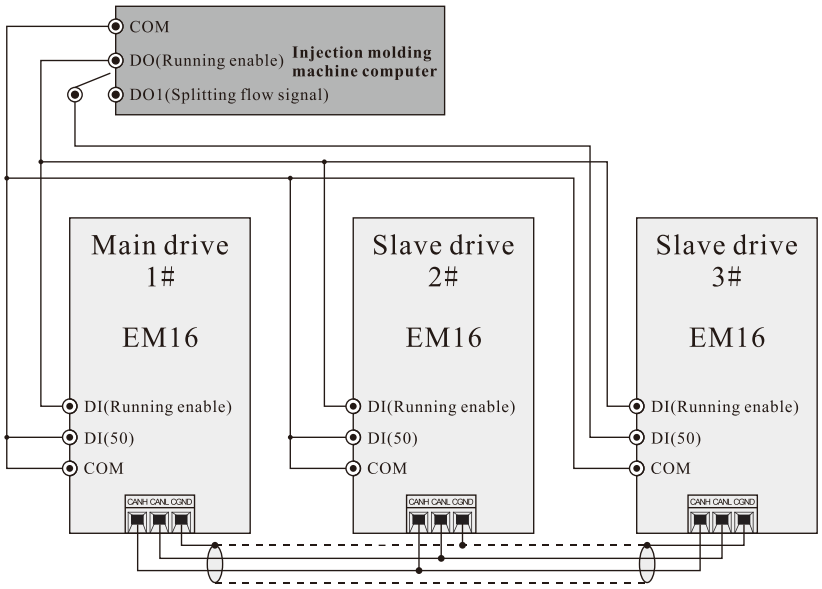


Diagram I-8 2+1 combined splitting flow control

1# main pump work with 2# slave pump, 3# pump switch to main pump works.

Switching of 3# slave pump as main pump is achieved by disconnecting the 50# DI terminal of 3# slave pump.

Other situations are analogized in turn.

Multi-pump mode 2(H2-03＝1):

For example: The injection moulding machine oil pump drive system has a total of 4 oil pumps with addresses 1#, 2#, 3# and 4#, with the following combinations of actions:

Combination 1: 4 pump combining flow.

Combination 2: 2+2 combined splitting flow control, 1# pump as main pump work with 2# slave pump, 3# pump as main pump work with 4# slave pump.

Combination 3: 3+1 combined splitting flow control, 1# pump as main pump work with 3# and 4# pump, 2# slave pump switch to main pump works.

The following are wiring and setting instructions for the above three combinations:

4 pumps with CAN communication address H2-01 respectively set to: 1#, 2#, 3# and 4#, all three combinations control the address of the main pump set to 1#.

2) Combination 1: 4 pump combining flow:

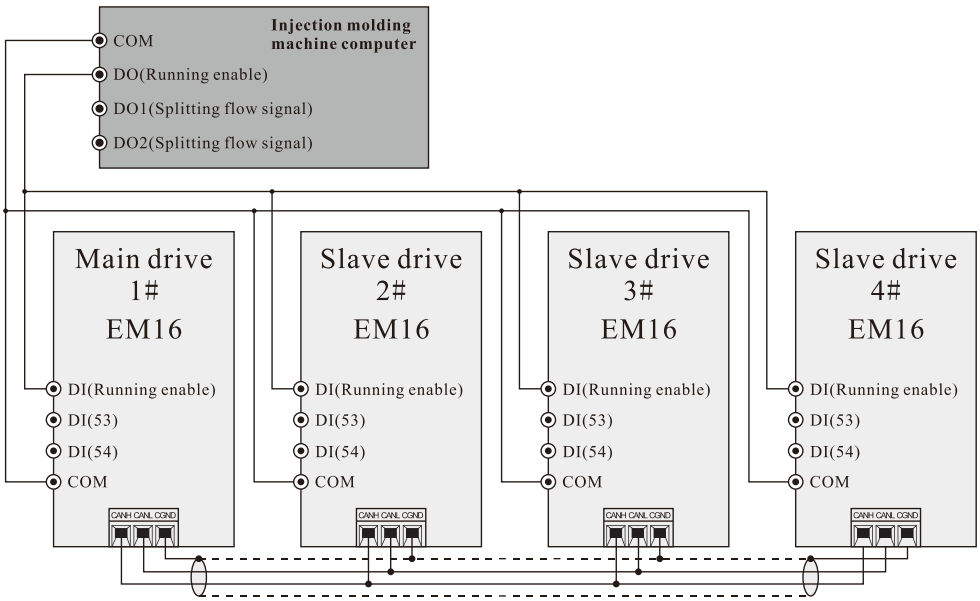


Diagram I-9 4 pump combining flow control

Wiring instructions:

In the case of combining flow only, the wiring is very simple, just need to connect all CAN and run enable DI terminal wires, etc.

Function code setting:

1# pump as main pump, slave pump have 2#, 3#, 4# in this action, and the corresponding slave pump address function code is H2-04 and the function codes set the values as shown below:

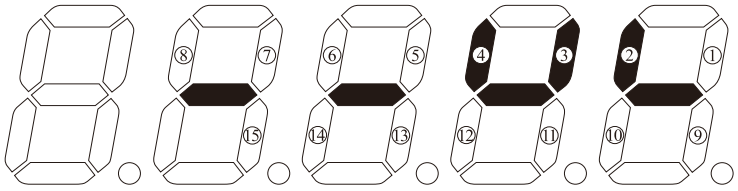


Diagram I-10 slave pump address function code setting

3) Combination 2: 2+2 combined splitting flow control, 1# pump as main pump work with 2# slave pump, 3# pump as main pump work with 4# slave pump.

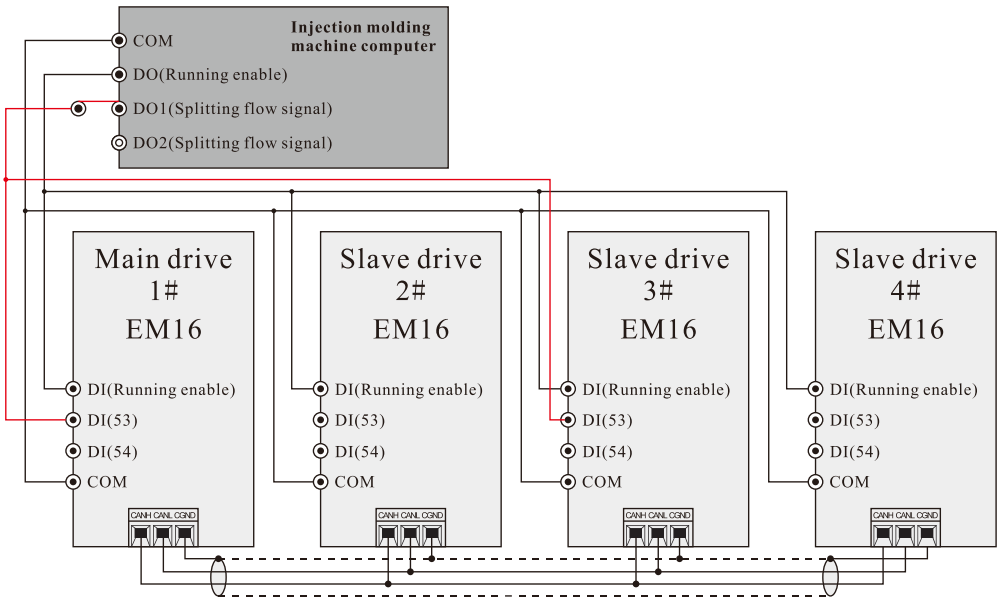


Diagram I-11 2+2 combined splitting flow control

Wiring instructions:

The upper computer provides a splitting flow signal to the drive 53# DI terminal of the main pump, the main pump uses this 53# DI signal to identify the slave pump address, while the slave pump uses this 53# DI signal to switch to the main pump and identify the slave pump address.

Function code setting:

The combination has 1# and 3# two main pumps, and the slave pumps have been changed and the slave pump address have to be set. The slave pump of 1# main pump is 2# and the H2-05 slave pump address is set as follows:

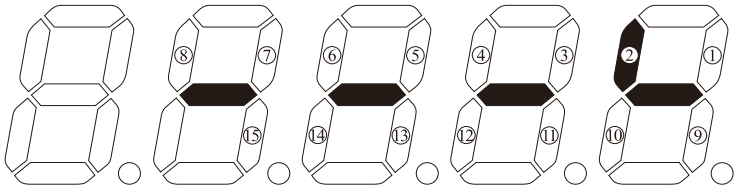


Diagram I-12 H2-05 Slave pump address setting

The slave pump of 3# main pump is 4# and the H2-05 slave pump address is set as follows:

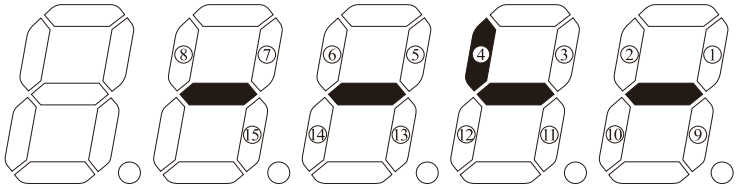


Diagram I-13 H2-05 Slave pump address setting

4）Combination 3: 3+1 combined splitting flow control, 1# pump as main pump work with 3# and 4# pump, 2# slave pump switch to main pump works.

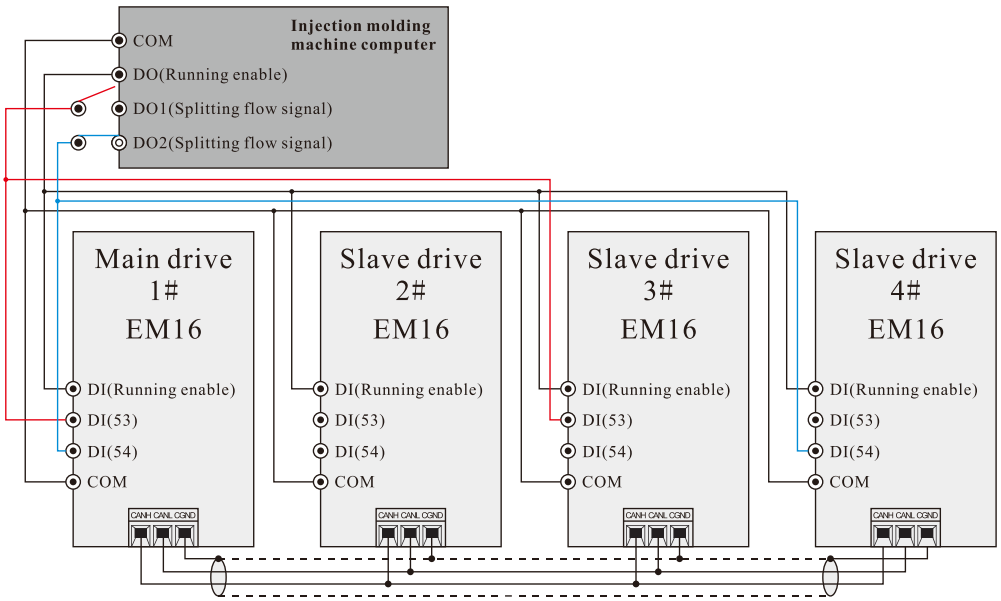


Diagram I-14 3+13+1 combined splitting flow control

Wiring instructions:

The upper computer provides a splitting flow signal to the drive 54# DI terminal of the main pump, the main pump uses this 54# DI signal to identify the slave pump address, while the slave pump uses this 54# DI signal to switch to the main pump and identify the slave pump address.

The 53#DI terminal signal of the combination 2 is disconnected

Function code setting:

The combination has 1# and 4# two main pumps, and the slave pumps have been changed, so the slave pump address have to be set. The slave pumps of 1# main pump are 2# and 3#, the H2-06 slave pump address is set as follows:

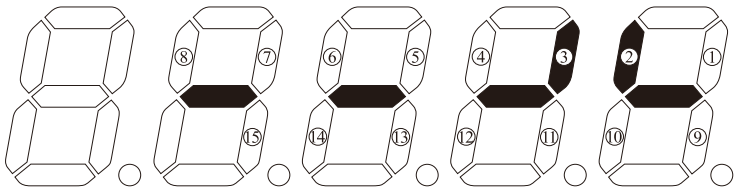


Diagram I-15 H2-06 Slave pump address setting

4# slave pump switch to main pump work without slave pump, so H2-06 need not to be set.

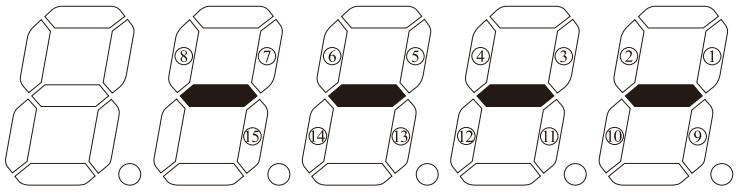


Diagram I-16 H2-06 Slave pump address setting

Fault alarm description

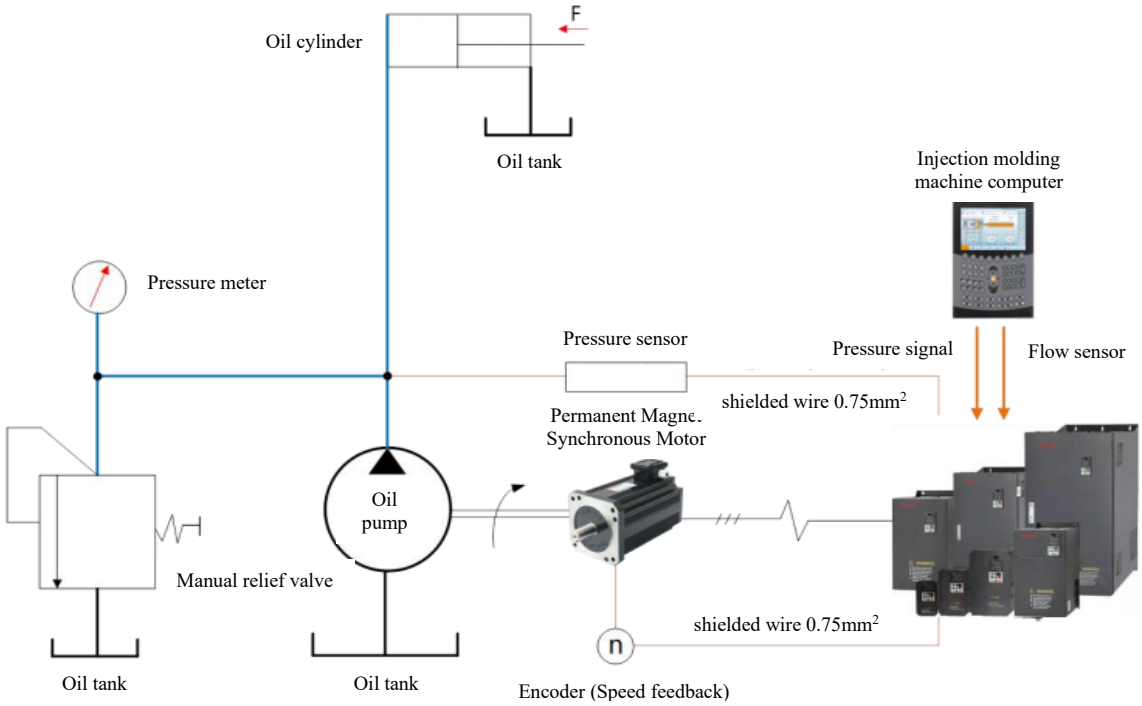
The following are descriptions of fault alarms specific to multi-pump control..

Fault name	Display	Troubleshooting	Solution
Slave fault warning	Err47-1	1. Check if the slave drive is faulty 2. Check if the CAN communication line is wrong 3. Control board failure	1. Exclude slave faults 2. Exclude the connection error 3. Replace the control board
CAN address	Err48-1	1. Check if more than one drive has	1. Exclude drive faults

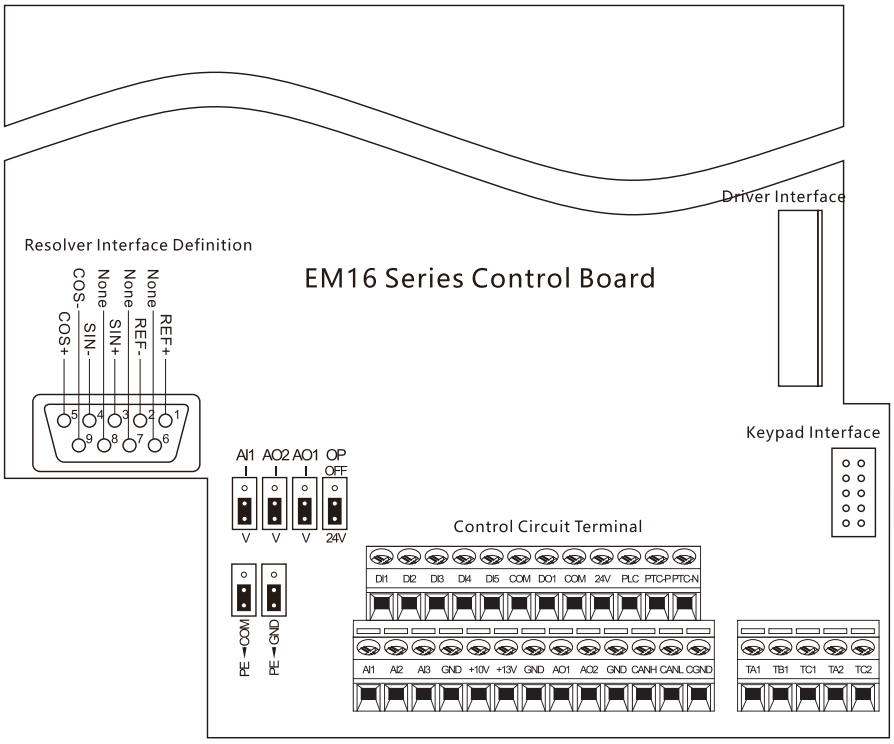
conflict		failed. 2. Check if the CAN communication line is wrong 3. Control board failure	2. Exclude the connection error 3. Replace the control board

Appendix II Debugging instructions for single pumps

1. System schematic diagram



2. Control wiring diagram



3. Wiring instructions

Terminal Symbol	Terminal Name	Description of the corresponding external equipment	Note
+13V	Pressure sensor power supply	Pressure sensor feedback	Sensor feedback
AI3	0-10V Pressure feedback		
AI1	0-10V Pressure given	Pressure given	Syestem given
GND	AI common		
AI2	0-10V Flow given	Flow given	Syestem given
GND	AI common		
REF+	Excitation signal +(Red&White)	Motor resolver	Colours correspond to Tamagawa encoders
REF-	Excitation signal -(Yellow&White)		
SIN+	Sine input + (Yellow)		
SIN-	Sine input – (Blue)		
COS+	Cosine input + (Red)		
COS-	Cosine input – (Black)		
DI1-COM	Digital input	Start signal terminal	
PTC-P/PTC-N	Motor temperature overheating protection PTC sensor	Motor temperature interface	PT130/150

4. Debugging instructions

Please follow the steps below for auto tuning of the drive:

Code	Parameter Name	Functional description	Note
P1-01	Rated motor power	Set according to the motor nameplate	Ensure correct input, otherwise the system may not run properly
P1-02	Rated motor voltage		
P1-03	Rated motor current		
P1-04	Rated motor frequency		
P1-05	Rated motor speed		
P1-16	Auto tuning selection	0: No action 1: Static auto-tuning 2: Dynamic auto-tuning without load, reverse high speed rotation 3: Static auto-tuning with load 5: Dynamic auto-tuning without load, forward high speed rotation	

Auto tuning is as below:

1. If the load can not be disconnected, please static auto tuning first, and set P0-05 to 0.50Hz after auto tuning is completed, press “RUN” to run the drive to check if the motor is forward running: if it is forward running, please operate reverse auto tuning. If it is reverse running, please swap the position of any two of the U, V and W wires on the output of the drive before operating the reverse auto tuning.

2. If the load can be disconnected, please forward dynamic auto tuning first, and check whether the motor is forward running at high speed during dynamic auto tuning process: If it is forward running, please operate forward auto tuning. If it is reverse running, please stop auto tuning first, and then swap the position of any two of the U, V and W wires on the output of the drive before operating the forward auto tuning.

AI analogue zero drift auto correction

Auto correction: H3-20=1, press “RUN” to zero drift auto correction, and after zero drift auto correction is completed, The value of the HI zero drift auto correction parameter H3-20 will automatically revert to "0".

Manual correction: When the drive is not enabled, the value of U1-04 (Corresponding to AI1), U1-05(Corresponding to AI2), U0-06(Corresponding to AI3), please write the maximum values of the 3 parameters viewed plus 10mV into the function codes P4-18, P4-23 and P4-28 respectively.

Adjust the pressure feedback, flow feedback and pressure sensor analog parameters in manual correction.

Code	Parameter Name	Functional description	Note
P4-18	AI1 minimum input	Factory default is 0.02V	Correct pressure given
P4-19	Corresponding setting of AI1 minimum input	Factory default is 0.0%	
P4-20	AI1 maximum input	Factory default is 10.00V	
P4-21	Corresponding setting of AI1 maximum input	Factory default is 100.0%	
P4-23	AI1 filter time	Factory default is 0.02V	Correct flow given
P4-24	AI2 minimum input	Factory default is 0.0%	
P4-25	Corresponding setting of AI2 minimum input	Factory default is 10.00V	
P4-26	AI2 maximum input	Factory default is 100.0%	
P4-28	Corresponding setting of AI2 maximum input	Factory default is 0.02V	Correct pressure feedback
P4-29	AI2 filter time	Factory default is 0.0%	
P4-30	AI3 minimum input	Factory default is 10.00V	
P4-31	Corresponding setting of AI3 minimum input	Factory default is 100.0%	

5. Adjust oil pump and system parameters

Set H3-00 to 2 to put the drive in pressure control mode 2 (analog channel given).

Code	Parameter Name	Functional description	Note
H3-00	Hydraulic control mode	0: Non-hydraulic control mode 1: Hydraulic control mode 1 (CAN setting) 2: Hydraulic control mode 2 (AI setting) 3: CAN hydraulic control mode (for special use)	The common mode is H3-00=2
H3-01	Maximum rotational speed	Factory default is 2000	
H3-02	System hydraulic pressure	Factory default is 175	Maximum set pressure for hydraulic equipment systems
H3-03	Maximum hydraulic pressure	Factory default is 250	Set according to the maximum range of the sensor
H3-05	Hydraulic pressure control Kp1	Factory default is 210.00	Adjust this parameter if the pressure exceeds the set value
H3-06	Hydraulic pressure control Ti1	Factory default is 0.100S	
H3-07	Hydraulic pressure control Td1	Factory default is 0.000ms	
H3-08	Maximum reverse rotational	Factory default is 20%	Maximum speed of reverse

Code	Parameter Name	Functional description	Note
	speed		unloading
H3-09	Minimum flow	Factory default is 0.5%	Due to the internal leakage of the oil pump, when the system is not given pressure and flow commands, the hydraulic oil in the oil circuit can flow backwards into the tank causing air to enter the circuit causing noise and instability in the system, so it is necessary to give a certain minimum pressure and minimum flow.
H3-10	Minimum pressure	Factory default is 0.5kg/cm^2	

If the value of Kp is more bigger, the value of Ti is more smaller, the value of Td is more bigger, so the response is more faster. But the response too fast will easy to cause system running oscillation and unstable.

If the value of Kp is more smaller, the value of Ti is more bigger, the value of Td is more smaller, so the response is more slower. But the response too slow will easy to cause reduced efficiency and unstable production of products.

EMHEATER

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