MT DRIVES

TROY EtherCat Servo Drives

M800 series

USER Manual

2020/2/1

Export Sponsor by TROY Intelligent Trading Ltd.

Chapter I Safety Information and Precautions

In this manual, Safety warning signs are defined as follows:



Indicates precautions in operation.



Indicates that failure to operate as required may cause moderate personal injury or material loss.



Indicates that failure to operate as required may cause serious damage to the equipment or personal injury.

1.1 Security Information

1.1.1 Before and during installation



- Do not use the servo drive with damaged or missing parts, otherwise it may cause personal injury, fire or other accidents.
- Please use the motor with Class B or above insulation, otherwise there is a risk of electric shock.
- It is forbidden to install the servo drive on inflammable materials, otherwise there is a fire risk.

1.1.2 Wiring



- The construction shall be carried out by professional electrical engineering personnel, otherwise there is a risk of electric shock.
- There must be a circuit breaker between the servo drive and the power supply, otherwise a fire may occur.
- Before wiring, please make sure that the power supply is off, otherwise there is a risk of electric shock.
- The grounding terminal must be reliably grounded, otherwise there is a risk of electric shock.



- Do not connect the input power cord to the output terminals U, V and W, otherwise the servo drive may be damaged!
- Make sure that the wiring meets the EMC requirements and the safety standards of the area; as the wire diameter, please refer to the recommendations in the manual, otherwise an accident may occur!
- Do not connect the braking resistor to the DC bus (+ (-) terminal directly, otherwise fire may be caused!

1.1.3 Before power on



- Please confirm whether the supply voltage class is consistent with the rated voltage of the servo drive, and whether the wiring positions of the input and output are correct, and note to check for short circuit in the peripheral circuit, and the connected circuit for tightness, otherwise the servo drive may be damaged!
- The servo drive cannot be powered on unless the cover plate is put on, otherwise electric shock may be caused!

1.1.4 After power-on



- Do not open the cover plate after power on, otherwise there is a risk of electric shock.
- Do not touch servo drive and peripheral circuit, otherwise electric shock may be caused.
- Do not touch the servo drive terminal (including the control terminal), otherwise there is a risk of electric shock.
- At the beginning of power on, the servo drive automatically carries out safety detection on the external strong current circuit. In this case, do not touch the U, V, W terminals of the servo drive or the wiring terminals of the motor, otherwise there is a risk of electric shock.



- According to different working conditions, it is recommended to adjust the parameters at zero speed or servooff, otherwise the sudden change to speed may be caused, resulting in accidents.
- Do not change the factory parameters of the servo drive at will, otherwise the equipment may be damaged.

1.1.5 In operation



- During the operation of servo drive, foreign matters shall be prevented from falling into the equipment, otherwise damage to the equipment may be caused .
- Do not use the contactor on-off method to control the start and stop of the driver, otherwise the equipment will be damaged.



- Never repair or maintain the equipment with electricity, otherwise there is a risk of electric shock.
- Confirm that the servo drive can only be maintained and repaired after the power indicator of the servo drive is completely off, otherwise the residual charge on the capacitor may cause harm to people.
- Personnel without professional training shall not repair or maintain the servo drive, otherwise personal injury or equipment damage may be caused.

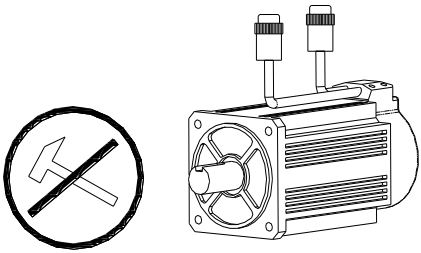
1.2 Precautions

1.2.1 Motor Insulation Inspection

Before the first use, reuse after long-term placement and regular examination of the motor, the motor insulation shall be inspected to prevent the drive from being damaged due to the insulation failure of the motor winding. During the insulation inspection, the motor wiring must be separated from the servo drive. It is recommended to use a 500V voltage type megger to ensure that the measured insulation resistance is not less than 5mΩ.

1.2.2 Motor

It is strictly forbidden to knock any position of the motor, especially the projecting shaft of the motor, as this may cause permanent damage to the motor. Please use a rubber hammer to exert moderate force during the installation process.



1.2.3 Motor heating and noise

The output voltage of servo drive is PWM wave, which contains certain harmonics, so the temperature rise, noise and vibration of motor may slightly increase compared with power frequency operation.

1.2.4 Use outside the rated voltage

It is not suitable for use outside the allowable working voltage range specified in the manual, as this may easily cause damage to the components in the servo drive. The corresponding step-up or step-down device should be used for voltage transformation if necessary.

1.2.5 The contactor and other switching devices used at the input and output ends of the servo drive

If a contactor is installed between the power supply and the input end of the servo drive, the contactor is not allowed to control the start and stop of the servo drive. When the contactor must be used to control the start and stop of the servo drive, the interval shall not be less than one hour. Frequent charging and discharging may easily reduce the service life of the capacitor in the servo drive. If there are contactors and other switching devices between the output end and the motor, it is necessary to ensure that the servo drive can perform make-and-break when there is no output, otherwise the module in the servo drive may be damaged easily.

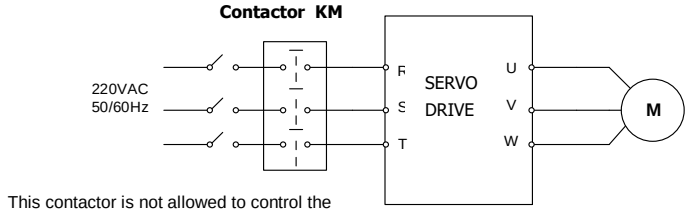
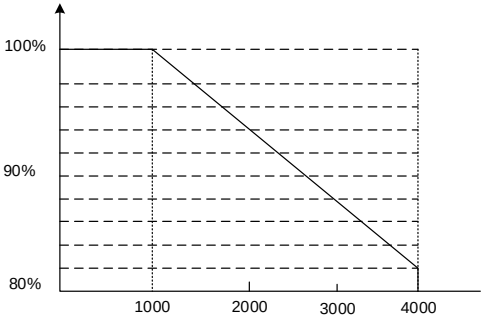


Figure 1-2

1.2.6 Altitude and derating

As the air in the area with altitude over 1000m is thin, the heat dissipation effect of the servo drive becomes poor, derating must be performed.



Driver rated output current and height derating curve

Figure 1-3

1.2.7 Cautions when when the servo drive is scrapped

Explosion may take place when the electrolytic capacitor of the main circuit and the electrolytic capacitor on the printed board are burned, and toxic gas will be generated when the plastic parts are burned. They should be treated as industrial waste.

1.2.8 Precautions on the drive

When the drive incurs over-current Er.002 ~ Er006, Er.009 ~ Er0012 and other faults, and the fault occurs again if it is started again, be sure to make troubleshooting, and do not start frequently for many times, otherwise the drive inverting module may be damaged by the impact of large current.

Chapter II Product Information

2.1 Naming Rules

2.1.1 Naming rules of servo

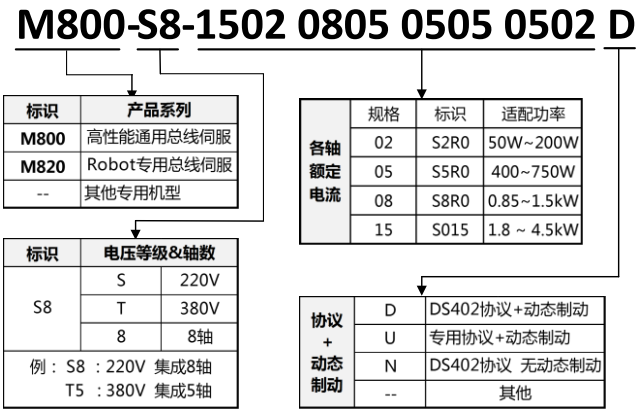


Figure 2-1 Model description of servo drive

1. M800 series drive products are composed of the power module, the double shaft drive module and the single shaft module, which can be flexibly combined into any number of shafts of 2-10 shafts.

2. The power of a single shaft drive module covers 50W ~ 4.5kw, and the maximum power of two shafts of double shaft power module is 4.5kw.

3. For the drives for M820 series robot and standard dynamic brake, DS402 protocol only supports the cycle synchronization mode (CSP) controlled by robot.

2.1.2 Naming rules of body label



Figure 2-2 Label description of servo drive body

2.2 Technical Specifications

Item		Specifications
Basic function	Power supply	Single-phase / three-phase AC220V (- 15% ~ + 10%) 50 / 60Hz **Note:** when the total rated current of multi shaft outputs exceeds 20A, three-phase AC220V power supply is recommended
	Control mode	Position, speed mode, torque mode, hybrid control mode.
	Maximum torque	Max 300%
	Output frequency	0~600Hz
	Cycle of current loop	62.5us
	Overload capacity	150% rated current output 100s; 300% rated current output 3S
Protection function	Protection function	Drive overload, overcurrent, short circuit, overvoltage, undervoltage, overheat, output default phase, etc
Bus	EtherCAT	Special EtherCAT, standard ds402 synchronization cycle 250us ~ 32ms
Environment	Ambient temperature	Operating temperature: - 10 ℃ ~ + 40 ℃ (Derating shall be performed at 40℃ ~ 50℃)
	Storage temperature	-20℃~60℃
	Humidity	＜ 90% RH, no condensation
	Protection level	IP20
	Vibration	0.5G（4.9m/s²）
	Altitude	Below 1000m (> 1000m, derating shall be performed)
	Others	1. Indoor, not exposed to direct sunlight;
		2. No strong electric field, strong magnetic field, radiation, etc;
		3. No corrosive gas or combustible gas, no splashing of water, oil or chemicals;
		4. No dirt, salt and metal dust;

2.3 Power Grading and Mechanical Installation

2.3.1 Specification of servo drive （*Note: 380V model is a single servo drive）

M800	T020*	T012*	S015	S8R0	S5R0	S2R0
Continuous output current [A] RMS	20.0	12.0	15.0	8.0	5.0	2.0
Instantaneous maximum current [A] RMS	60.0	36.0	45.0	24.0	15.0	6.0
Main circuit power supply	Three-phase AC 380V 50Hz		Single-phase / three-phase AC 220V (- 15% ~ + 10%), 50 / 60Hz			
Overvoltage class	III					

2.3.2 Installation of servo drive

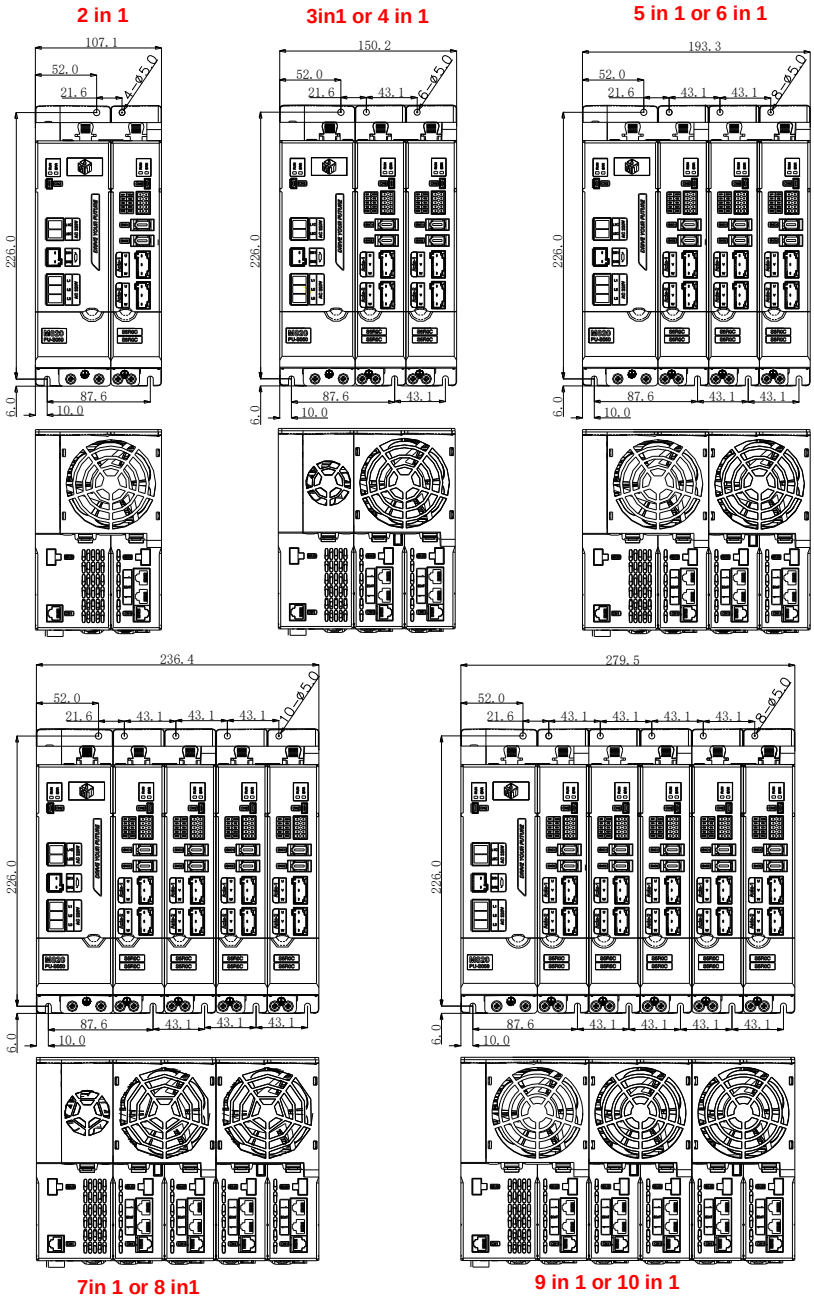


Figure 2-3 Installation sizes (mm) of servo drive

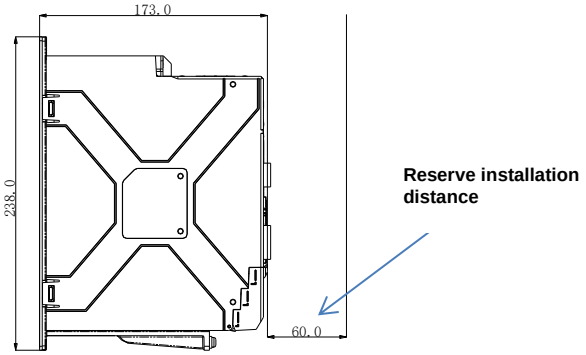


Figure 2-4 Drive depth and outgoing line distance (mm)

Precautions for installation of drive electric cabinet:

1. When M800 series drives are installed in cabinets, space ≥ 40mm shall be reserved at the top and bottom for air circulation and good heat dissipation effect;

2. For the front outgoing line of M800 series drives, 50-80mm outgoing line space shall be reserved on the basis of thickness D.

Chapter III Wiring Instructions

3.1 Definition Of Servo Drive Terminal

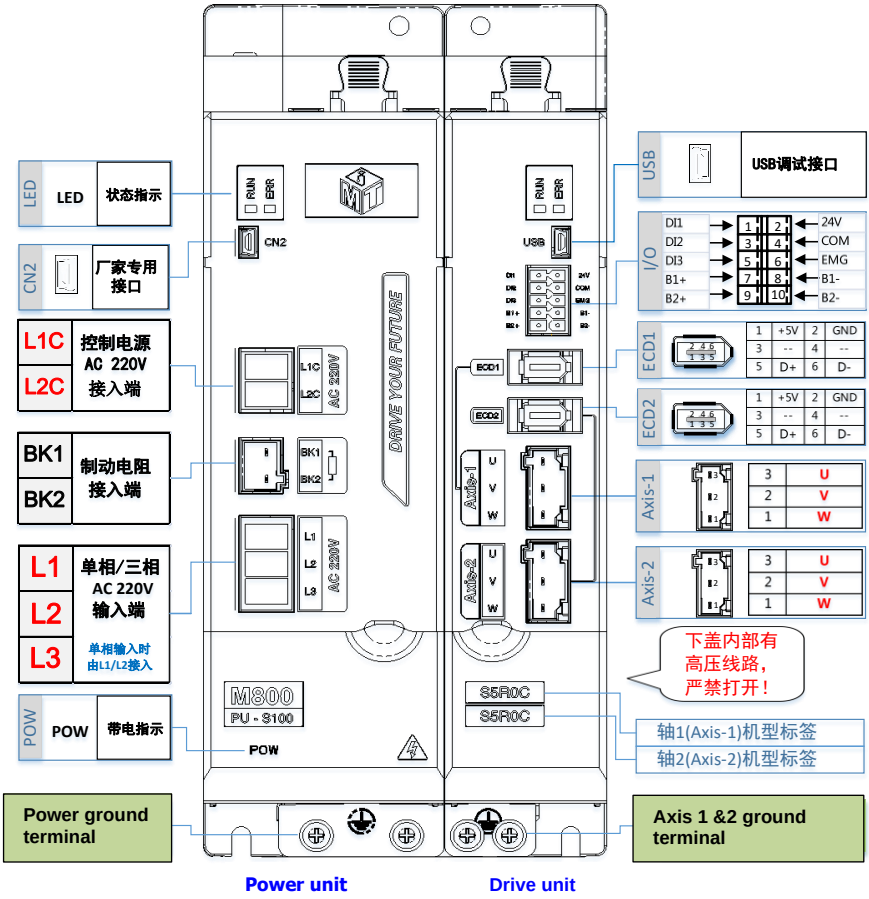


Figure 3-1 Distribution of servo drive terminals (front)

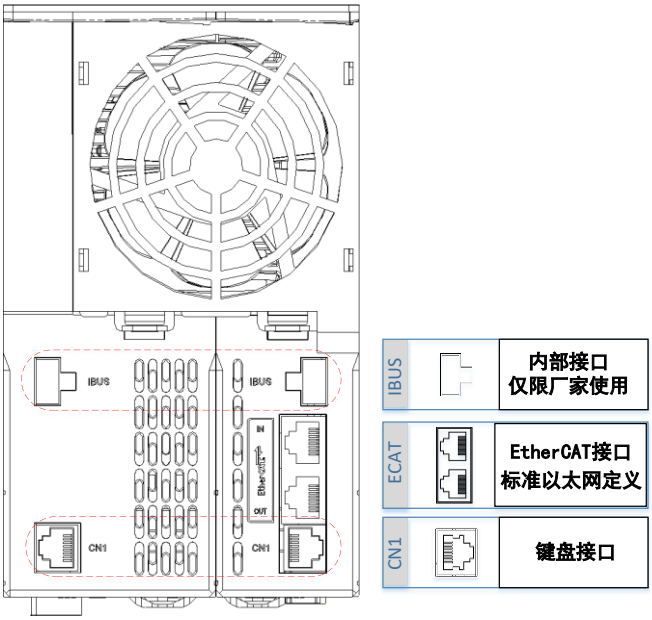


Figure 3-1 Distribution of servo drive terminals (top)

Precautions:

- ECD1 of the same drive module corresponds to Axis-1, and ECD2 corresponds to Axis-2

- Power line (power supply, motor power line) and signal line (control IO, encoder cable, Ethrechat network cable, etc.) shall be at least 30cm away from each other; strong and weak cables shall not pass through the same pipe or be bundled together, otherwise, uncontrollable interference may be introduced;
- The motor power cable and the encoder cable shall be Max 30 meters, and if an encoder cable is more than 5 meters, a 0.3mm^2 cable shall be used., Encoder cables and control cables shall be shielded cable, and the shielding layer shall be reliably grounded.

- If the brake resistance of M800 / M820 modular bus drive is ≥ 20 Ω (25-30 Ω recommended), the braking IGBT may be damaged if the brake resistance is less than 20 Ω; the brake resistance power can be adjusted according to the multi-axle comprehensive braking ratio.

3.1.1 Description of module indicator

	ERR	RUN	POW	
Power Supply Modular		--	On	The DC bus is powered on.
	Flicker	--	--	Fault (overvoltage, undervoltage, overcurrent, etc.)
	--	On	--	Power module output
Driving module	--	--	On	The DC bus is powered on.
	--	Single flicker	--	Servo module axis 1 ready
	--	Double flicker	--	Servo module axis 2 ready
	--	Uniform flash	--	All axes of servo module are ready
	--	On	--	Servo enable running
	Single flicker	--	--	Servo module axis 1 not ready
	Double flicker	--	--	Servo module axis 2 not ready
	Uniform flash	--	--	Each axis of the module not ready (check the power supply and encoder)
	On	--	--	Fault

Note: '--' does not affect the current indication.

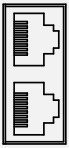
3.1.2 Main circuit terminal wiring description

Position	Terminal identification	Terminal name	Function description	Position
Power unit	L1C	Auxiliary power input terminal	AC single-phase 220V 50 / 60Hz power connection terminal	Front of power module
	L2C			
	BK1	Brake resistance connection terminal	External brake resistance access terminal Recommended resistance value ≥ 25 Ω, power 200W ~ 2000W Note: when the resistance is less than 25 Ω, the brake circuit may be damaged	
	BK2			
	L1	Three-phase power supply input terminal	AC single-phase / three-phase 220V 50 / 60Hz (in case of single-phase input, it is connected by L1 / L2 terminal)	
	L2			
	L3			
	PE	Earthing terminal	Power point input grounding	
Drive unit	U	Driver power output terminal	Connect according to the corresponding UVW, otherwise the motor will not turn and run	PE
	V			
	E			
	PE	Ground terminal	Motor ground terminal	
Warning	Never connect the input power cord to the U, V, W at the output side, or to the input terminal of the brake resistor (BK1, BK2), otherwise the drive may be permanently damaged!			

3.1.3 Function description of control circuit terminal

A> Control circuit terminal signal definition

PORT	Name	View	Pin	Function	Remark
CN1	Keyboard interface		1,2 3,4 5,6	Special definition of debugging keyboard	Please use our keyboard cable
USB	USB interface		1,2 3,4	Debugging and monitoring interface	Isolated Mini USB cable is recommended
I/O	Control teminal		1:DI1 , 2: +24V		DI and Motor holding brake control 24V input

			3:DI2, 4: COM		DI1~DI3: Digital input 1~3
			5: DI3, 6: EMG		EMG: Emergency stop input
			7: B1+, 8: B1-		Axis 1 motor holding brake control output
			9: B2+ 10: B2-		Axis 1 motor holding brake control output
ECAT	EtherCAT interface		1,2	RJ45 standard Define the network interface x2	Please use Category 5 or higher Twisted shielded network cable
			3,4		
			5,6		
			7,8		
			Shell		
ECD1	Module shaft 1 Encoder interface		1	+5V	5V Power supply access, requires twisted pair
			2	GND	
			3,4	--NC	Reserved pin
			5	Data+	Communication signal end, need twisted pair
			6	Data-	
			--	FG	Shielded wire connection and connector shell
ECD2	Module shaft 2 Encoder interface		1	+5V	Encoder 5V power supply, need twisted pair
			2	GND	
			3,4	--NC	Reserved pin
			5	Data+	Encoder signal line, need twisted pair
			6	Data-	
			--	FG	Shielded wire connection and connector shell

B> Description of electrical characteristics of control circuit terminals

Type	Interface	Function	Electrical characteristics
FG	Shield wire connection and connector shell	category	Module shaft 2
			--
			Signal name
+24V power supply	24V + 10%	Power Supply	+24V-COM
			+24V-COM
			+24V-COM
Digital input	Max 3A	Digital input	DI1~DI3-COM
	1 isolated input programmable terminal, input frequency ≤ 1kHz;		DI1~DI3-COM
Motor holding brake control output	3 threshold opening and closing voltage 10V,	Digital output	DI1~DI3-COM
			B1+, B1-
	Data+/Data-	Serial encoder interface	Standard 485 physical layer electrical specification
USB monitoring	USB-P/USB-M	USB monitoring / debugging interface	It is recommended to use USB isolation module and standard minusb cable, with length ≤ 2.5m and recommended cable length of 1.5m

Note:

- The DI and brake control circuits are completely isolated from the servo drive circuits, and no input or output interference is introduced to each other
- The control output circuit (B1 + / B1 -, B2 + / B2 -) of motor brake has the function of short circuit protection.
- When the adaptive motor is a multi-turn absolute value encoder, in order to ensure the safety specifications and prevent signal crosstalk, it is recommended that the batteries of each axis motor encoder be connected independently of each other, and parallel connection is not recommended.

3.2.1 Control circuit terminal (DI, DO) connection

- When DO (brake) control output current ≤ 1.5A, B1 and B2 outputs are directly used to control the motor brake

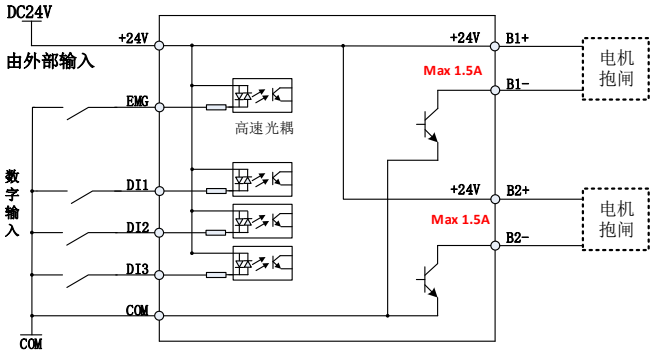


Figure 3-4 Wiring diagram 1 of digital input (DI) and output control (B1, B2)

- **When DO (brake) control output current ＞ 1.5A, the motor brake will be controlled through a relay**

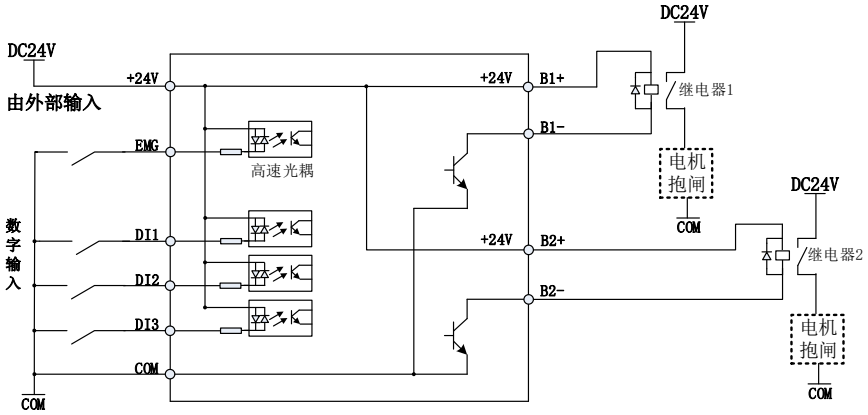


Figure 3-5 Wiring diagram 2 of digital input (DI) and output control (B1, B2)

Chapter IV Operation and Commissioning

4.1 Use Of Operation Panel

The servo drive can achieve debugging, parameter setting or modification, working state monitoring and other operations through the remote keyboard:

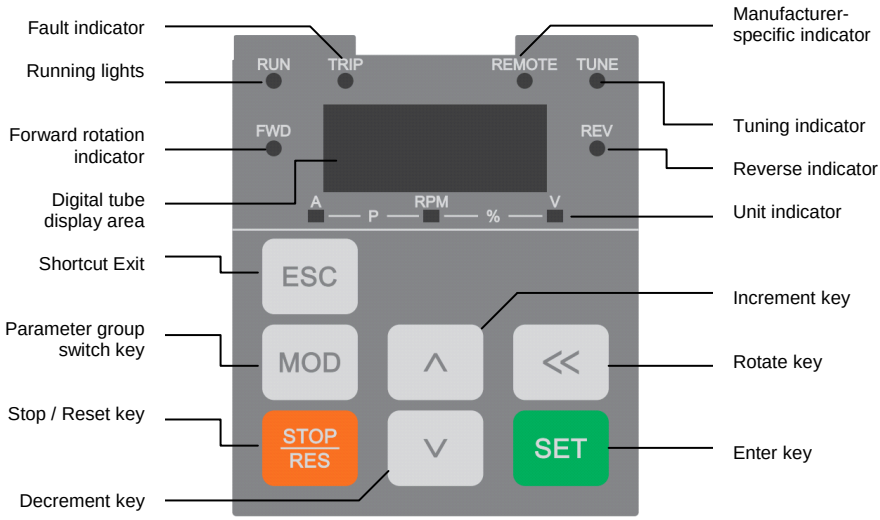


Figure 4-1 Introduction to LED operation panel

4.1.1Keyboard panel key operation

Key	Name	Function introduction
ESC	Shortcut exit key	Quickly exit the current interface to the normal monitoring interface
MOD	Function switch key	Entry and exit of primary menu
∧	Increment key	Data or function code increment
∨	Decrement key	Data or function code decrement
<<	Shift key	When modifying the parameter, select the modification bit of the parameter through the shift key
SET	Setting key	Enter submenu and set parameters step by step

STOP RES	Stop / reset key	Under the control mode of operation panel, press this key to stop the drive; in case of fault status, press this key to reset the fault

4.1.2 Menu operation

The parameter setting is described as follows:

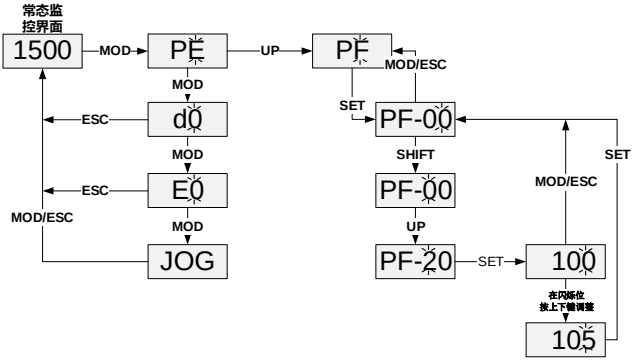


Figure 4-2 Parameter setting process

4.2 List Of Function Codes

4.2.1Definition of parameters and attributes

Parameter group description		Function code identification description	
PE00~99	Axis 1 servo parameter group	R	Read only parameter, which cannot be modified by user
PF00~99	Axis 2 servo parameter group	H	Hexadecimal parameter, bitwise modification
Er.000~227	Error alarm group	L	32 bit data
d0-00~49	Axis 1 monitoring parameters	■	Cannot be modified in servo operation status
d0-50~99	Axis 2 monitoring parameters	▲	Parameter values cannot be saved after power failure
		●	Parameter modification cannot be effective unless power-on is made again
		☆	Related to drive or motor model
		※	Realized after configuration of DI / DO, refer to the DI /DO function configuration table

Axis 1 servo parameter group

Function code	Mapped address	Function code name	Content and scope	Resolution	Factory value	Attribute
PE00	0x2E00	Kernel version	1000~3000	1	☆	R
PE01	0x2E01	Drive model	2：S2R0 (1.5A) 220V 4：S5R0 (5.0A) 220V 5：S8R0 (8.0A) 220V 6：S015 (15A) 220V 7~8 ：Reserved 9： T012 (12A) 380V 10：T020 (20A) 380V Single axis servo	1	☆	R/■
PE02	0x2E02	Servo motor code	Motor ID: 1000 ~ 3500	1	--	■
PE03	0x2E03	Parameter management	Digits，Ten digits: reserved Hundred bits: Reset factory parameters 0: no action 1: Restore factory (auto clear after completion) Thousands: reserved	1	0x0000	H/■
PE04	0x2E04	Reserved	--	--	--	--
PE05	0x2E05	Maximum speed threshold	0~6000rpm	1	4500	
PE06	0x2E06	Forward maximum torque limit	0~300%	1	300	
PE07	0x2E07	Reverse	0~300%	1	300	
PE08	0x2E08	Motor direction logic	0: positive CCW 1: reverse CW	1	0	■
PE09	0x2E09	Encoder type setting	**Digits**: encoder type 0: incremental, 1: Absolute value type **Tens and Hundreds**: Reserved **Thousands:** motor code identification 0: The motor code is not recognized. The value of PE02 shall prevail.	1	1	H/■

			1: Automatically identify the motor code and write to PE02			
PE10	0x2E0A	control method	0：TRQ， 1：SPD， 2：POS， 3：EtherCAT	1	0	■
PE11	0x2E0B	Brake ON delay time	Delay time from servo receiving Servo On command to brake on （100~500ms）	1	100	■
PE12	0x2E0C	Standstill, brake OFF-servo OFF delay	Delay time from servo receiving Servo Off command to motor power off （1~1000ms）	1	100	■
PE13	0x2E0D	Auxiliary gain	0~500%	1	0	
PE14	0x2E0E	Auxiliary gain type	0：Type A 1: Type B	1	0	
PE15	0x2E0F	Motor overload protection factor	10~100%	1	100	
PE16	0x2E10	USB monitoring settings		1	0x0000	H/■
PE17	0x2E11	Enable	0 : Servo OFF, 1 : Servo ON	1	0	■
PE18	0x2E12	External emergency stop shield	0: external emergency stop shield 1: Effective external emergency stop	1	0	■
PE19	0x2E13	Reserved	--	--	--	--
PE20	0x2E14	Speed rigidity coefficient	Correlation adjustment speed gain 50-300%	1	100	
PE21	0x2E15	Velocity loop gain	The larger the response is, the faster the response will be, and the larger the vibration will be 0~500	1	☆	
PE22	0x2E16	Integral time constant of velocity loop	The smaller the integral function is, the stronger the speed tracking ability is 0~300	1	☆	
PE23	0x2E17	Position loop gain	The larger the position tracking speed is, the greater the vibration will be	1	12	

			0~100			
PE24	0x2E18	2nd speed loop gain	The larger the response is, the faster the response will be, and the larger the vibration will be 0~500	1	1	
PE25	0x2E19	Integral time of the second speed loop constant	The smaller the integral function is, the stronger the speed tracking ability is 0~300	1	1	
PE26	0x2E1A	2nd position loop gain	The larger the position is, the faster the position tracking will cause excessive vibration. 0~100	1	1.0	
PE27	0x2E1B	Torque speed function switch	**Digits:** Speed feed forward selection 0: Internal speed feed forward (PE28) 1: External given **Ten digits:** Torque feedforward selection 0: Internal torque feedforward 1: External given **Hundreds:** Multi-segment gain selection 0: Default first set of gain parameters 1: Two sets of gain switching (PE72,73) **Thousands:** Torque limit selection 0: Internal clipping (PE05,06) 1: External Clipping-Object Dictionary 0x6072-Axis 1	1	0x0000	H/■
PE28	0x2E1C	Speed feedforward gain	The steady-state position deviation can be reduced by increasing, and the overshoot will be 0-100% if it is too large	1	0	
PE29	0x2E1D	Velocity feedforward smoothing	Smooth speed feedforward, and adjust 0 ~ 64 with	1	0	

		filter constant	speed feedforward gai			
PE30	0x2E1E	Damping coefficient	Damping coefficient of position ring 50 ~ 500	1	100	
PE31	0x2E1F	DI1 function setting	Individual & Ten: 00: no function 01-04: reserved 05: servo enable 06: urgent stop 07: origin switch 08: forward limit 09：negative limit 0A：axis 1 probe 0B：axis 2 probe Hundreds: 0：positive logic 1：Negative logic	1	0000	H/■
PE32	0x2E20	Di2 function setting	Same PE31	1	0000	H/■
PE33	0x2E21	Di3 function setting	Same PE31	1	0000	H/■
PE34	0x2E22	Di4 function setting	Same PE31	1	0000	H/■
PE35 ~ PE36	0x2E23 ~ 0x2E24	Reserved	--	--	--	--
PE37	0x2E25	DI Terminal filtering time	0~32ms	1	5	
PE38	0x2E26	Electronic gear selection	0: set value with object dictionary 0x6091 1: Use pe39 (high) PE40 (low) value	1	0	■
PE39	0x2E27	Number of command pulses of correspondin g position of motor rotating for one cycle (high position)	0~20000	1	0	■
PE40	0x2E28	Number of position command pulses correspondin g to one rotation of the motor (low order)	0~9999	1	0	■

PE41	0x2E29	Moving average filter constant	0~1024(x0.25ms)	1	0	■
PE42	0x2E2A	First order low pass filter onstant	0~6000(x250us)	1	0	
PE43 ~ PE48	0x2E2B ~ 0x2E30	Reserved	--	--	--	--
PE49	0x2E31	Position deviation limit	0.1~50.0 circle	0.1	10.0	■
PE50	0x2E32	EtherCAT synchronization cycle	1~128 (x0.25ms)=[250us~32ms]	1	4	■
PE51	0x2E33	CCW direction compensation value of quadrant bulge	0~1000 ‰	1	0	
PE52	0x2E34	Compensation value in CW direction of quadrant bulge	0~1000 ‰	1	0	
PE53	0x2E35	Quadrant bulge compensation delay	0~1000ms	1	0	
PE54	0x2E36	Quadrant convex compensation filter	0~100ms	1	0	
PE55	0x2E37	Gravity compensation value	0~1000 ‰	1	0	
PE56	0x2E38	Gravity compensation polarity	0: CCW direction compensation, 1: CW direction	1	0	
PE57	0x2E39	Reserved	--	--	--	--
PE58	0x2E3A	Type a vibration suppression frequency	5~200Hz	1	50	
PE59	0x2E3B	Type a vibration suppression gain	0~300%	1	0	
PE60	0x2E3C	Reserved	--	--	--	--
PE61	0x2E3D	Speed mode keyboard setting value pe10 = 1 valid	0~6000rpm		0	
PE62 ~ PE69	0x2E3E ~ 0x2E45	Reserved	--	--	--	--

PE70	0x2E46	Speed (pe61) polarity Speed (pe61) polarity	0：Speed is PE61 1：Speed is -PE61	1	0	
PE71	0x2E47	Servo adaptive rigidity	0 ~ 100 (to prevent nodding during enabling process with gravity or load)	1	30	
PE72	0x2E48	First group of gain velocity inflection point	0~6000rpm	1	6000	
PE73	0x2E49	Second group gain velocity inflection point	0~6000 rpm	1	6000	
PE74 ~ PE92	0x2E4A ~ 0x2E5C	Reserved	--	--	--	--
PE93	0x2E5D	USB Monitoring interface enable	0：Close the USB interface 1：Enable USB interface	1	1	
PE94 ~ PE99	0x2E5E ~ 0x2E63	Reserved	--	--	--	--

Axis 2 servo parameter group

Function code	Mapped address	Function code name	Content and scope	Resolution	Factory value	Attribute
PF00	0x2F00	Kernel version	0~65535	1	☆	R
PF01	0x2F01	Drive model	2：S2R0 (1.5A) 220V 4：S5R0 (5.0A) 220V 5：S8R0 (8.0A) 220V 6：S015 (15A) 220V 7~8 ：Reserved 9： T012 (12A) 380V Single axis servo 10：T020 (20A) 380V Single axis	1	☆	■

			servo			
PF02	0x2F02	Servo motor code	Motor ID: 1000 ~ 1600	1	--	■
PF03	0x2F03	Reserved	--	--	--	--
PF04	0x2F04	Reserved	--	--	--	--
PF05	0x2F05	Maximum speed threshold	0~6000rpm	1	☆	
PF06	0x2F06	Forward maximum torque limit	0~300%	1	300	
PF07	0x2F07	Reverse maximum torque limit	0~300%	1	300	
PF08	0x2F08	Motor direction logic	0: positive CCW 1: reverse CW	1	0	■
PF09	0x2F09	Encoder type setting	**Digits**: encoder type 0: Incremental, 1: Absolute value type **Tens and Hundreds**: Reserved **Thousands:** motor code identification 0: The motor code is not recognized. The value of PE02 shall prevail. 1: Automatically identify the motor code and write to PE02	1	1	H/■
PF10	0x2F0A	Control mode	0:TRQ， 1: SPD，2：POS， 3:EtherCAT	1	0	
PF11	0x2F0B	Brake ON delay time	Delay time from servo receiving Servo On command to brake on (100~500ms)	1	100	■
PF12	0x2F0C	Standstill, brake OFF-servo OFF delay	Delay time from servo receiving Servo Off command to motor power off (1~1000ms)	1	100	■
PF13	0x2F0D	Auxiliary gain	0~500%	1	0	
PF14	0x2F0E	Auxiliary gain type	0: Type A 1: Type B	1	0	
PF15	0x2F0F	Motor overload protection	10~100%	1	50	

		factor				
PF16	0x2F10	Reserved	--	--	--	
PF17	0x2F11	Enable	0 : Servo OFF, 1 : Servo ON	1	0	■
PF18	0x2F12	External emergency stop shield	0: external emergency stop shield 1: Effective external emergency sto	1	0	■
PF19	0x2F13	Reserved	--	--	--	--
PF20	0x2F14	Speed rigidity coefficient	Correlation adjustment speed gain 50-300%	1	100	
PF21	0x2F15	Speed loop gain	Velocity loop gain The larger the response is, the faster the response will be, and the larger the vibration will be 0~500	1	☆	
PF22	0x2F16	Speed loop integration time constant	The smaller the integral function is, the stronger the speed tracking ability is 0~300	1	☆	
PF23	0x2F17	Position loop gain	The larger the position tracking speed is, the greater the vibration will be 0~100	1	12	
PF24	0x2F18	2nd Speed loop integration time constant	The larger the response is, the faster the response will be, and the larger the vibration will be 0~500	1	☆	
PF25	0x2F19	2nd Speed loop integration time constant	The smaller the integral function is, the stronger the speed tracking ability is 0~300	1	☆	
PF26	0x2F1A	2nd position loop gain	The larger the position is, the faster the position tracking will cause excessive vibration. 0~100	1	☆	
PF27	0x2F1B	Torque speed function switch	**Digits :** Speed feed forward selection 0 : Internal speed feed forward (PE28) 1: External given **Ten digits :** Torque feedforward selection 0 : Internal torque feedforward 1: External given	1	0x0000	H/■

			Hundreds: Multi-segment gain selection 0: Default first set of gain parameters 1: Two sets of gain switching (PE72,73) **Thousands:** Torque limit selection 0: Internal clipping (PE05,06) 1: External Clipping-Object Dictionary 0x6072-Axis 1			
PF28	0x2F1C	Speed feedforward gain	The steady-state position deviation can be reduced by increasing, and the overshoot will be 0-100% if it is too large	1	0	
PF29	0x2F1D	Velocity feedforward smoothing filter constant	Smooth speed feedforward, and adjust 0 ~ 64 with speed feed forward gain	1	0	
PF30	0x2F1E	Damping coefficient	Damping coefficient of position ring 50 ~ 500	1	100	
PF31 ~ PF37	0x2F1F ~ 0x2F25	Reserved		--	--	--
PF38	0x2F26	Electronic gear selection	0: set value with object dictionary 0x6891 1: Use pe39 (high) PE40 (low) value	1	0	■
PF39	0x2F27	Number of command pulses of corresponding position of motor rotating for one cycle (high position)	0~20000	1	0	■
PF40	0x2F28	Number of position command pulses corresponding to one rotation of the motor (low order)	0~9999	1	0	■

PF41	0x2F29	Moving average filter constant	0~1024(x0.25ms)	1	0	■
PF42	0x2F2A	First order low pass filter onstant	0~6000(x250us)	1	0	
PF43 ~ PF48	0x2F2B ~ 0x2F30	Reserved	--	--	--	--
PF49	0x2F31	Position deviation limit	0.1~50.0 circle	0.1	10.0	■
PF50	0x2F32	EtherCAT synchronization cycle	1~128 (x0.25ms)=[250us~32ms]	1	4	■
PF51	0x2F33	CCW direction compensation value of quadrant bulge	0~1000‰	1	0	
PF52	0x2F34	Compensation value in CW direction of quadrant bulge	0~1000‰	1	0	
PF53	0x2F35	Quadrant bulge compensation delay	0~1000ms	1	0	
PF54	0x2F36	Quadrant convex compensation filter	0~100ms	1	0	
PF55	0x2F37	Gravity compensation value	0~1000 per thousand	1	0	
PF56	0x2F38	Gravity compensation polarity	0: CCW direction compensation, 1: CW direction	1	0	
PF57	0x2F39	Reserved	--	--	--	--
PF58	0x2F3A	Type A vibration suppression frequency	5~200Hz	1	50	
PF59	0x2F3B	Type A vibration suppression gain	0~300%	1	0	
PF60	0x2F3C	Reserved	--	--	--	--
PF61	0x2F3D	Speed mode keyboard setting value pe10 = 1 valid	0~6000rpm		0	
PF62 ~ PF69	0x2F3E ~ 0x2F45	Reserved	--	--	--	--

PF70	0x2F46	Speed (pe61) polarity Speed (pe61) polarity	0: Speed is PE61 1: Speed is -PE61	1	0	
PF71	0x2F47	Servo adaptive rigidity	0 ~ 100 (to prevent nodding during enabling process with gravity or load)	1	30	
PF72	0x2F48	First group of gain velocity inflection point	0~6000rpm	1	6000	
PE73	0x2F49	Second group gain velocity inflection point	0~6000 rpm	1	6000	
PE74 ~ PE92	0x2F4A ~ 0x2F5C	Reserved	--	--	--	--

D0 monitoring parameter group

Function code	Communication code	Description	Data range	Unit resolution	attribute
d0-00	0x3000	Axis1 motor speed	0~±6000rpm	1	R
d0-01	0x3001	Reserved	--	--	R
d0-02	0x3002	DIDO Status Monitor	Top half from right to left : DI1~DI6 Bottom half from right to left : DO1~DO3	--	R
d0-03	0x3003	Axis 1 encoder position feedback low	0~9999	1	R
d0-04	0x3004	Axis 1 encoder position feedback high	0~9999	1	R
d0-05	0x3005	Position deviation of axis 1	0~65535	1	R
d0-06	0x3006	Axis 1q voltage	0~±300.00V	0.01	R
d0-07	0x3007	Reserved	--	--	R
d0-08	0x3008	Shaft 1D shaft voltage	0~±200.00V	0.01	R
d0-09	0x3009	Average load rate of axis 1	0~300%	1	R
d0-10	0x300A	Encoder 1 multi turn information feedback	0~65535	1	R

d0-11 ~ do-14	0x300B ~ 0x300E	Reserved	--	--	R
d0-15	0x300F	Axis 1 Motor electrical angle feedback	0~2048	1	R
d0-16	0x3010	Drive bus voltage	0~410.0V	0.1	R
d0-17	0x3011	The lowest historical bus voltage after the motor is enabled	0~410.0V	0.1	R
d0-18	0x3012	Historical highest bus voltage	0~410.0V	0.1	R
d0-19	0x3013	Drive temperature	0~100.0℃	0.1	R
d0-20	0x3014	AxiS1 Encoder communication failure count	0~65535	1	R
d0-21	0x3015	Axis 1Target position command high	0~65535	1	R
d0-22	0x3016	Axis 1Target position command low	0~65535	1	R
d0-23 ~ d0~35	0x3017 ~ 0x3023	Reserved	--	--	R
d0-36	0x3024	Axis 1 Motor torque feedback	0~300%		R
d0-37	0x3025	Reserved	--	--	R
d0-38	0x3026	Axis 1 Motor torque reference	0~300%		R
d0-39 ~ d0~49	0x3027 ~ 0x3031	Reserved	--	--	R
d0-50	0x3032	Axis 2 motor speed	0~±6000rpm	1	R
d0-51	0x3033	EtherCATMaximum communication cycle	0~512 (x62.5us)	1	R
d0-52	0x3034	EtherCAT Real-time communication cycle	0~512 (x62.5us)	1	R
d0-53	0x3035	Axis 2 Encoder position feedback low	0~9999	1	R
d0-54	0x3036	Axis 2 Encoder position feedback high	0~9999	1	R
d0-55	0x3037	Axis 2 Position deviation	0~65535	1	R
d0-56	0x3038	Axis 2 q Shaft voltage	0~±300.00V	0.01	R

d0-57	0x3039	Reserved	--	--	R
d0-58	0x303A	Axis 2d Shaft voltage	0~±200.00V	0.01	R
d0-59	0x303B	Axis 2 Load average	0~300%	1	R
d0-60	0x303C	Encode 2 Multi-turn information feedback	0~65535	1	R
d0-61 ~ d0-64	0x303D ~ 0x3040	Reserved	--	--	R
d0-65	0x3041	Axis 2 Motor electrical angle feedback	0~2048	1	R
d0-66 ~ d0-69	0x3042 ~ 0x3045	Reserved	--	--	R
d0-70	0x3046	Axis 2 Encoder communication failure count	0~65535	0.1	R
d0-71	0x3047	Axis 2 Target position command high	0~65535	0.1	R
d0-72	0x3048	Axis 2 Target position command low	0~65535	1	R
d0-73 ~ do-85	0x3049 ~ 0x3055	Reserved	--	--	R
d0-86	0x3056	Axis 2 Motor torque feedback	0~300%	1	R
d0-87	0x3057	Reserved	--	--	R
d0-88	0x3058	Axis 2 Motor torque reference	0~300%	1	R
d0-89 ~ d0-96	0x3059 ~ 0x3060	Reserved	--	--	R
d0-97	0x3061	Software Version-Year	2018~2028	1	R
d0-98	0x3062	Software Version-Month	000~1231	1	R
d0-99	0x3063	Software Version-Model SN	000~1259	1	R

Er Fault alarm group

Note:

1: 'ECAT code' 'is the fault code written into PDO dictionary 0x603f (axis 1) or 0x683f (axis 2) after servo slave station alarms.

2: "Error code" is the alarm code displayed on the drive keypad.

Error code	ECAT code	Error name	Reset or not	
Er.000	0xFF00	No fault	--	R
Er.001	0xFF01	Emergency stop alarm	YES	
Er.002	0xFF02	Shaft 1 overcurrent	**NO**	Motor code error, encoder cable does not correspond to motor, UVW short circuit, short circuit to ground, power module drive undervoltage, drive short circuit to ground damage (one phase of UVW is not grounded) clear the alarm after power on again
Er.003	0xFF03	Shaft 2 overcurrent	NO	
Er.004	0xFF04	External bus disconnection	YES	No DC bus is connected, communication between drive modules is abnormal, check the top IBus
Er.005	0xFF05	Axle 1 overload	YES	Motor code error, motor brake not open, motor load locked, motor phase loss, motor selection is too small and load is too heavy, etc
Er.006	0xFF06	Axle 2 overload	YES	
Er.007	0xFF07	Axis 1 motor initializing	YES	Motor encoder is not connected, encoder cable is abnormal (wiring error), encoder protocol is abnormal (motor encoder protocol corresponding to motor code is not the same as the actual connected encoder), current sampling is abnormal, etc
Er.008	0xFF08	Axis 2 Motor initializing	YES	
Er.009	0xFF09	Three-phase current of axis 1 is abnormal	YES	The motor is not connected, the motor is out of phase, the motor phase sequence is wrong, the motor code is set incorrectly, the power supply voltage of the drive is low, the load exceeds the allowable value at the high speed of the motor, and the drive gain parameter is abnormal, etc
Er.010	0xFF0A	Three-phase current of axis 2 is abnormal	YES	
Er.011	0xFF0B	DC bus under voltage	YES	The power grid voltage is too low, the main circuit input of the drive is in poor contact, etc
Er.012	0xFF0C	DC bus overvoltage	YES	The brake resistance is not connected, the value of the brake resistance is too large, the load feedback energy is too large, etc
Er.013	0xFF0D	Axis 1 position command too large	YES	The increment of master station position instruction is too large, the master station encoder unit setting is wrong, the synchronization cycle (PX. 50) setting is wrong, the drive is not set to absolute value type, resulting in the loss of reference point after power on, and the parameter setting of electronic gear is wrong
Er.014	0xFF0E	Axis 2 position command too large	YES	
Er.015	0xFF0F	Drive overheating	YES	The ambient temperature is too high, the installation environment is not forced

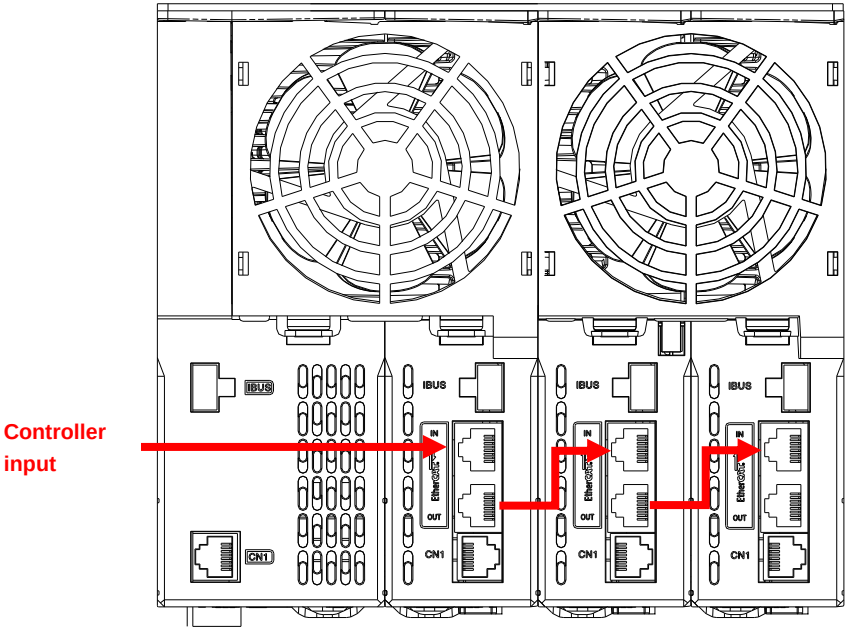
				ventilation, the drive fan is damaged, etc
Er.016	0xFF10	Failed to write EEPROM	YES	Parameter setting is incorrect, EEPROM is abnormal
Er.017	0xFF11	Failed to read EEPROM	YES	EEPROM anomaly
Er.018	0xFF12	Position deviation of axis 1 is too large	YES	The position gain setting is too small, the speed gain parameter setting is unreasonable, the load is too heavy, the position deviation alarm threshold setting is too small, the motor is locked, the motor line sequence is wrong, the motor torque limit is too small, etc
Er.019	0xFF13	Excessive position deviation of axis 2	YES	
Er.020	0xFF14	Axis 1 encoder error	YES	Abnormal encoder communication, unreliable encoder wiring, encoder interference
Er.021	0xFF15	Abnormal speed measurement of axis 1	YES	Abnormal speed measurement, encoder interference, encoder abnormality
Er.022	0xFF16	Axis 1 encoder initializing	YES	Encoder is not connected, encoder wiring is not reliable
Er.023	0xFF17	Reserved	--	
Er.024	0xFF18	External bus error	YES	External module alarm input
Er.025	0xFF19	Reserved	--	
Er.026	0xFF1A	Reserved	--	
ER.027	0xFF1B	EEPROM parameter verification error	YES	EEPROM anomaly
Er.028	0xFF1C	Axis 2 encoder error	YES	Encoder communication is abnormal, too much interference
Er.029	0xFF1D	Abnormal speed measurement of axis 2	YES	Abnormal speed measurement, encoder interference, encoder abnormality
Er.030	0xFF1E	Axis 2 encoder initializing	YES	Encoder is not connected, encoder wiring is not reliable
Er.031	0xFF1F	Alarm clear too frequently	YES	Clear the alarm several times in a short time
Er.032	0xFF20	Parameter initialization error	YES	Eerpom parameters need to be initialized to restore factory settings
Er.033	0xFF21	EtherCAT communication error	YES	The main station is not connected, the main station is disconnected, the EtherCAT network cable is not reliable, the EtherCAT network cable receives interference, etc
Er.034	0xFF22	Encoder 1 battery failure	YES	Low battery power, no encoder battery connected; Note: if the battery is not replaced, the alarm will be given again after 1 minute of operation
Er.035	0xFF23	Encoder 2 battery failure	YES	

				after the fault is reset.
Er.036	0xFF24	Encoder 1 multi turn value lost	YES	The absolute encoder is not connected to the battery, or insert and swapping causes the loss of multi-turn information when the battery is in place. DS402 statusword bit3 = 1 when alarming, controlword setting 0x80 cannot be cleared, can be cleared only when controlword bit 12 setting is 1, and statusword bit3 = 0 after successful clearing
Er.037	0xFF25	Multi-turn value of Encoder 2 lost	YES	
Er.227	0xFFE3	Drive hardware encryption error	NO	The drive does not perform hardware decryption or pirated drive hardware is used.

4.3.3 Communication protocol description

EtherCAT supports ds402 protocol and our customized communication protocol (to consult our marketing personnel)

M800 / M820 EtherCAT network topology:



Chapter V Appendix

5.1 Maintenance

As a typical product combining power electronic technology and microelectronic technology, the drive has the dual characteristics of industrial equipment and microelectronic devices. The change of operating environment, such as temperature, humidity, salt fog and other factors, as well as the aging of internal components of the drive, may lead to various failures of the drive. Therefore, in order to ensure the normal operation of the product for a long time, it is necessary to carry out daily inspection and regular maintenance (once every 3 months or 6 months) of the drive during storage and use.

5.1.1 Items of daily inspection:

- Whether the sound changes abnormally during the operation of the motor;
- Whether there is vibration during the operation of the motor;
- Whether the installation environment of servo drive changes;
- Whether the cooling fan of servo drive works normally;
- Whether the servo drive is overheated.

5.1.2 Daily cleaning:

- Keep the servo drive in a clean state at all times;
- Effectively remove the dust on the upper surface of the servo drive to prevent the dust from entering the servo drive, especially metal dust;
- Effectively remove the oil dirt of the cooling fan of the servo drive.

5.1.3 Regular inspection

- Check the air duct and clean it regularly;
- Check whether the screw is loose;
- Check whether the servo drive is corroded;
- Check whether the wiring terminal has arc trace;
- Main circuit insulation test.

5.2 Replacement of Vulnerable Parts

Some components and parts inside the servo drive may wear or degrade in the use process. In order to ensure the stable and reliable operation of the drive, preventive maintenance of the drive shall be carried out, and components shall be replaced if necessary.

1) Cooling fan (standard replacement years: 2-3 years)
Possible causes of damage: bearing wear, blade aging.
Criteria: whether there are cracks in fan blades, etc., and whether there is abnormal vibration sound during startup.

2) Electrolytic capacitor (standard replacement years: 4-5 years)
Possible causes of damage: poor quality of input power supply, high ambient temperature, frequent load jump, electrolyte aging.

Criteria: liquid leakage, the safety valve protrusions, the measurement of electrostatic capacitance, and the measurement of insulation resistance.

5.3 Storage Of Servo Drive

After purchase of the servo drive, the user must pay attention to the following points for temporary storage or long-term storage:

- When storing, try to put it into the packing box provided by our company according to the original packing.
- It shall be placed in a well ventilated place with the specified temperature and humidity range, without humidity, dirt, and metal dust
- Long term storage may lead to the deterioration of electrolytic capacitor. It must be ensured to power on once within half a year, and the power on time shall not be less than 0.5 hours. The input voltage must be slowly increased to the rated value with a voltage regulator.

Attachment: Product warranty agreement and product warranty card

1） The warranty period of this product is 18 months (subject to the barcode information of the body). If, during the warranty period, the product fails or is damaged, if used normally according to the user manual, our company is responsible for free maintenance.

2） If, during the warranty period, the damage is caused by the following reasons, a certain maintenance fee will be charged:
   - Damage to the machine due to wrong use or unauthorized repair or modification;
   - Machine damage caused by fire, flood, abnormal voltage, other natural disasters and secondary disasters;
   - Hardware damage caused by artificial falling and transportation after purchase;
   - Damage to the machine caused by operation not in accordance with the user manual provided by our company;
   - Faults and damages caused by failure other than the machine (such as external equipment factors).

3） In case of any fault or damage to the product, please fill in the contents of the product warranty card on the back.

4） The charge of maintenance cost shall be subject to the latest adjusted maintenance price list of our company.

5） This warranty card will not be reissued under normal circumstances. Please be sure to keep this card and present it to the maintenance personnel when repair is made.

6） For any questions during the service, please contact our agent or our company in time.

The right to interpret this agreement belongs to our company

<table>
<tr><td colspan="3"><u>Warranty Card</u></td></tr>
<tr><td rowspan="3">Customer Information</td><td colspan="2">Address of employer:</td></tr>
<tr><td>Name of employer:</td><td>Contact person:</td></tr>
<tr><td>Zip code:</td><td>Contact telephone:</td></tr>
<tr><td rowspan="5">Product Information</td><td colspan="2">Product model:</td></tr>
<tr><td colspan="2">Body barcode:</td></tr>
<tr><td colspan="2">Motor model:</td></tr>
<tr><td colspan="2">Motor purpose:</td></tr>
<tr><td colspan="2">Name of agent (distributor)</td></tr>
<tr><td>Fault Information</td><td colspan="2">Record of customer fault :

Date of record of fault:</td></tr>
</table>

	Record of fault maintenance: Maintenance person: Maintenance date: