[V2.0]

SM10 Servo Drive User Manual

Zhejiang Synmot Electrical Technology Co., Ltd

Preface

Thank you to purchase and use SM10 series general-purpose servo drive produced by Zhejiang Synmot Electrical Technology Co., Ltd.

Zhejiang Synmot Electrical Technology Co., Ltd. (Synmot) is a professional manufacturer of servo motors and servo drive. The power levels of the products cover: 400W - 160kW all-series servo motors and servo drive.

Synmot SM10 series drive are a type of general-purpose servo drive developed specifically to drive the permanent magnet synchronous motor (PMSM). This series servo drive have a wide capacity range (rated power: 0.4kW ~ 160kW), can realize the general-purpose servo control functions including position, speed and torque control and are widely applied in various types of automation equipment.

SM10 series servo drive are suitable to various application and support multiple position feedback devices, including incremental encoders, absolute value encoders and resolvers, etc. They support multiple communication protocols, including RS485 Modbus, CANopen, and EtherCAT, etc. It has a high-performance DSP as the core and combines various advanced control algorithms to meet the demands of various servo controls.

The manual is the operating instructions of SM10 series servo drive. Please keep properly to check as necessary. The manual provides the users with the related precautions and instructions including safety precautions, product information and model selection, installation and wiring, parameter setting, operation and adjustment, communication functions, fault diagnosis, and daily maintenance. In order to correctly use the series of servo drive, fully play the outstanding performance of products and ensure the safety of users and equipment, please ensure to carefully read the manual before use of SM10 series of servo drive. Improper use may result in the abnormal operation, failure, and reduced service life of drive and even the accidents of damaged equipment and personal injury!

The manual is suitable as the reference for the following users:

- Servo system designers
- Installation or wiring personnel
- Engineering commissioning personnel
- Maintainers or inspectors

If you have any doubt on the uses, please consult the dealer or customer service center of our company.

Because we continue to improve the servo drive, the information provided by our company may be subject to change without prior notice. The update version can be downloaded from our official website www.synmot.com.

Note: The instruction applies only to the general-purpose servo applications. The users of electro-hydraulic server can consult:

"Synmot Servo Drive User Manual（for Hydraulic）"

The contents in the descriptions about operating safety signs are very important and must be followed.

The receiving inspection, installation, wiring, operation, maintenance, and inspection should always pay attention to various safety precautions.

The contents related to safety in the manual use the following identifications:

	**Danger**	Refers to the potential dangers. It needs to pay special attention during the uses. Otherwise, it may cause serious or fatal personal injury.
	**Warning**	Refers to potential dangers. Failure to follow warnings may cause moderate damage to the human body or lead to serious product damage or even failure.
	**Forbidden**	Refers to the actions absolutely forbidden. Failure to follow may cause product damage or even failure to get unusable.

Version information record

Date	Revised version	Description	Author
5/1/2014	V1.0	V1.0	R&D department Engineering application department
10/1/2017	V2.0	V2.0	R&D department Engineering application department

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Chapter 1 Safety information and precautions

1.1 Precautions before usage

(1) Precautions of goods arrival/storage/handling

	Receiving inspection: Please use the auxiliary products designated for servo motors and drive. Otherwise, it may lead to fire or failure.
	a) Please do not store or place the product in the following environment. Otherwise, it may lead to fire, electric shock or machine damage: ➢ Places exposed to direct sunlight ➢ Places that the ambient temperature exceeds the storage / placement temperature ➢ Places that the relative humidity exceeds the storage / placement humidity ➢ Places of high temperature differences or dewing ➢ Places close to corrosive gas and combustible gas ➢ Places with many dust, dirt, salt, and metal dusts ➢ Places with water, oil, and drug dripping ➢ Places with vibrational or shock transferable to main body
	b) Please do not stack up too many products together; otherwise, it will cause damage or failure. c) The servo drive or servo motors cannot bear force or knock. Otherwise, it will lead to product damage or failure.
	d) Please do not pull the electric wires, motor shaft, and encoder during moving the servo motor. Otherwise, it will lead to product damage or failure.

(2) Installation precautions

	a) Please follow the requirement on installation direction. Otherwise, it may lead to malfunctions. b) Please avoid excessive shock. Otherwise, it may lead to malfunctions. c) Please do not install the product in the places possibly splashed by water or in the environment easy to corrode. Please avoid using the product near inflammable gas or combustible material. Otherwise, it will lead to the risk of electric shock or fire. d) Please do not sit on the product or place a weight on it. Otherwise, it will lead to damage. e) Please avoid the blockage of air inlet and air outlet and the foreign matter into the product. Otherwise, it may lead to malfunction and fire due to internal device aging.
	f) Upon setting, please ensure to maintain the specified spacing between the servo drive and the internal surface of electric cabinet as well as other machines. Otherwise, it will lead to over-heat or malfunction. g) Must install in the control cabinets with adequate IP grade. Otherwise, it will lead to the risk of electric shock or fire. h) Please do not install if the product is damaged or lack of component.

1.2 Application precautions

1.2.1 Wiring precautions

a) Please do not connect 3-phase power supply on drive output terminals U, V and W. Otherwise, it may lead to damage or fire.

b) Please securely and properly connect the power terminals and motor connecting terminals. Otherwise, it may lead to fire.

c) Please use the designated power voltage. Otherwise, it may lead to machine damage.

d) Please correctly and reliably wiring. Otherwise, it may lead to motor out of control, damage, or malfunctions.

e) Ensure the wires are insulated and avoid the wire squeezing. Otherwise, it may lead to electric shock.

f) The electric wires and non-heat-resistant body cannot be close to the heat sink of drive or motor. Otherwise, it will lead to the failure of equipment to operate abnormally or shock.

g) Please install a safety device such as breaker to avoid the short-circuit of external wiring. Otherwise, it will lead to fire.

h) Please do not place the power lines and signal lines in the same conduit and also not bundle them up. Upon wiring, the power line and signal line should separate over 30cm.

i) Please use the shielded twisted pair cable for signal lines and encoder signal lines.

j) The maximum wiring length of command input line is 3m and the maximum wiring length of encoder feedback line is 20m. The wiring length should be as short as possible. For the applications needing longer wire, please contact the technical support of our company.

k) After the power is switched off, there is still high voltage in the drive. Thus, please postpone (5 min) to contact the power terminal.

l) The servo drive and servo motor must contact the ground well. The installation should ground at single point and the ground impedance should be lower than 5Ω. Otherwise, it will lead to failure to work properly.

m) Please conduct the inspection after confirming the display panel is off.

n) If the power supply is poor, please ensure to use the product in the designated voltage range. Otherwise, it may lead to damage.

o) Prevent the conductive fastener and wire end from entering the servo drive. Otherwise, it may lead to equipment damage or malfunction.

p) The freewheel diode connected in parallel to the dc signal relay cannot be connected inversely. Otherwise, it may lead to equipment damage or malfunction.

In the event of the following cases, please take the appropriate shielding measures. Otherwise, it may lead to the machine damage:

- Interference due to static electricity
- Places to near strong electric field or strong magnetic field
- Places possible to radiate radioactive rays
- Places with power line nearby

1.2.2 Power-on / operation precautions

Power-on precautions

	a) Do not open the cover plate after power-on. Otherwise, it may lead to electric shock. b) Do not use the wet hands to contact the servo drive and surrounding circuit. Otherwise, it may lead to electric shock. c) Do not contact the servo drive terminal (including control terminal). Otherwise, it may lead to electric shock. d) Immediately after power-on, the servo drive will automatically run safety diagnoses on the power circuit. Now, please do not contact the connection terminals of servo drive U, V and W. Otherwise, it may lead to electric shock.
	e) If it needs to modify the zero position of encoder, please pay attention to the risk of injuring people by rotating motor. Otherwise, it may lead to occurrence of accident. f) Please do not arbitrary alter the parameters of servo drive. Otherwise, it may lead to equipment damage.

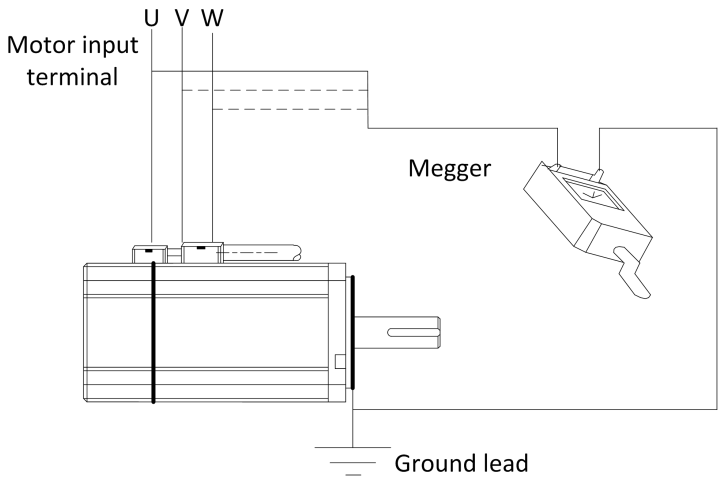
Operation precautions

	a) When using the servo motor on vertical shaft, please install the safety device to avoid the accidental falling at the state such as alarming and over travel. b) The motor shaft cannot bear the load beyond the limit. Otherwise, it may lead the equipment failure or malfunction. c) During trial runs, in order to avoid accidents, please conduct the no-load trial run. Otherwise, it will lead to damage. d) To operate after being installed on the machine, please firstly set up the user parameters.
	e) In the event of alarming, please reset the alarming to restart the operation after finding the reason and ensuring the safety. Otherwise, it may lead to damage. f) During the operation of servo drive, avoid the falling of anything into the equipment. Otherwise, it may lead to equipment damage. g) Do not control the start / stop of drive via the method of switching on / off contactor. Otherwise, it may lead to the equipment damage.
	h) During power-on or when the power is just shut off, the heat sink of servo drive, regenerative resistor and motor may be at high temperature. Thus, please do not touch. Otherwise, it may lead to burns. i) When the motor is running, do not contact the motor component during rotation. Otherwise, it may lead to human injury. j) Because the extreme parameter adjustment can lead to an instable action of servo system. Thus, please tune the parameters gradually, otherwise, it may lead to damage.

1.2.3 Other protections

a) Thermal protection of motor: Please first confirm whether a temperature sensor is embedded in the motor body. Synmot drive support PT100 or KTY temperature sensor. If the motor has a rated capacity not matching the servo drive, in particular, its rated power of the latter is higher than that of the former, the parameters related to motor temperature protection in the servo drive must be adjusted or a thermo-relay need be added on the motor surface to protect the motor.

b) Motor insulation inspection: When the motor is checked at the first time or again after long-term out of service, the motor insulation inspection should be conducted to avoid the insulation failure of motor winding resulting the damage of servo drive. The insulation inspection must be conducted after the motor wiring is disconnected from the servo drive. It is recommended to use 500V megger and ensure the insulation resistance be no less than 5MΩ. As shown in Figure:



c) About heats and noises of motor: Because the output voltage of servo drive is PWM modulated and contains some harmonics. Thus, the temperature rise, noise, and vibration of motor are slightly higher than those of the line operating motor.

d) About adaptive motor: 1) Adaptive permanent magnet synchronous motor as the standard. 2) The parameters of Synmot standard motor are saved in the servo drive. Users can modify the default value to match the actual value. 3) The internal short-circuit of wire or motor will result in alarming of servo drive. Thus, please first run the short-circuit test to the motor and cable initially installed. The daily maintenance also needs this test. Note: This test must be conducted after the servo drive is completely disconnected from the tested parts.

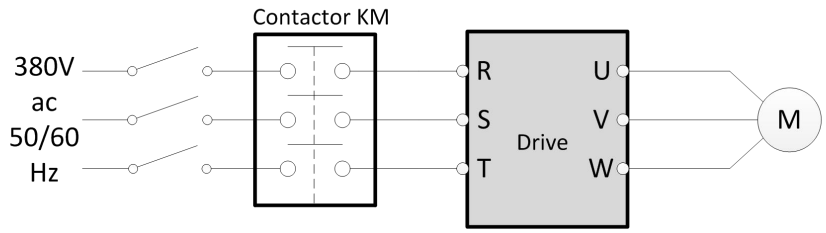
e) Lightning impulse protection: This series of drive are built with a lightning over-voltage protection device inside and thus have some self-protection against an inductive thunder. For the customers where the thunder and lightning are frequent, the protection should be added in the front of the drive.

f) Altitude and derating usage: In the regions with an altitude over 1000m, the thin air will cause the deterioration of heat dissipation of the servo drive. It needs to debate it. Please consult the technical support of our company.

g) Requirements of leakage protector RCD: For the selection of RCD, the transient and stable earth leakage current possible to occur upon equipment start-up and during operation should be considered. The special-purpose RCD to inhibit the high harmonics or the general-purpose RCD with large residual current is selected. It is recommended to use the rapid-response leakage protector or the leakage protector designated to be used with PWM inverter. Never use a time-delay leakage protector.

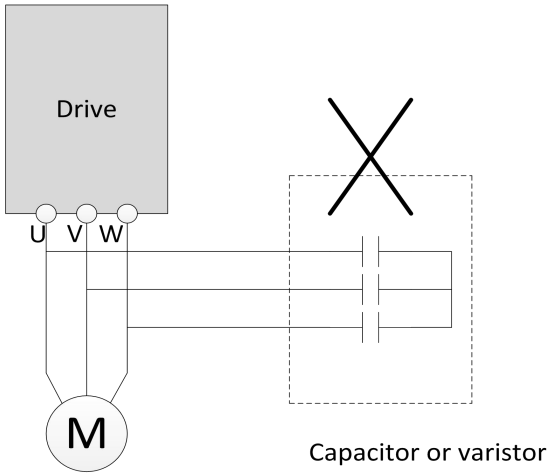
h) Surge suppressor: There are visitors installed in the drive which can absorb the surge voltage pulses generated upon the switch-on / off of inductive load around the drive. When the surge voltage generated by an inductive load has a large energy, please ensure using a surge suppressor or a diode simultaneously on the inductive load. (Note: please do not connect the surge suppressor to the output side of drive.)

i) Switching element such as contactor: If a contactor is added between the power supply and the input terminal of the servo drive, it is forbidden to be used to control the start-up / stop of the servo drive. If such contactor must be used to control the start-up / stop of the servo drive, the time interval shall not be shorter than 1 hour. The frequent charge / discharge will reduce the service life of the capacitor inside the drive. If a switching device is installed between the output terminal and motor, it should ensure that the drive be switch on / off when there is no output. Otherwise, the contactor will not blow out the arc normally, leading to the damaged contactor and drive.



Do not use a contactor to control the start / stop of the drive; otherwise, the time interval cannot be smaller than 1 hour.

j) Cases with varistor or capacitor at the output side: The servo drive outputs a PWM wave. If there is a capacitor to improve the power factor or varistor installed at the output side, it tends to induce a transient over-current of the servo drive or even damage the servo drive. Please do not use it.



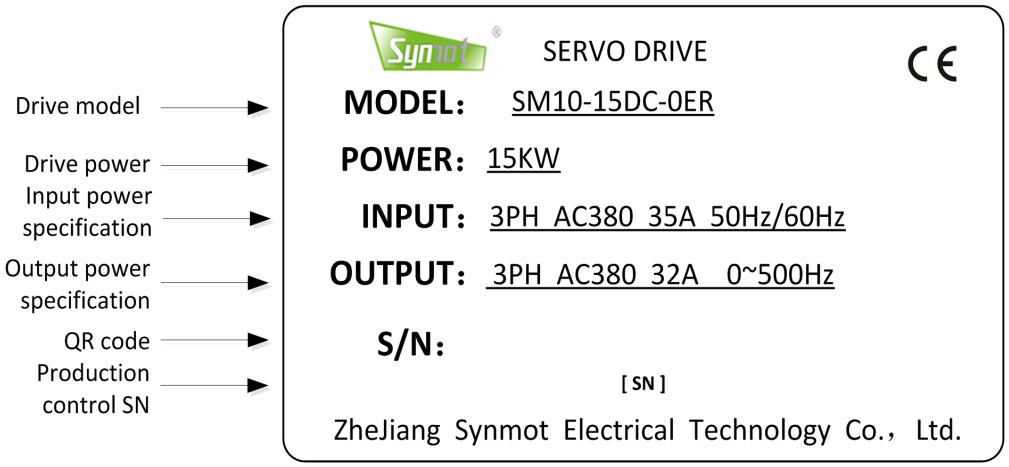
Chapter 2 Product inspection and product information

2.1 Product confirmation and nameplate

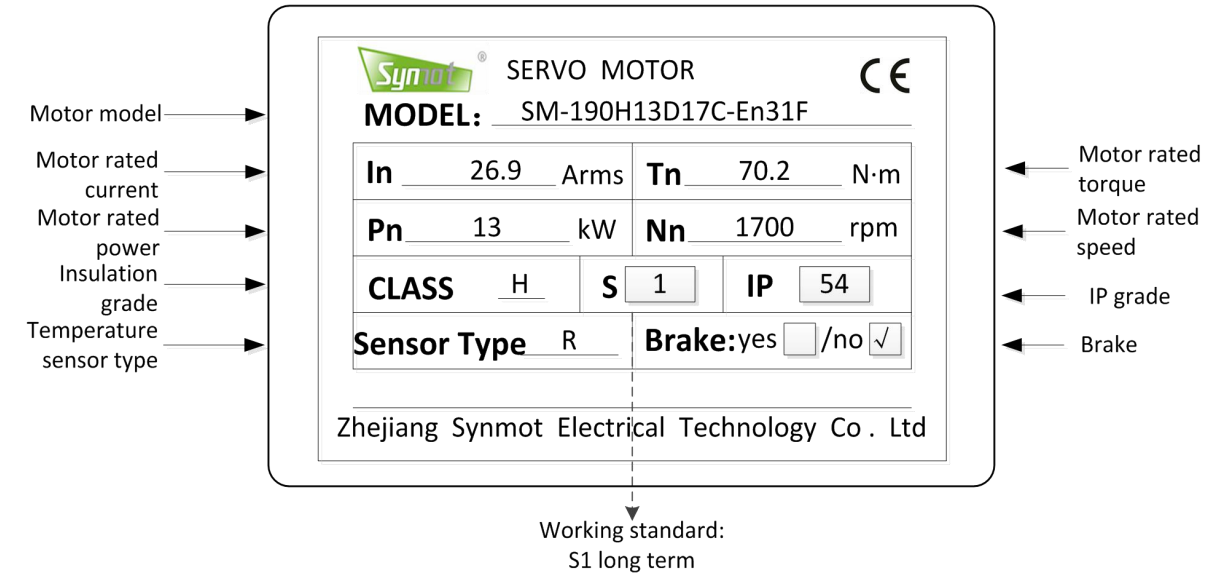
All Synmot drive have been fully tested. Sometimes it happens that the drive are damaged due to negligence during the product transportation. All drive shall be inspected in terms of the following items after arrival:

Items to validate	Description
Whether delivered products are the same as the product models ordered?	Please confirm via the column "Model" in the product nameplate.
Confirmation of product accessory?	Please confirm as per the shipping list.
Whether the motor ration shaft runs smoothly?	It will be normal if the hand can rotate it slightly. Except those with "power-off breaker".
Check whether there is any damage on the appearance?	Please check the machine appearance whether there is any damage due to transportation.

Nameplate of servo drive



Nameplate of servo motor



2.2 Product designation and outline

1) Designation rule of servo drive

SM 10 -15D C -0 E R

Designation	Company code
SM	Synmot

Designation	Serial number
10	General-purpose

Designation	Max. power (W)
Double-digit power number + one letter	
A	X 1
B	X 1 0
C	X 1 0 0
D	X 1 0 0 0
E	X 1 0 0 0 0
50A	50W
75B	750W
15D	15kW

Designation	Voltage class
A	One-phase 220V
B	Three-phase 220V
C	Three-phase 220V
D	Three-phase 220V

Designation	Type of interface board
R	RS485
C	CAN
E	EtherCAT

Designation	Position feedback interface
E	Incremental
A	Absolute
R	Resolver

Designation	Model code
0	Standard
1	Internal code

2) Designation rule of servo motor

SM - 190 H 13D 17C-En 3 1 F

Designation	Company code
SM	Shortened form of Synmot

Designation	Seat No.
Three digital numbers	
130	
190	
...	

Designation	Voltage class
A	220V
H	380V
Z	Others

Designation	Power (W)
Double-digit power number + one letter	
A	X 1
B	X 1 0
C	X 1 0 0
D	X 1 0 0 0
E	X 1 0 0 0 0
75 B	7 5 0 W
1 5 D	1 5 0 0 0 W

Designation	Revolution (rpm)
Double-digit revolution + one letter	
A	X 1
B	X 1 0
C	X 1 0 0
D	X 1 0 0 0
E	X 1 0 0 0 0
1 5 C	1 5 0 0 rpm

Designation	Encoder type
E	Incremental
A	Absolute
En	2500PP incremental encoder
R	One-pair-pole resolving
Rn	Multi-pair-pole resolver
Z	Others

Designation	Cooling method
N	Natural cooling
F	Fan cooling
L	Liquid cooling

Designation	Brade, speed reducer , oil seal
0	No
1	Oil seal
2	DC24V brake
3	Speed reducer
4	Oil seal + brake
5	Oil seal + speed reducer
6	Brade + speed reducer

Designation	Shaft connection mode
0	Customized
1	Optical axis
2	Solid + key
3	Solid + key + threaded
4	Solid + threaded
5	Hollow + internal spline
6	Hollow + internal flat key

3) Outline of servo drive

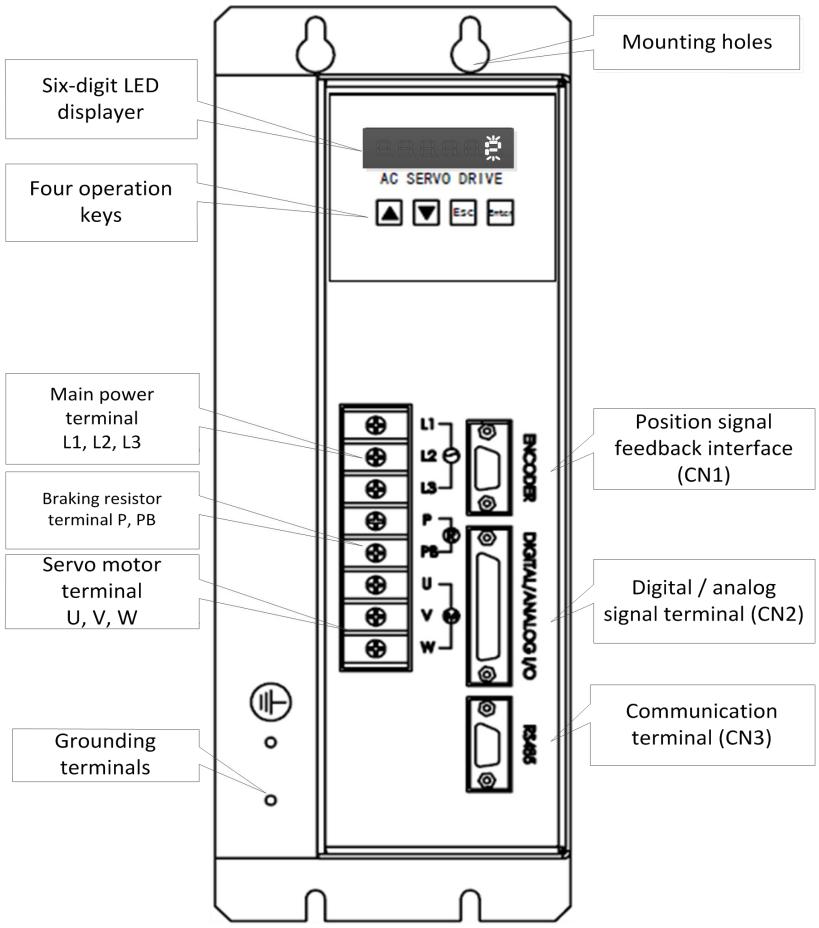


Figure 2-1 SM10 series (<11kW)

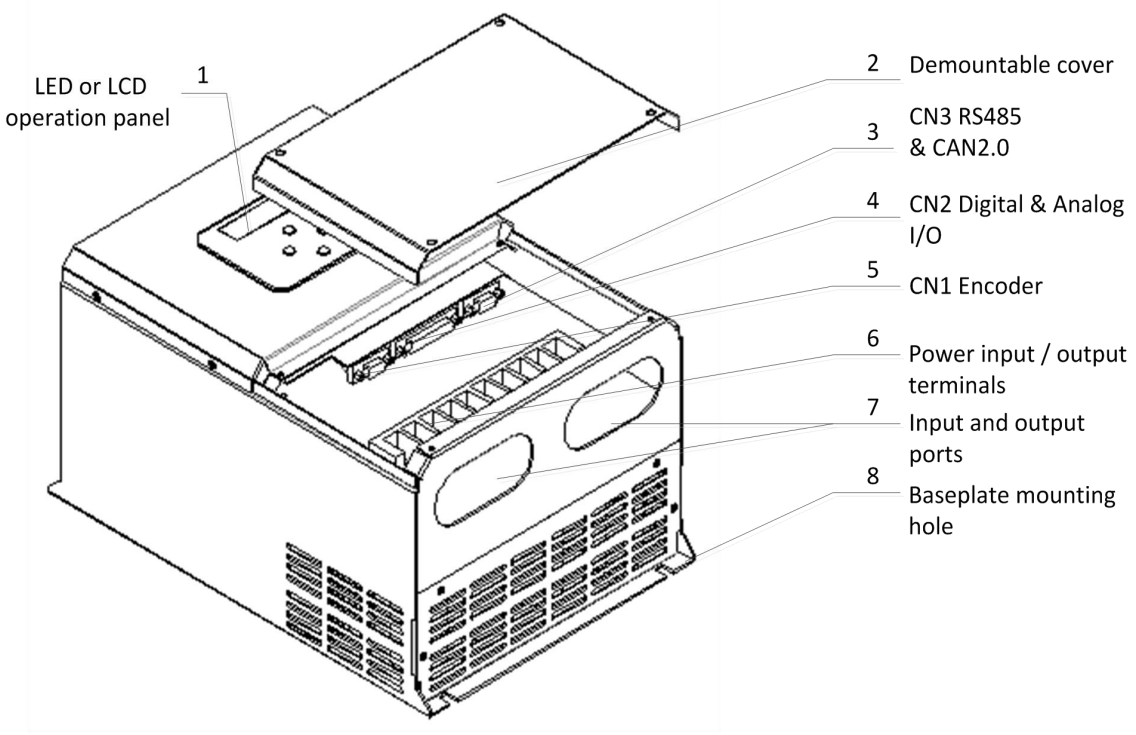


Figure 2-2 SM10 series (>15kW)

2.3 Technical specification of servo system

Classification		Specification
Property	Frequency response	0~400Hz
	PWM frequency	4~16KHz
	Pulse input frequency	≤2000kHz
	Speed adjusting ratio	1: 5000 or higher
	Speed fluctuation ratio	≤±0.02% (load: 0~100%)
	Over-load capacity	150% rated current 60s 180% rated current 6s >200% need to customize
Product functions	Position feedback type	Incremental encoder and resolver Absolute encoder: EnDAT, Hiperface DSL and Smart ABS
	Speed control mode	-10V ~ +10V differential bi-polar analog voltage input
		0 ~ +10V unipolar analog voltage input (2 channels optional)
		Speed curve preset by user (external optional)
		RS485 speed command (CANopen, Ether CAT optional)
	Position control mode	Direction + Pulse (can directly replace stepper motor drive)
		90^0 phase difference bi-phase pulse input control (Phase A + Phase B)
		CCW+CW pulse input control
		RS485 position command (CANopen, EtherCAT optional)
	Analog output	0 ~ +10V, 2-channel (can feedback speed or output torque of motor)
	Digital IO Input / Output	Servo-ON DI, 6-channel programmable input DI 4-channel programmable output DO
	DC power output	10V / 24V power output available for user
	Brake function	Built-in brake unit below 160kW, braking ratio: 0.0~100%
	Protection	Over-voltage, under-voltage, IGBT shortage, over-current, over-load, motor overheat and drive overheat, stall, position error, encoder / resolver error etc.
	Communication function	CANopen, EtherCAT and RS485 Modbus communication
	Other function	Support dynamic electronic gear ratio function Automatic zero-position detection and harmonic suppression function; Encoder position signal pulse output (frequency dividing ratio of 1 ~ 256)
Others	Cooling method	Natural cooling below 1kW, automatic fan cooling below 1.5kW-160kW Support water cooling and oil cooling for other partial power range
	IP grade	IP20 (below 11kW), IP40 (above 15kW) and above IP54 (custom-made)
	Installation way	Pad-mounting
Environment	Places of uses	Inside of electric control cabinet, no exposure to direct sunlight, no dust, corrosive gas, combustible gas, oil mist or water vapor, etc.
	Environment temperature	-10℃~+40℃ (please derating use at environment temperature of 40~50℃)
	Temperature	5%~95%RH, no droplet freeze
	Vibration	Lower than 4.9m/s^2 (0.5G) 10~60Hz (non-continuous)
	Storage temperature	-20℃~+60℃

2.4 Servo drive specification and braking resistor selection

Drive model	Input voltage	Rated power	Rated current	Max current	Adaptive motor capacity	Power of braking resistor	Braking resistance	Built-in braking resistor
	V	kW	A	A	kW	Recommended		
SM10-40BB-0ER	Single-phase 3-phase AC220V -15% ~ +10% 50/60Hz	0.4	2	4	0.4	-	-	50W/100Ω
SM10-75BB-0ER		0.75	3	5	0.75	-	-	100W/100Ω
SM10-10CB-0ER		1.0	4.5	8	1.0	-	-	100W/100Ω
SM10-15CB-0ER		1.5	6	11	1.5	-	-	100W/100Ω
SM10-22CB-0ER		2.2	7	13	2.2	-	-	100W/100Ω
SM10-30CB-0ER		3.0	10	30	3.0	300W	≥60Ω	100W/300Ω
SM10-40CB-0ER		4.0	12	22	4.0	300W		100W/300Ω
SM10-55CB-0ER		5.5	17	31	5.5	300W		100W/300Ω
SM10-30CC-0ER	3-phase AC380V -15% ~ +10% 50/60Hz	3.0	7	13	3.0	300W	≥60Ω	100W/300Ω
SM10-40CC-0ER		4.0	10	18	4.0	300W		100W/300Ω
SM10-55CC-0ER		5.5	13	24	5.0	400W		100W/300Ω
SM10-75CC-0ER		7.5	17	31	7.5	800W		100W/300Ω
SM10-11DC-0ER		11	25	45	11	1000W	≥32Ω	No
SM10-15DC-0RC		15	32	58	15	1000W		
SM10-18DC-0RC		18	37	67	18	2000W	≥16Ω	
SM10-22DC-0RC		22	45	81	22	2000W		
SM10-30DC-0RC		30	60	108	30	2500W		
SM10-37DC-0RC		37	75	135	37	5000W	≥8Ω	
SM10-45DC-0RC		45	90	162	45	5000W		
SM10-55DC-0RC		55	115	207	55	5000W		
SM10-75DC-0RC		75	150	270	75	5000W		
SM10-90DC-0RC		90	175	315	90	5000W*2	≥6Ω	
SM10-11EC-0RC		110	210	378	110	5000W*2		
SM10-13EC-0RC		132	253	455	132	6500W*2	≥4Ω	
SM10-16EC-0RC		160	304	547	160	7500W*2		

Chapter 3 Installation

3.1 Dimensions of servo drive

Installation and dimensions of SM10 series 400W~11kW drive

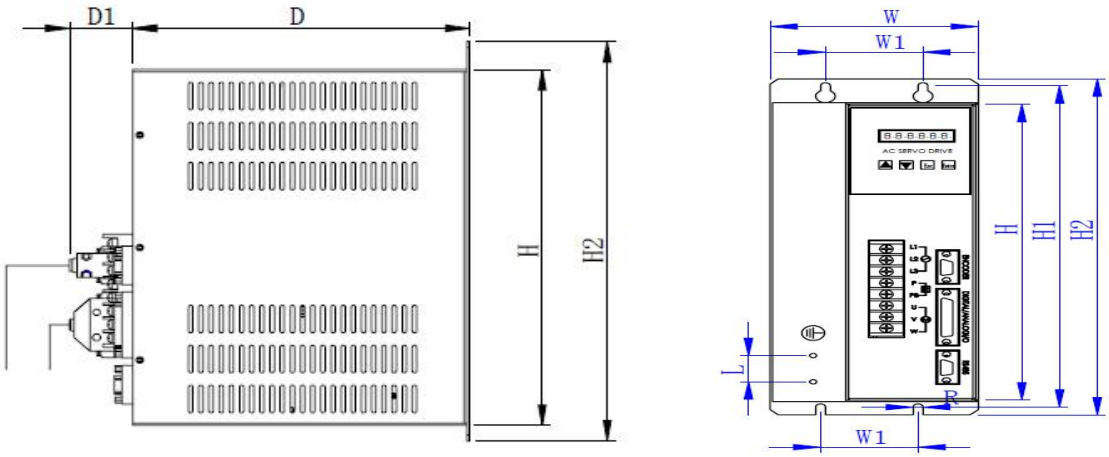


Figure 3-1 400W~11kW drive

Table 3.1 Dimensions of SM10 series 400W~11kW drive (mm)

Drive model	Height of plug	Location of mounting holes		Overall dimensions					Diameter of mounting holes	Weight (Kg)
	D1	W1	H1	H	H2	W	D	L	R	
SM10-40BB-0ER	40	40	202	176	222	78	180	20	Ø5	2
SM10-75BB-0ER	40	40	202	176	222	78	180	20	Ø5	2
SM10-10CB-0ER	40	40	202	176	222	78	180	20	Ø5	2
SM10-15CB-0ER	40	40	202	176	222	90	180	20	Ø5	2.5
SM10-22CB-0ER	40	40	202	176	222	90	180	20	Ø5	2.5
SM10-30CB-0ER	40	50	250	232	275	115	180	20	Ø6	4
SM10-40CB-0ER	40	50	250	232	275	115	180	20	Ø6	4
SM10-55CB-0ER	40	50	250	232	275	115	180	20	Ø6	4
SM10-75CC-0ER	40	70	306	285	320	128	237	20	Ø6	7
SM10-11DC-0ER	40	70	306	285	320	128	237	20	Ø6	7
SM10-75BC-1ER	40	72	168	180	180	83	143	20	Ø5	1.6
SM10-10CC-1ER	40	45	190	182	208	84	192	20	Ø6	2
SM10-15CC-1ER	40	45	190	182	208	84	192	20	Ø6	2
SM10-22CC-1ER	40	45	190	182	208	84	192	20	Ø6	2

Installation and dimensions of SM10 series 11W~160kW drive

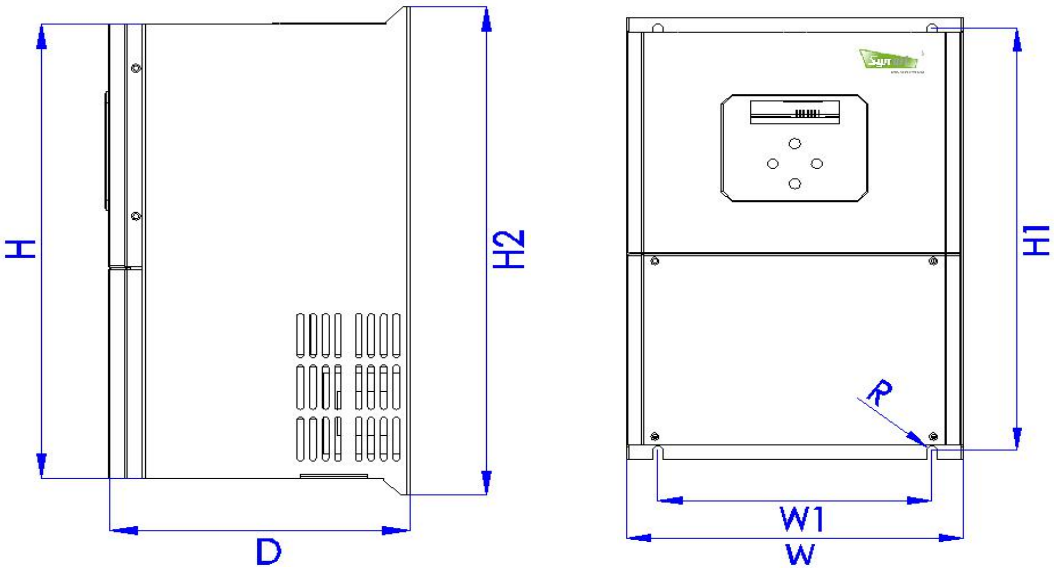


Figure 3-2 11W~160kW drive

Table 3.2 Dimensions of SM10 series 11~160 kW drive (mm)

Drive model	Location of mounting holes		Overall dimensions				Diameter of mounting holes	Weight (Kg)
	W1	H1	H	H2	W	D	R	
SM10-11DC-0RC	187	315	307	330	230	180	Ø7	12
SM10-15DC-0RC								
SM10-18DC-0RC	235	445	430	460	285	226	Ø8	21
SM10-22DC-0RC								
SM10-30DC-0RC								
SM10-37DC-0RC	245	523	484	540	324	275	Ø10	32
SM10-45DC-0RC								
SM10-55DC-0RC	260	580	544	600	384	265	Ø10	40
SM10-65DC-0RC								
SM10-75DC-0RC	343	678	650	690	470	300	Ø10	66
SM10-90DC-0RC								
SM10-11EC-0RC	449	903	888	930	600	384	Ø10	90
SM10-13EC-0RC								
SM10-16EC-0RC								

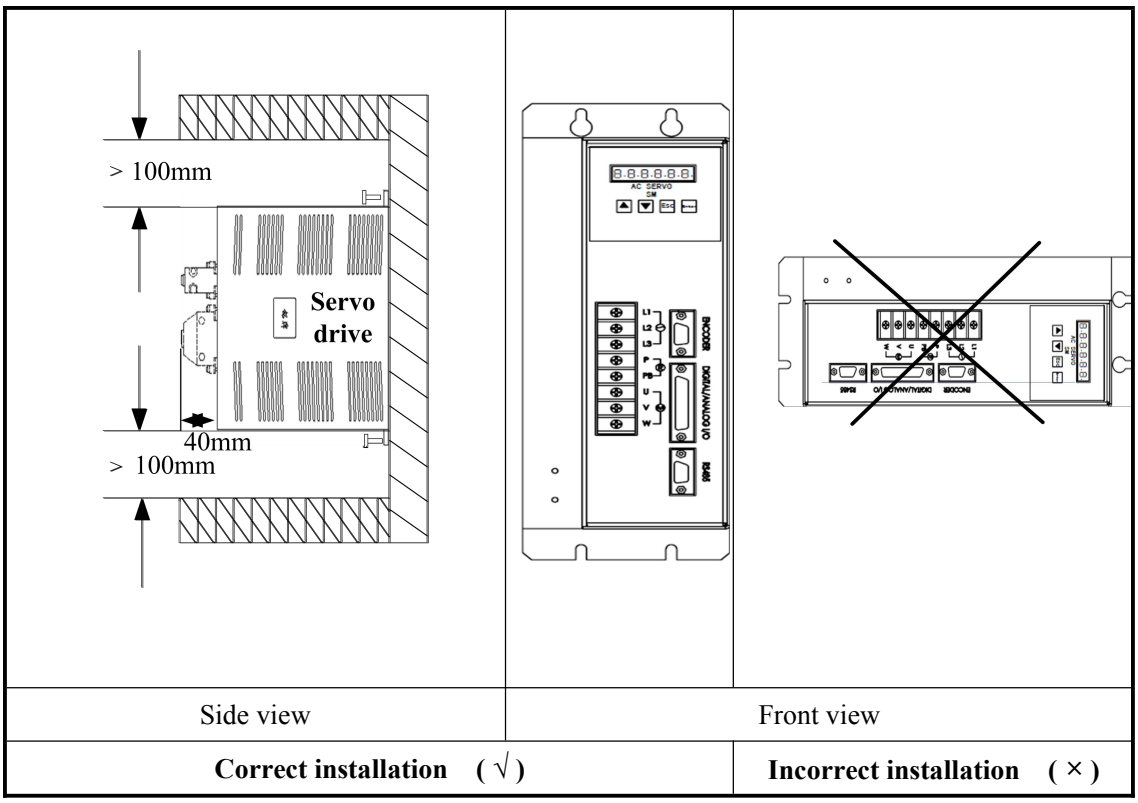
3.2 Installation requirement and method

1） Installation environmental requirement

Item	Operating environment	Points for attention
Temperature	-10-～40[℃]	Cabinet must be provided with cooling device to prevent the ambient temperature from being too high.
Humidity	Less than 95[%]RH	Long-term out-of-service will damage the drive due to water drop or freeze. Thus, the water vapor needs to be removed completely after operation
External vibration	Vibration acceleration is smaller than 4.9[m/s²]	Over-vibration will lead to reduced service life of drive and error operation. Be sure to away from the equipment such as punch.
Environment	- Avoid the places exposed to direct sunlight and with high heating. - Places without water drop, water vapor, dust, oily dust and metal particles. - Avoid corrosive and combustible gas. - Places without strong electromagnetic noise interference. - Keep heat dissipation and ventilation. Cooling fan must be installed in the electric control cabinet.	

2) Installation direction

The user should employ the pad-mounting method and the installation direction should be upward and vertical to installation surface. Below Figure is the installation schematic diagram.



Side view	Front view	
Correct installation (√)		**Incorrect installation (×)**

Figure 3-3 Diagram of drive pad-mounting way

3) Installation spacing

Figure 3.4 shows the installation spacing of single drive and Figure 3.5 shows the installation spacing of multiple drive. During the actual installation, the spacing should be as wide as possible to keep a good heat dissipation condition.

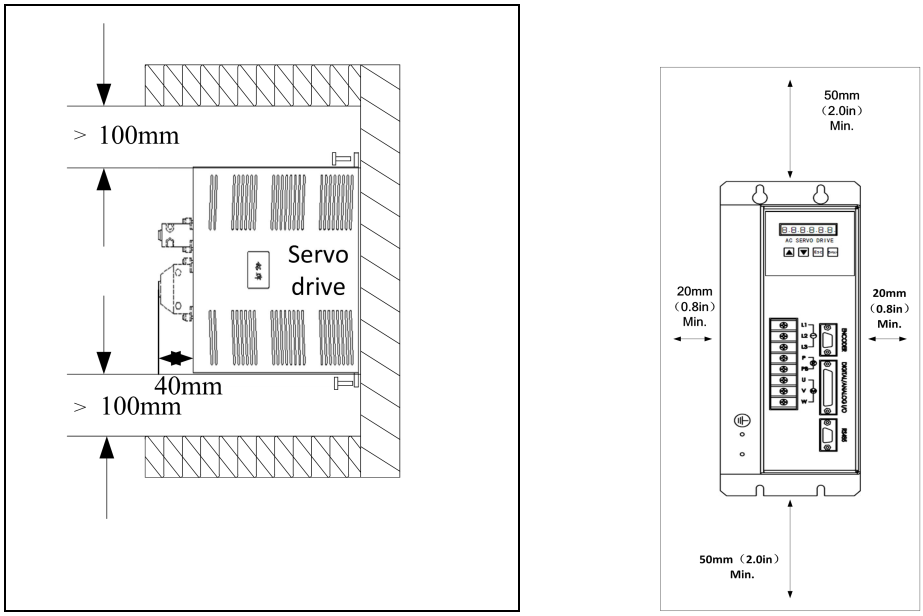


Figure 3-4 Installation spacing of single drive

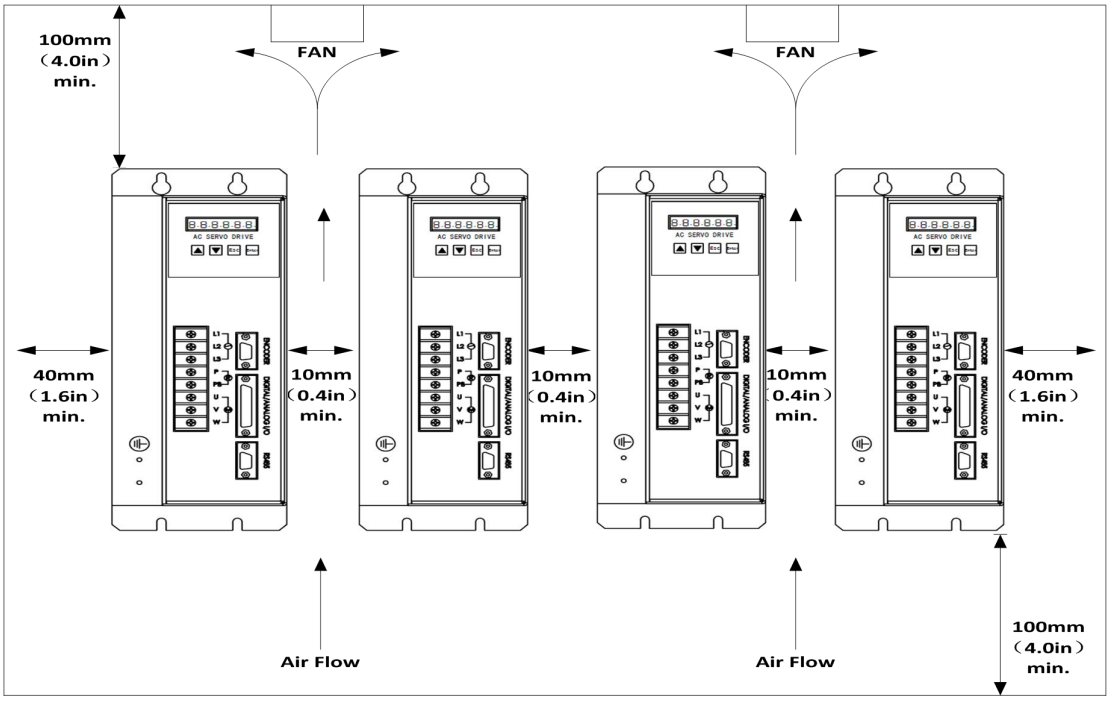
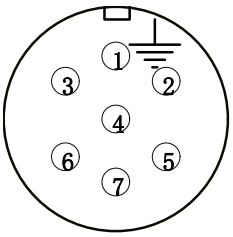


Figure 3-5 Installation spacing of multiple drive

⚠	**Note:** The spacing on the installation diagram is not the dimension proportional to that in text remark. The spacing for the drive of 15kW or higher should be added by more than 100mm.

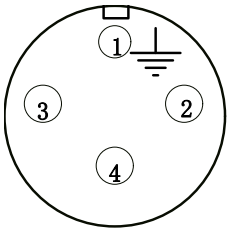
3.3 Definition of servo motor connectors

■ **Definition of motor power aviation socket**



Pin	Definitions
1	Shielded ground
2	Phase U
3	Phase V
4	Phase W
5	NC
6	24V(+)
7	24V(-)

(a) 7-core motor power aviation socket

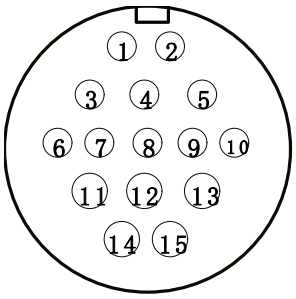


Pin	Definitions
1	Shielded ground
2	Phase U
3	Phase V
4	Phase W

(b) 4-core motor power aviation socket

Applicable scope: 110mm, 130mm and 190mm servo motors (self-cooling type)

■ **Definition of aviation socket of encoder signal line at motor side**



(c) 15-core encoder signal aviation socket

Pin	Definition of incremental encoder signals	Definition of resolver signals	Definition of absolute encoder signals
1	Encoder A+	SIN+	S+
2	Encoder A-	SIN-	S-
3	Encoder B+	COS+	BAT+
4	Encoder B-	COS-	BAT-
5	Encoder Z+	REF+	PG5V
6	Encoder Z-	REF-	PG0V
7	Encoder U+	PE	
8	Encoder U-	-	
9	Encoder V+	-	
10	Encoder V-	-	
11	Encoder W+	-	
12	Encoder W-	-	
13	+5V	-	
14	+5VG	RT-1	RT-1
15	shielding mesh	RT-2	RT-2 or shielding mesh

1. 110mm, 130mm, 190mm, 200mm, 215mm and 260mm servo motor.
2. PT100, KTY or PTC type temperature sensors are built in the forced-air cooling motors and the self-cooling type is not equipped with temperature sensor.
3. Some high-power motors is defaulted as terminal box.

Chapter 4 Wiring

4.1 Connection of main power circuit

4.1.1 Wiring diagram of peripheral devices

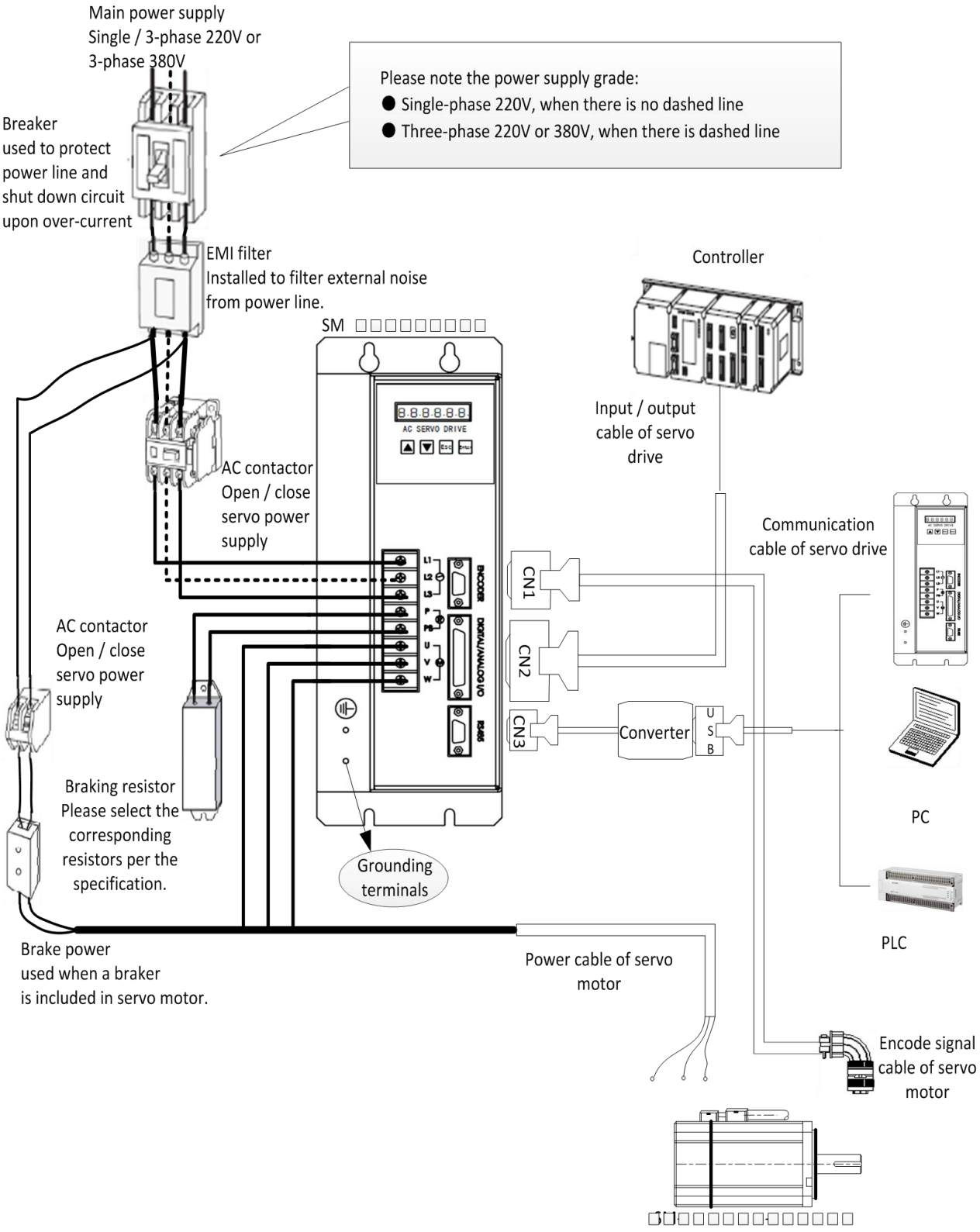


Figure 4-1 Wiring diagram of main circuit

4.1.2 Wiring diagram and grounding of main power supply

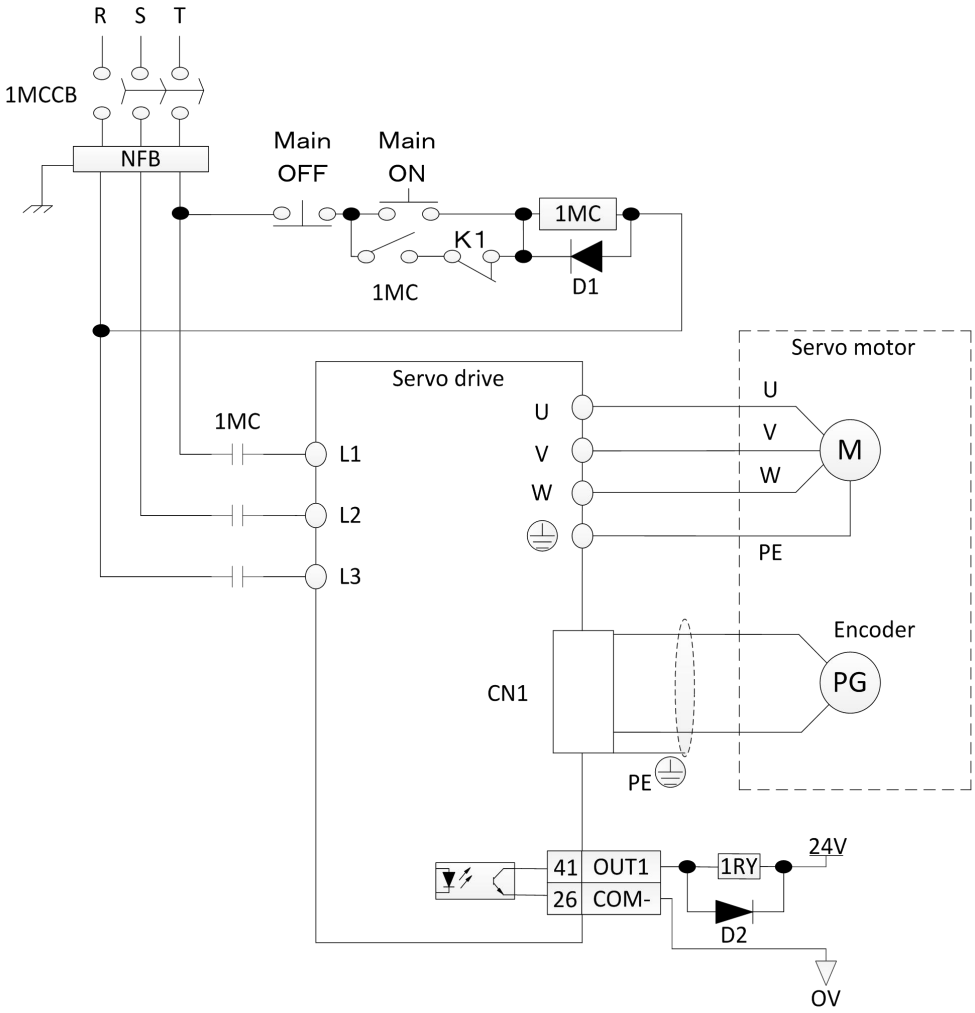


Figure 4-2 Main power supply

In order to use safely and stably, please correctly connect the ground:

1) Grounding of electric motor

Please ensure to connect the terminal PE of servo motor with the grounding terminal PE of servo drive.

The grounding terminal must be connected to the protection ground. Incorrect grounding may lead to the servo system or even the peripheral equipment failing to operate properly.

2) Interference occurring in command input line

In the event of an interference occurring in command input line, please connect the shield of input line to the ground. When passing the wire of main circuit through the metal conduit, please connect the conduit and terminal box to the ground. Please connect the grounding wires above to the same point.

4.1.3 Standard wiring diagram of input / output

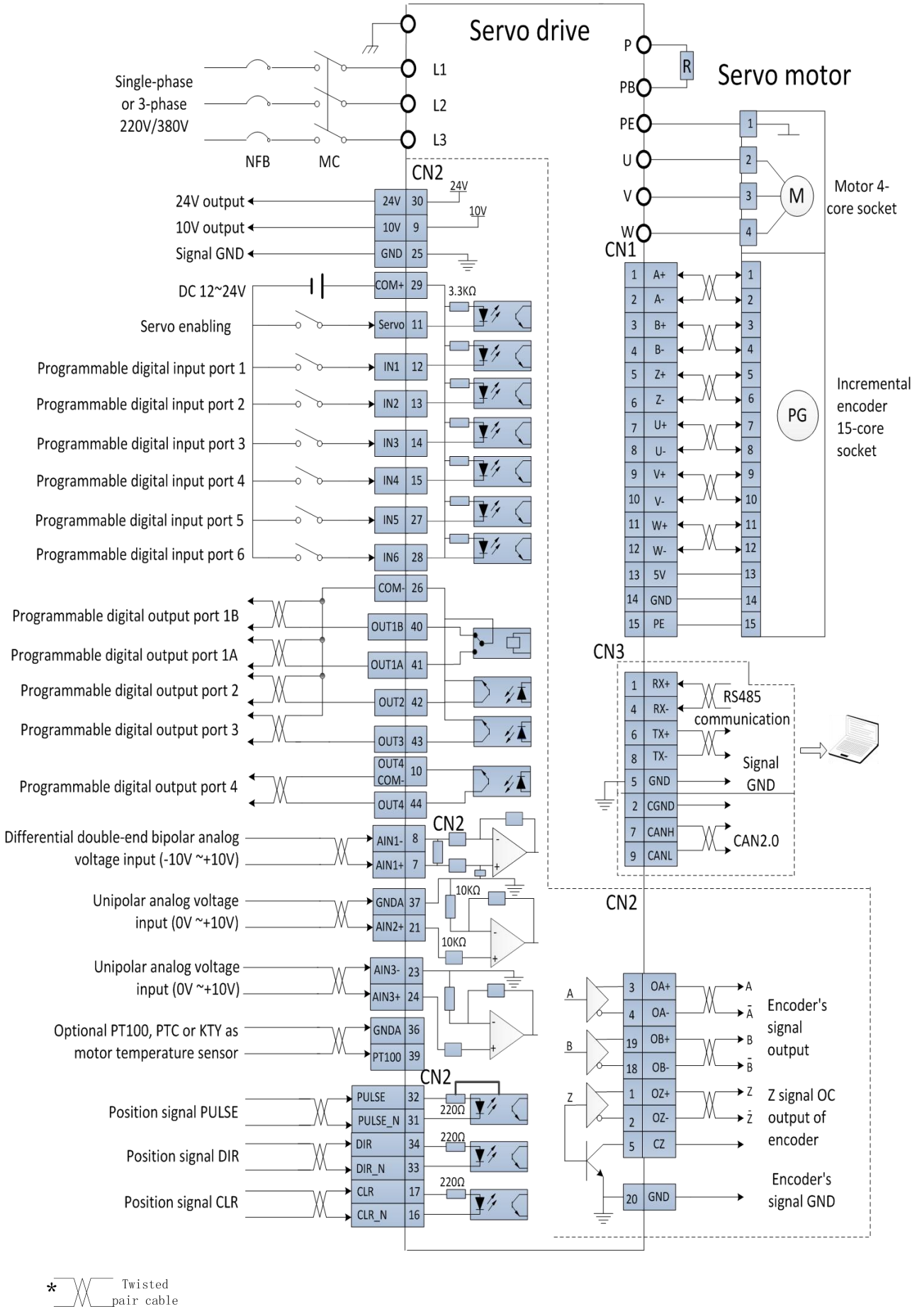


Figure 4-3: Standard wiring diagram of drive

4.2. Drive terminal and functions

4.2.1 Power terminals

Table 4.1 Power terminals

Terminal mark	Terminal name	Function description
PE	Grounding terminal	Connecting the earth ground. Must connect well to the ground!
L1	3-phase input of main power supply	Voltage class: Single, 3-phase 220VAC, 3-phase 380VAC, 3-phase 480VAC **Note**: Cannot connect with the motor output terminal U, V, and W !
L2		
L3		
P, N, or P, (-)	DC bus terminal	Common DC bus input point
P, PB	Connecting terminal braking resistor	Connecting braking resistor. The braking resistor power and resistance must be determined as per the specific model of the drive. Please see Section 2.5.
P, (+)	Connecting terminal of DC inductance	Connecting DC inductance (drive over 75kW)
U	Motor terminal drive output	Connect with the 3-phase servo motor.
V		
W		

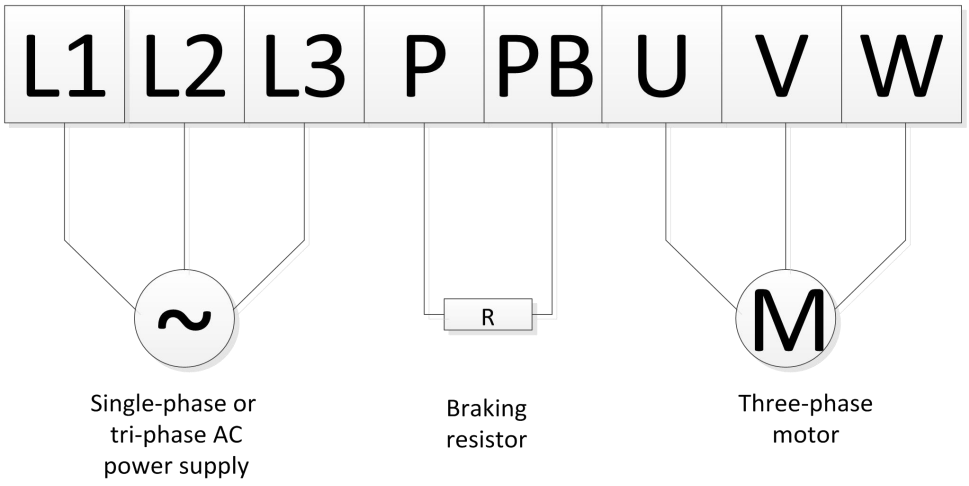


Figure 4-4A Power terminals of drive below 11kW

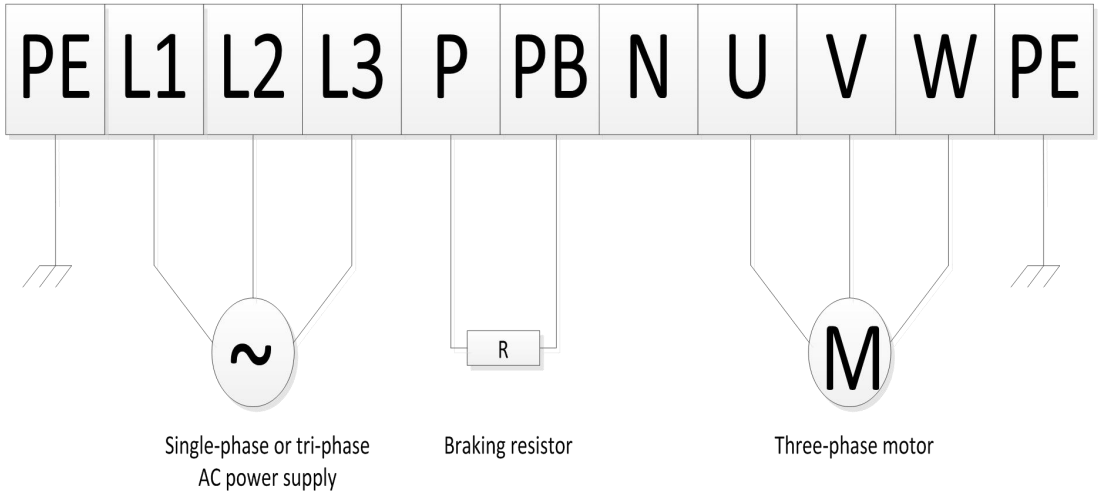


Figure 4-4B Power terminals of drive below 75kW

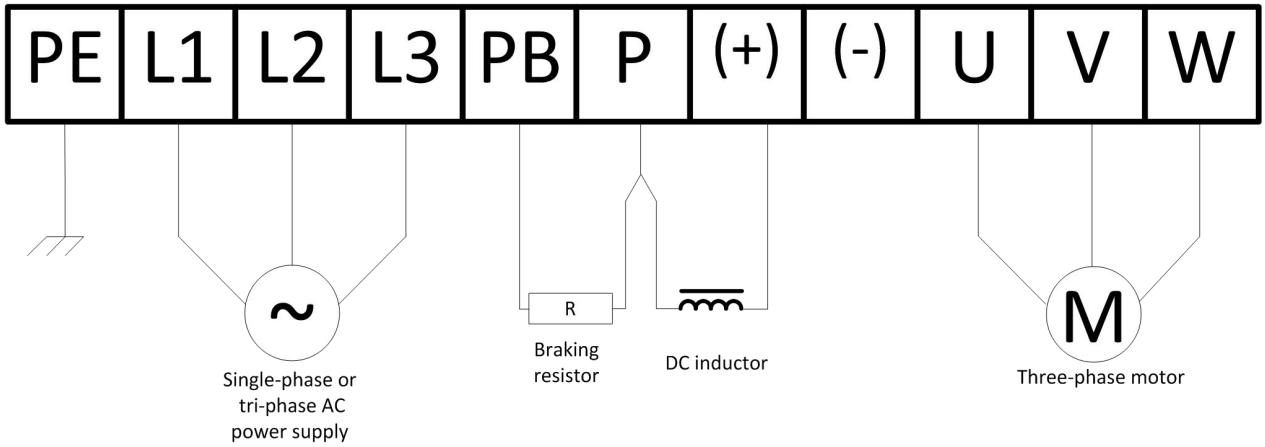


Figure 4-4C Power terminals of drive above 75kW

STOP	■ The voltage level can be 220V AC, 380V AC or 480V AC as per the difference of drive type. Please verify the voltage class as per the drive model and nameplate before connection and power-on. ■ Never connect the input power line to the output terminal U, V and W of drive. Otherwise, it will cause the damage of servo drive. ■ Never connect the braking resistor between the terminal P and N. Otherwise, it may lead to fire!

4.2.2 Position signal feedback interface (CN1)

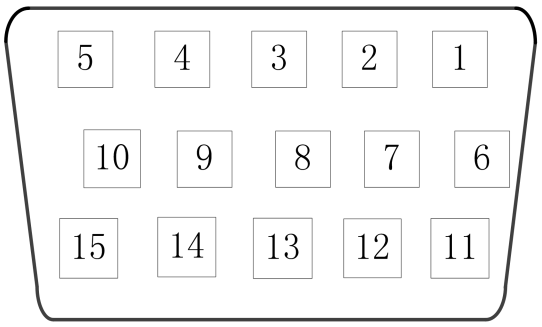


Figure 4-5 Position feedback terminal, DB15

Table 4.2 Definition of position feedback terminals (CN1) -DB15 socket

Pin	Incremental encoder (standard)		Absolute encoder		Resolver	
	Name	Mark	Name	Mark	Name	Mark
1	Encoder signal input phase A	A+	ABS-1 input	ABS-1	Resolver signal SIN	SIN+
2		A-	ABS-1N input	ABS-1N		SIN-
3	Encoder signal input phase B	B+	—	—	Resolver signal COS	COS+
4		B-	—	—		COS-
5	Encoder signal input phase Z	Z+	—	—	Resolver signal EX	REF+
6		Z-	—	—		REF-
7	Encoder signal input phase U	U+	—	—	—	—
8		U-	—	—	—	—
9	Encoder signal input phase V	V+	—	—	—	—
10		V-	—	—	—	—
11	Encoder signal input phase W	W+	—	—	—	—
12		W-	—	—	—	—
13	5V power	5V	5V power	VCC	—	—
14	5V ground	GND	5V ground	GND	5V ground	GND
15	Motor temperature sensor input	RT1	Motor temperature sensor in out	RT1	Motor temperature sensor input	RT1

NOTE Note:

1) Please use the shielded cable with twisted pair, and ensure the shielding net connecting to the ground.

2) Pin15 RT1 interface, three temperature sensors of PT100, KTY83 and PTC are optional, default is PT100.

3) Standard wiring of input / output see Figure 4-3.

4.2.3 Digital / analog signal terminal (CN2)

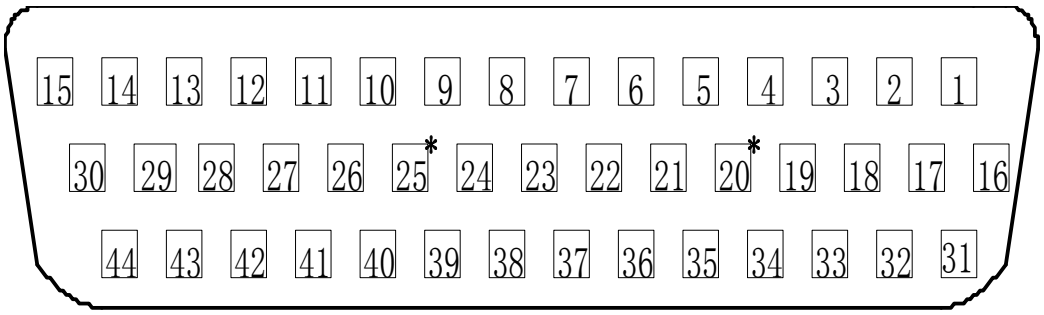


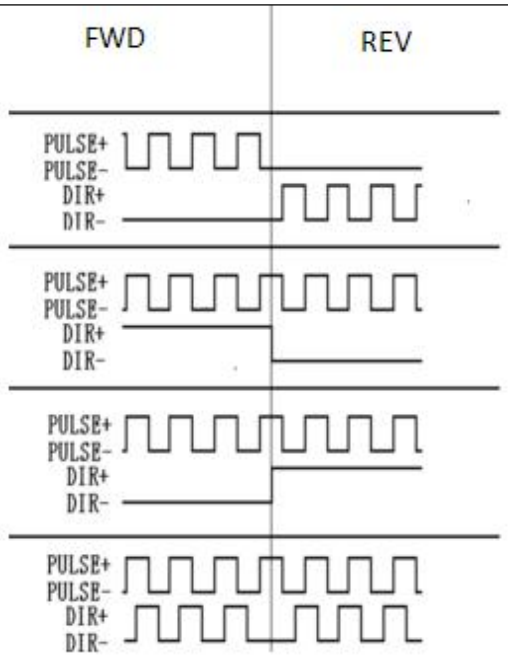
Figure 4-6 Digital / analog signal terminal, DB44

Table 4.3 Digital / analog signal input terminal (CN2)

Signal type	No.	Terminal name	Mark	Description
Digital input (DI)	25	Digital GND	GND	Digital GND of drive
	30	24V	+24V	Internally provide 24V power supply for the digital input and output circuit. The load current cannot exceed 100mA.
	29	Input common anode	COM+	Input common anode of input opto-couplers DC12~24V, max. 100mA.
	11	Servo enabling	Servo On/Off	Input terminal of servo enabling, Servo ON/OFF Servo ON: Allow the drive to work. Servo OFF: Stop the operation. When there is self-locking signal, the motor is at the state of self-locking.
	12	Programmable digital input	IN1	Programmable digital input port The parameters of Pr-80 ~ Pr-85 are used to select the setting for the specific functions. Please see the instruction 4.3.1 for the interface circuit and optional functions. Note: Only IN1 and IN2 are valid for compact drive.
	13		IN2	
	14		IN3	
	15		IN4	
	27		IN5	
	28		IN6	

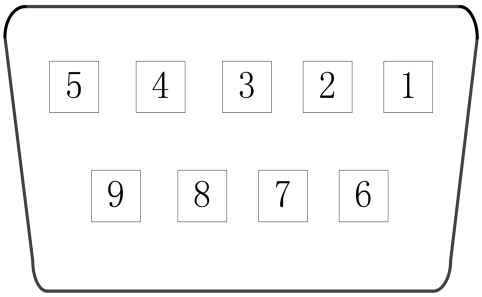
Digital output (DO)	40	Programmable digital output	OUT1B	Programmable digital output port The specific output signal can be set up separately via the parameters Pr-86~Pr-89. Please see the instruction 4.3.2 for the interface circuit and optional functions.
	41		OUT1A	
	42		OUT2	
	43		OUT3	
	44		OUT4	
	26	OUT1A, OUT1B OUT2, OUT3 Common cathode	COM-	
	10	OUT4 Common cathode	OUT4 COM-	Note: Only OUT1A, OUT2, COM are available for compact drive, no OUT3 and OUT4 in compact drive
Analog (ANLOG) input output	9	+10V	10V	Internal +10V analog circuit power supply The load should not exceed 100mA
	37	Analog GND	GNDA	Analog GND of the drive
	7	Differential double-end bipolar input	AIN1+	Differential double-end, bipolar analog voltage input In case of double-end differential connection, the input voltage range: -5V ~ +5V In case of single end grounding, the input voltage range: -10V ~ +10V
	8		AIN1-	
	21	Unipolar input	AIN2+	Unipolar analog voltage input, the reference point is GNDA. Input voltage range: 0~10V
	24	Differential double-end bipolar input 2	AIN3+	Differential double-end bi-polar analog voltage input, the reference point is GNDA. Input voltage range: -10V~+10V Note: The compact drive version has no this signal.
	23		AIN3-	
	6	Analog voltage output 1	DAC1	Bi-channel analog voltage output with the reference point of GNDA. Output voltage range: -10V~+10V The output signal can be set up separately with the parameter Pr-091 (DAC1) and Pr-101 (DAC2). Note: The compact drive has no this signal
	22	Analog voltage output 2	DAC2	
	39	RT1	PT100a	Input of motor temperature sensor has no polarity. If the motor temperature sensor has been connected via the encoder port, then the two pins are left unconnected. If no temperature sensor is installed in the motor, a resistor of about 100Ω, 1/4 W must be installed between two pins. Otherwise, the drive will identify that the motor temperature is too high.
	36	Analog GND	PT100b GNDA	

Encoder's signal output	3	Output of encoder phase A	OA+	+ signal output of encoder phase A after frequency division
	4		OA-	— signal output of encoder phase A after frequency division
	19	Output of encoder phase B	OB+	+ signal output of encoder phase B after frequency division
	18		OB-	— signal output of encoder phase B after frequency division
	1	Output of encoder phase Z	OZ+	+ signal output of encoder phase Z
	2		OZ-	— signal output of encoder phase Z
	5	Collector output of phase Z	CZ	Collector output of encoder phase Z
	20	GND	GND	Signal GND
Position control signal input	32	Position pulse input	Pulse+	The drive can receive four types of command pulses.
	31		Pulse-	Command type
	34	Position pulse, direction signal	Dir+	Pulse + Pulse Pulse + Direction
	33		Dir-	Pulse - direction Pulse A+B
	17	Error clearing signal	CLR+	Error clearing signal input +
	16		CLR-	Error clearing signal input —

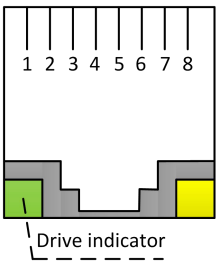


4.2.4 RS485 / CAN / Ether CAT communication terminal (CN3)

RS485/CAN communication signals of Synmot drive are accumulated in one communication terminal. As per the difference of drive type, there are two types of network ports of DB9 and RJ45 standards. The user can select it as per the actual drive.



(a) DB9 port



(b) RJ45 network port

Figure 4-7 RS485/CAN communication plug

Table 4.4 Definition of communication terminals (CN3)

DB9 Pin	Mark	Definitions		Pin of network port	Mark	Definitions
1	RX+	Positive receiving terminal of RS485 communication signals		1	RX+	Positive receiving terminal of RS485 communication signals
2	CGND	CAN signal GND		2	RX−	Negative receiving terminal of RS485 communication signals
3	-	Do not use.		3	TX+	Positive transmitting terminal of RS485 communication signals
4	RX−	Negative receiving terminal of RS485 communication signals		4	TX−	Negative transmitting terminal of RS485 communication signals
5	GND	RS485 signal GND		5	GND	RS485 signal GND
6	TX+	Positive transmitting terminal of RS485 communication signals		6	-	-
7	CAN H	Positive terminal of CAN communication signals		7	-	Do not use.
8	TX−	Negative transmitting terminal of RS485 communication signals		8	-	-
9	CAN L	Negative terminal of CAN communication signals		-	-	-

Note: Paired signals need twisted shielded pair

Ether CAT communication terminal

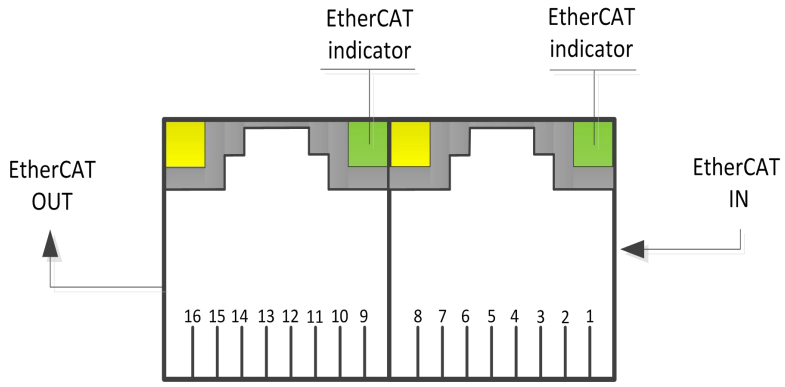


Figure 4-8 Drive Ethernet port (viewed with facing to the port)

Table 4.5 Definition of Ethernet communication port

Pin of network port	Mark	Definitions
1	TX+	Data transmission +
2	TX-	Data transmission -
3	RX+	Data receiving +
4	-	-
5	-	-
6	RX-	Data receiving -
7	-	-
8	-	-
9	TX+	Data transmission +
10	TX-	Data transmission -
11	RX+	Data receiving +
12	-	-
13	-	-
14	RX-	Data receiving -
15	-	-
16	-	-

4.3 Input / Output interface circuit

4.3.1 Digital input interface circuit

Synmot servo drive use the intelligent programmable digital input port. Each digital input (DI) port is available to configure over 20 functions. The user can use 6 parameters Pr-80 ~ 85 to respectively set up the functions of 6 digital input ports. The specific input circuit is as shown in below Figure.

The factory default of the digital input port is 0 – active low. If one port is set to active high, then it only needs to set up the internal parameter Pd-58. The specific configuration refers to Appendix III (internal parameter list).

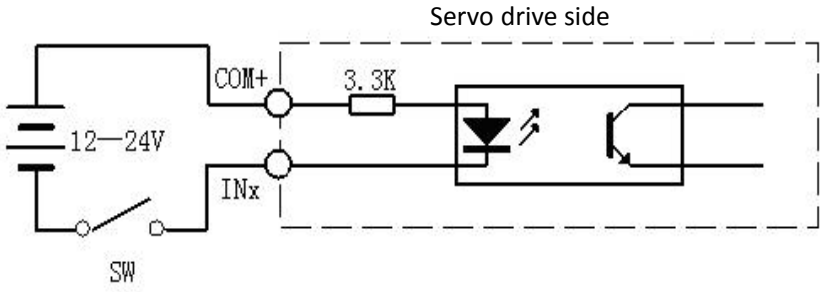


Figure 4-9 Digital input port

Table 4.5 Selectable function of digital input port

Functions				
Pin	**Code**	**Set value**	**Definition of input signal**	**Function description**
IN1~IN6 arbitrary set	FunIn.0	0	Disable	The pin is not used
	FunIn.1	1	Zero Speed & CLR	zero-speed clamping signal, which blocks speed and position command, and position error cleared simultaneously
	FunIn.2	2	Braking Mo de	Self-locking after motor stops, the drive display: 
	FunIn.3	3	Dir. control	Direction control 1 — FWD 0 — REV
	FunIn.4	4	+ Dir Prohibit	Motor FWD run forbidden (over-travel protection)
	FunIn.5	5	- Dir Prohibit	Motor REV run forbidden (over-travel protection)
	FunIn.6	6	CLR Rev/Angle	Zero clearing of motor cumulative rotation number and motor angle
	FunIn.7	7	RS485 Enable	Switch to RS485 control mode. (Note 1)
	FunIn.8	8	Preset Enable	Switch to Preset control mode. (Note 1)

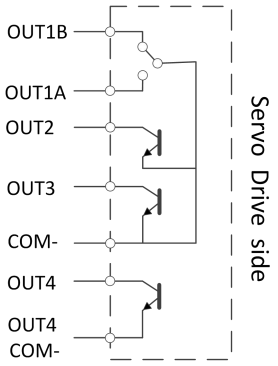
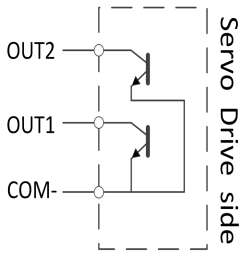
	FunIn.9	9	Preset-1	At the Preset control mode (Pr-41) of preset speed curve or the digital input Preset Enable = 1, the motor speed is selected via these three digital inputs: Total 8 speed curves are optional. Each curve has up to 32 data points and the repeated operating number of curve can be independently set.
	FunIn.10	10	Preset-2	
	FunIn.11	11	Preset-3	
	FunIn.12	12	+Torque Limit	The maximum torque limit during FWD or REV rotation. The torque limit value are set by the parameter FWD torque limit and REV torque limit (Pr-37 and Pr-38).
	FunIn.13	13	- Torque Limit	
	FunIn.14	14	reset	After the error alarming, the input is effective for 1s and then the drive will reset and exits the error state. The system error has many causes. Please carefully inspect the system and exclude the malfunction, then power on again.
	FunIn.15	15	Speed ⇔ Position	Switch between speed and position control mode (note 1)
	FunIn.16	16	+10V ⇔ ±10V	Unipolar +10V control and bipolar -10V~+10V control switch. (Note 1)
	FunIn.17	17	Go Stop Position	Drive homing function At the state of P and Servo-OFF, if the input signal is effective, the motor rotates to the stop angle (parameter Pr-26) at JOG speed (parameter Pr-28), and then stop using the stop mode control (parameter Pr-24)
	FunIn.18	18	Gear_B_1	Selection of the 2nd electronic gear ratio.
	FunIn.19	19	Gear_B_2	Selection of the 3rd electronic gear ratio.
	FunIn.20	20	CCW_Run_Enable	FWD key. It is valid in the analog control mode, and the motor rotates forward. (Note 1)
	FunIn.21	21	CW_Run_Enable	REV key. It is valid in the analog control mode, and the motor rotates reversely. (Note 1)
	FunIn.22	22	Speed_Pulse_Enabl	At the position control mode, it changes to pulse speed control.
	FunIn.23	23	Forced_Fan_on	Forced the cooling fans on.
	FunIn.24	24	CAN_Disable	Disable CAN communication.
	FunIn.25	25	External Error	Report an external error.
	FunIn.26	26	Flux mode	Flux control mode (used in hydraulic control)
	FunIn.27	27	-	Reserved internally
	FunIn.28	28	-	Reserved internally
	FunIn.29	29	-	Reserved internally

Note 1: The switching of control mode must be conducted at the state of P.

4.3.2 Digital output interface circuit

The power level of Synmot servo drive covers 400W-160kW and includes many types. For the compact drive, there are only two outputs of OUT1 and OUT2. But the standard type has 4 channels of output of OUT1 ~ OUT4 and one channel is the relay output as shown below.

The factory default of the digital output port is 0- active low. If one port is set to active high, then it only needs to set up the internal parameter Pd-59. The specific configuration refers to Appendix III (internal parameter list).

Standard type drive		The max. load current OUT1 is 2A and the max. voltage is 30V (Relay output) The max. load current of OUT2 is 100 mA and the max. voltage is 24V The max. load current of OUT3 is 30 mA and the max. voltage is 30V The max. load current of OUT4 is 30 mA and the max. voltage is 30V Wherein: OUT1 OUT2 OUT3 share the common port COM- OUT4 independent use common port (OUT4) COM-
Compact type drive		The max. load current of OUT1 is 30 mA and the max. voltage is 30V The max. load current of OUT2 is 30 mA and the max. voltage is 30V Wherein: OUT1 OUT2 share the common port COM-

NOTE Note:

1) An outside power supply can be provided by the user. But, it needs to note that the reverse polarity of power supply may damage the servo drive.
2) The load of the output signal must satisfy the limit of voltage and current at the same time. If the required limit is exceeded or the output connects directly with the power supply, it may lead to the damaged servo drive.
3) If the output transistor is Darlington type, when it is conducted, the voltage drop Vce will be about 1V that cannot satisfy the requirement of TTL low level. Thus, it cannot directly connect with TTL IC.

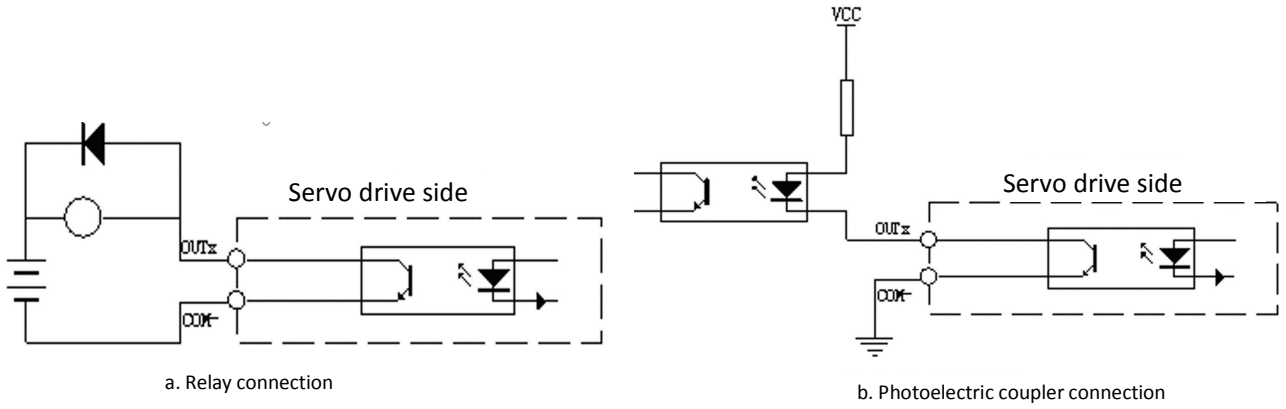


Figure 4-10 Application of typical digital output port

Synmot servo drive use the intelligent programmable digital output port. Each digital output (DO) port are available to configure over 10 functions. The user can use 4 parameters Pr-86 ~ Pr89 to respectively set up the functions of 4 digital input ports. The specific functions are as follows.

Functions				
Pin	**Code**	**Set value**	**Name of output signal**	**Function description**
OUT1 ,OUT2, OUT3, OUT4, Arbitrary set	FunOut.0	0	Disable	The pin is not used.
	FunOut.1	1	SERVO Ready	The drive is powered on and can receive the control signal.
	FunOut.2	2	Drive Fault	The drive has an error.
	FunOut.3	3	Pos.Err.Alarm	The position error exceeds the set value of Pr-76.
	FunOut.4	4	Position Reach	Arrive to the position, i.e., the position error is smaller than the set value.
	FunOut.5	5	Speed Reach	Speed arrival, i.e., the speed is higher than the set speed (Pr-43).
	FunOut.6	6	Brake Release	Release the brake signal
	FunOut.7	7	Internal Test	For internal test only
	FunOut.8	8	Zero Speed	Output of zero-speed signal
	FunOut.9	9	Pressure Reach	Pressure arrival (for hydraulic control)
	FunOut.10	10	-	Reserved internally
	FunOut.11	11	-	Reserved internally
	FunOut.12	12	-	Reserved internally
	FunOut.13	13	-	Reserved internally

4.3.3 Analog input interface circuit

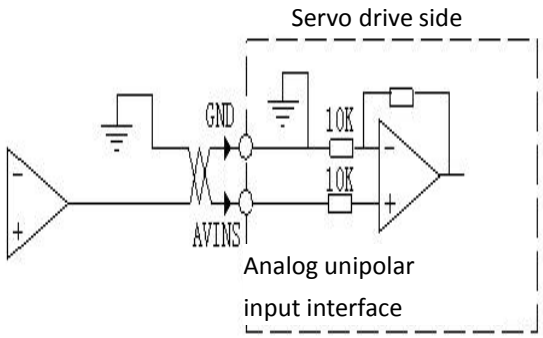


Figure 4-11a Voltage range 0~＋10V

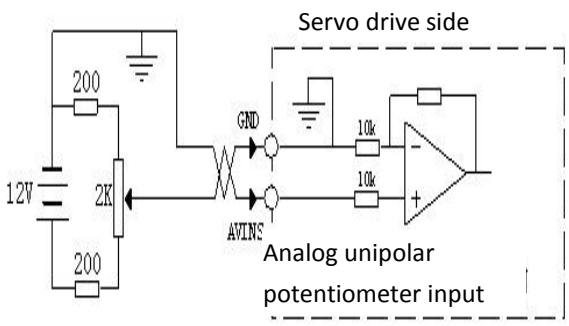


Figure 4-11b Using potentiometer

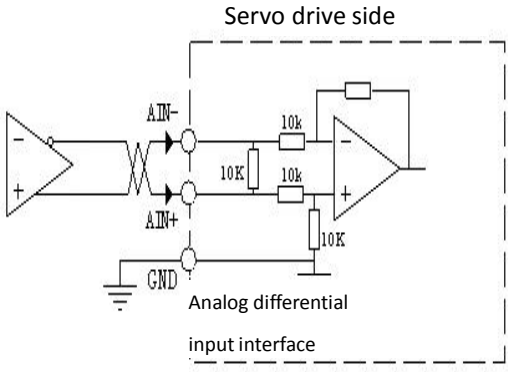


Figure 4-11c Differential voltage, －5V~＋5V

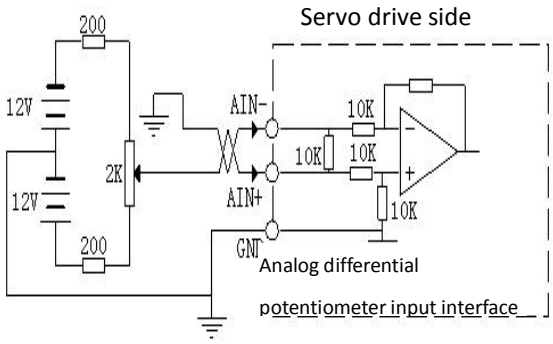


Figure 4-11d single end input, －10V~+10V

NOTE Note:

1) The analog input is divided into two types as unipolar input and bipolar input. The input impedance is 10k. Input voltage range is: Unipolar: 0V~＋10V; bipolar: －10~＋10V;

2) In the differential connection, the analog GND and the input end GND are connected. It needs three wires for connections from the main controller to the drive.

   Bipolar differential voltage range: －5V~＋5V;

3) In the single end connection, the analog GND and the negative input are connected at the side of. It needs two wires for connection from the main controller to the drive.

4) The input voltage cannot exceed the range of －10V~＋10V, otherwise, it may lead to a damaged drive.

5) It is suggested to use a shielded twisted pair to connect and reduce the electromagnetic interference.

6) The analog interface is not electrically isolated. Thus, it needs the special care to use it.

4.3.4 Interface circuit of encoder and definition of signal Z

The signal of encoders are outputted after frequency division and transmitted to the upper controller. It is suggested to use a differential receiving circuit to receive as shown in Figure 4-12a. Wherein the signal Z of the encoder has both the differential output and OC output as shown in Figure 4-13.

1） The encoder signals are outputted by the differential drive 26LS31 and is a non-isolated output.

2） The GND of main controller must be connected securely with the GND of drive.

3） The input end of the controller can also use a photoelectric coupler to receive. But it must be a high-speed optical coupler (for example, 6N137).

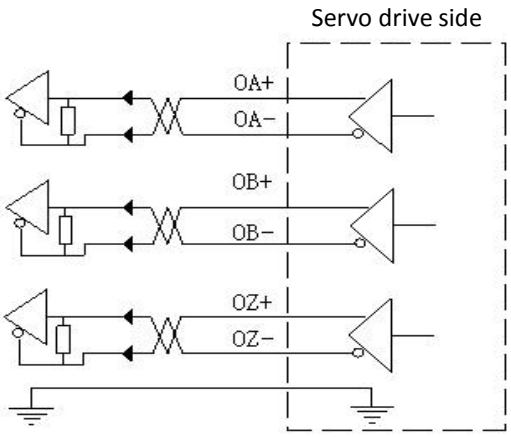


Figure 4-12a Differential interface

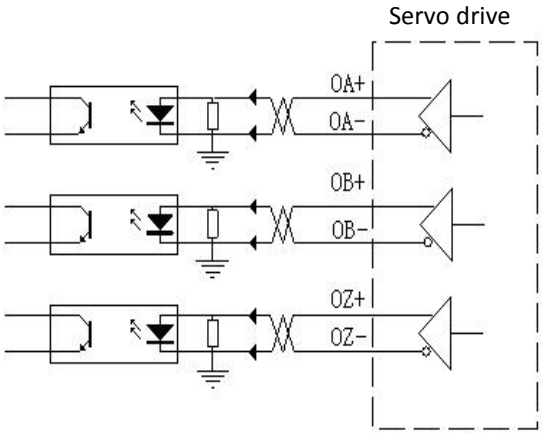


Figure 4-12b Optical coupler interface

Z signal OC output interface circuit

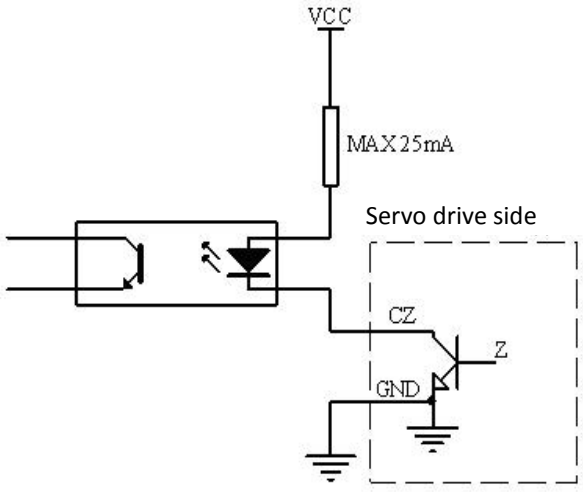


Figure 4-13 Open-collector output of phase Z signal

NOTE:

1) Phase Z signal of the encoder is outputted from the collector. When Phase Z signal of encoder occurs, the output will be ON (output is conducted), otherwise, the output will be OFF (output is cutoff).

2) Un-isolated output (not insulated).

3) The pulse of Phase Z signal is usually very narrow. Thus, it needs to receive with a high-speed optical coupler (for example, 6N137).

Definition of Phase Z signal position of motor encoder

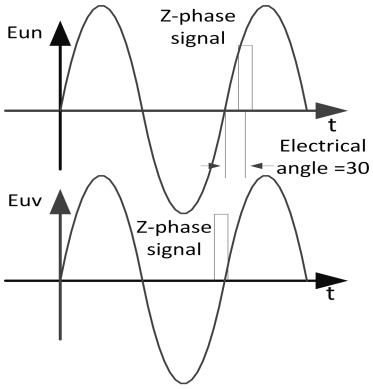


Fig. 4-14a Definition of Phase Z signal

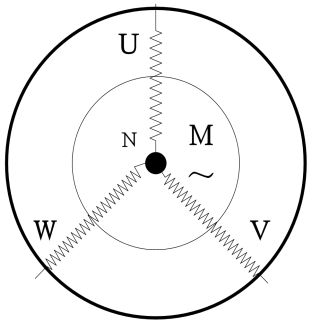


Fig. 4-14b Diagram of 3-ph motor winding

1. The schematic diagram of AC servo motor is as shown in the winding diagram. If viewed along the motor shaft, the motor will rotate counter-clockwise.
2. E_{un} is the voltage waveform between phase U and center line N, E_{uv} is the voltage waveform between phase U and phase V.

4.3.5 Position pulse input interface circuit

In order that the pulse data can be transmitted properly and reliably, it is recommended to use the differential signal and use the RS422 drive chips such as 26LS31 and MC3487. Please ensure "2.8V≤ (H level) - (L level)≤3.7V". If the conditions above cannot be met, the input pulse of the servo drive will get instable and may lead to: losing pulse or even fetching an inverse command.

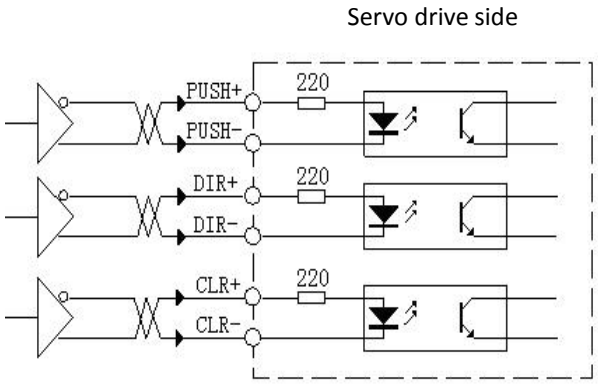


Figure 4-15a Differential pulse input interface (recommended)

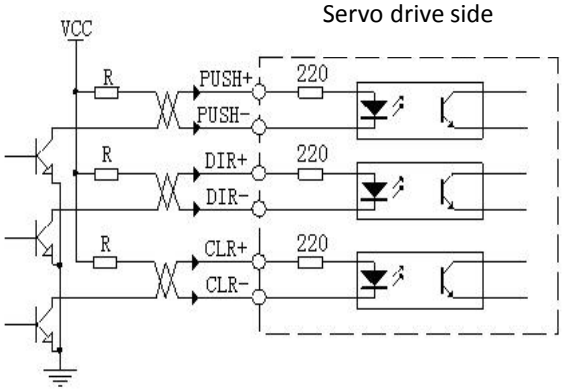


Figure 4-15b Single end pulse input interface

NOTE

It needs to reduce the maximum operating frequency when the single-end drive mode is used.

The drive current of the pulse input circuit is 10 ~ 15mA and the maximum voltage of external power supply is 24V.

The recommended value of series resistor R is:

if VCC=24V, R＝2kΩ

if VCC=12V, R＝750Ω

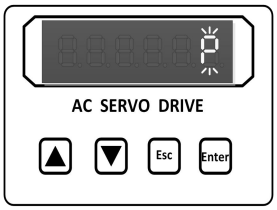
if VCC=5V,　R＝100Ω

Chapter 5 Display and keypad operation

The chapter mainly introduces the display and keypad operation. The keypad operation panel of the drive can be used to set user parameters and display the drive status. The power of Synmot servo drive covers 400W to 160kW. The size of servo drive also has a big change. There are three types of different keypad operation panels: 4-key LED, 8-key LED and 9-key LCD as shown in Figure 5-1.

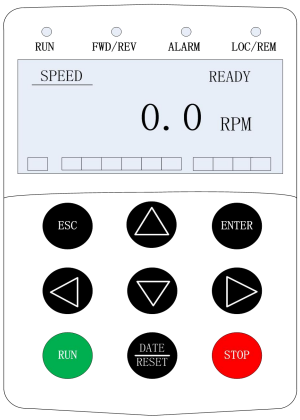
The operating methods of these three keypad operation panels are basically the same. The users can read the corresponding operating instructions as per the type of the actual panels: 4-key LED (Section 5.1), 8-key LED (Section 5.2) and 9-key LCD (Section 5.3).

Please note: The keypad operation and RS485 communication can both conduct the parameter setting. Nevertheless, please do not perform keypad operations and RS485 communication simultaneously in order not to cause a malfunction.



(a) 4-key LED

(b) 8-key LED



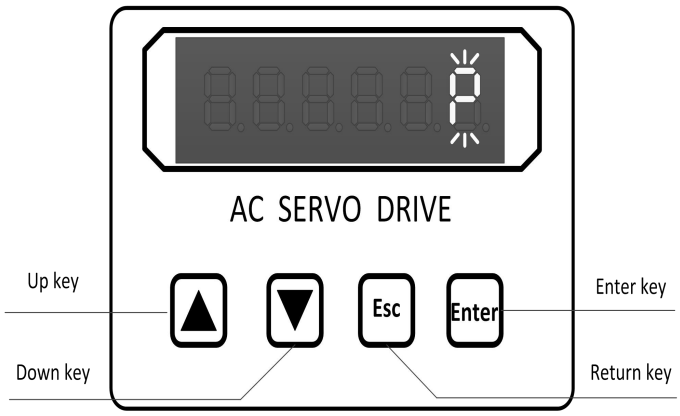
(c) 9-key LCD

Figure 5-1 Display and keypad panels

5.1 Instructions of 4-key LED panel

5.1.1 Interface introduction

The drive panel consists of 6 LED digital displays and 4 keys. It is used to display various statuses of the system and set the parameters. Control forward and backward of menu operation.



Press the key ▲, ▼ and hold it, it will function as the effect of repeating. The longer the holding time is, the higher the repeat rate

5.1.2 Function selection

When the motor is not powered on, i.e., at the state of "P" Normal operating state or "Err---" Error / alarming state, press Enter and can enter the layer-1 menu. Layer-1 menu has 5 states. Press Enter to enter the keypad operation.

"P" or "bP" indicates that the drive is powered on and waiting for the start-up signal. Meanwhile, the motor shaft is locked. It is shown as follows.

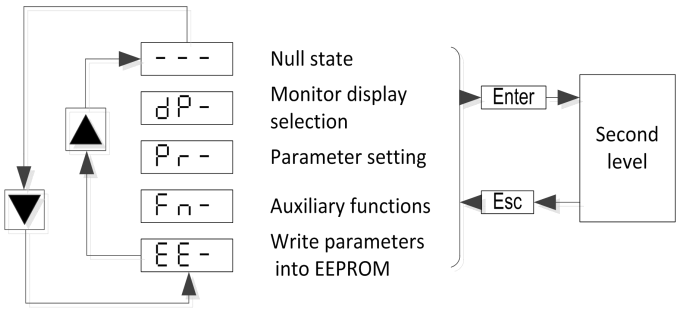


Figure 5-2 - Block diagram of layer-1 main menu

Press ▲, ▼ to select these 5 states. Press Enter to confirm the selection and enter the state, i.e., Layer-2. Press Esc to exit Layer-2 to Layer-1.

5.1.3 State monitoring

Select "dP-" from Layer-1 main menu and press Enter to enter LED monitoring mode dP-** selection. There are totally 23 display states. The user can use the key ▲, ▼ to select the desired display mode. Then press Enter to confirm entering the real-time monitor screen to monitor the data.

⚠	**Note:** The display mode selected through this method is only valid during this power-on process. It will return to the default mode after the drive is reset or after power-on. The default display mode is set by the user parameter "Pr- 90".

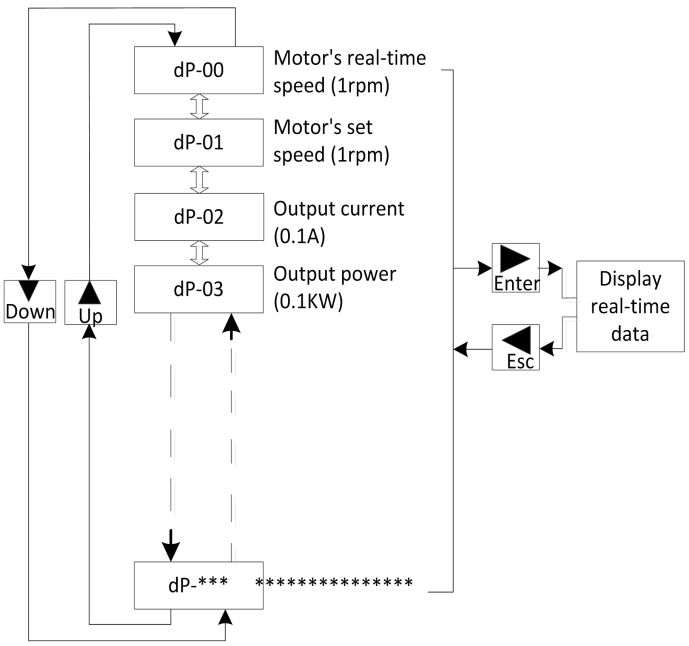


Figure 5-3 Monitoring method

5.1.4 Parameter setting and storage

Select "Pr- " from Layer-1 main menu and press Enter to enter the parameter setting method. There are totally 127 parameters. The user can select the parameter number via the key ▲, ▼. Press Enter to display the value of the parameter.

If it needs to modify the parameter, the password must be entered in "Pr- 000". Press Enter to enter the item (use the key ▲, ▼ to modify the parameter value, each press of ▲ or ▼ will increase or reduce the parameter by 1. Press and hold ▲ or ▼, the number of the parameter will increase or reduce continuously). Enter the corresponding password as per the requirement of operation.

"Pr- 001" ~"Pr- 009" is unchangeable parameters, which indicate the model of the drive, rated operating current and drive software version, etc.

If the password is not entered, the parameters of "Pr- 10" ~"Pr- 127" can only be viewed but cannot be modified. After the parameters are modified, the values cannot be immediately reflected in the drive. It needs to modify all the data and press Esc to exit to Layer-2, press ▲, ▼ to enter "EE- " to save the modified parameters into EEPROM as shown in Figure 5.4. The procedure to modify and save the parameters:

A. Enter the state "Pr- ":

1. Press Enter at the state " P" or "Err".
2. Press the key ▲, ▼ to set to display "Pr-".

B. Input the password

3. Press Enter to enter "Pr- 000".
4. Press Enter to enter the password entry box "00 120".
5. Press the key ▲, ▼ to enter the password "00 123".
6. Press Enter to confirm the password entry. The drive display jumps back to "Pr- 0 10".

C. Parameter modification

7. Press ▲, ▼ to select "Pr- 022" (zero-position of motor encoder).
8. Press Enter to confirm the modification on the parameter and enter the parameter modification options "3000", indicating that the zero-position of the motor encoder is 300°.
9. Press ▲, ▼ to modify the parameter and adjust the value to "3300".
10. Press Enter to confirm the modification of the parameter. The drive display jumps back to "Pr- 022".

D. "EE-" save

12. Press Esc to exit to "Pr-".
13. Press ▲, ▼ to select "EE- "(Menu for write the parameter into EEPROM).
14. Press Enter to enter "EE- --- ".
15. Press ▲, ▼ to select "EE- SAV", save the parameters to EEPROM (Save).

Press Enter to save the parameters into EEPROM. The drive will reset automatically.

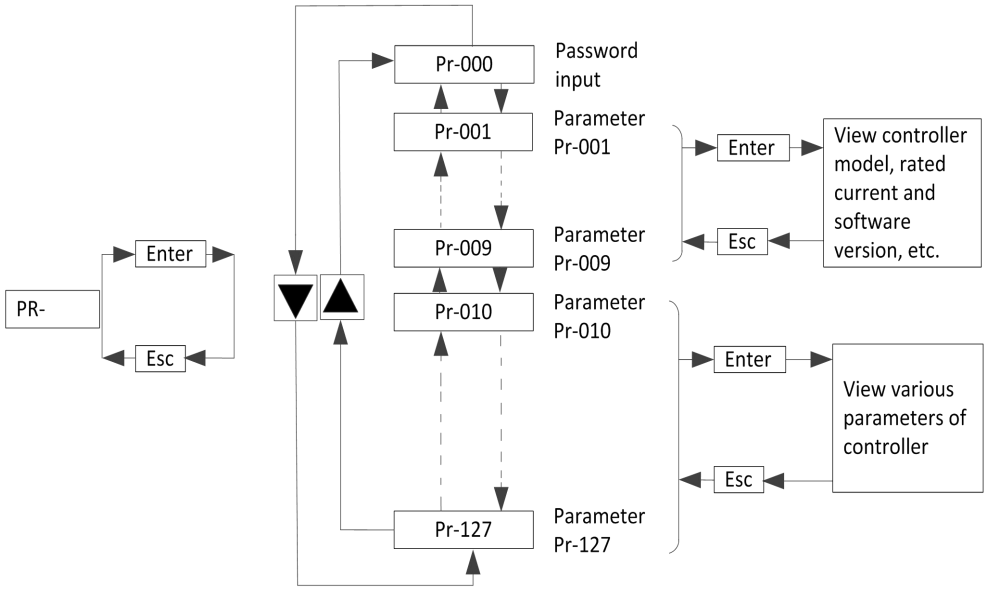


Figure 5-4 Parameter setting

⚠	**Note:** If it needs to modify multiple parameters, the operation of **parameter modification** can be repeated as per Article 3 of Case 2. After all the parameters to modify are modified, perform the operation of "EE-" to save the modifications into EEPROM.

Restore factory settings

A. Enter the state "Pr- ":

1. Press Enter at the state " P" or " Err".
2. Press the key ▲, ▼ to set to display "Pr- ".

B. Input the password:

1. Press Enter to enter "Pr- 000".
2. Press Enter to enter the password entry box.
3. Press the key ▲, ▼ and enter the password " 125 ", press Enter to automatically jump to "Pr- 000".

C. "EE- dEF" restores factory settings:

1. Press Esc to exit to "Pr- ".
2. Press ▲, ▼ to select "EE- ", EEPROM setting.
3. Press Enter to enter "EE - SAV ".
4. Press ▲, ▼to select "EE- dEF", load the factory settings of parameters.
5. Press Enter to conform the loading of factory parameter setting.
6. Restart the drive and load the factory settings into the drive.

⚠	**Note:** After the factory settings are restored, the parameters modified by the user will be overridden and the user must set up again.

5.1.5 Examples of operation

(I) Automatic encoder zero setting

	**Note:** Usually, it needs not to set the encoder zero for the system provided by Synmot. Nevertheless, if it needs to set up the zero indeed, please separate the motor and the load. The motor shaft cannot carry any load, otherwise, the zero position of the encoder after automatic setting will have a big error.

A. Enter the state "Pr- ":

1. Press Enter at the state " P" or " Err".
2. Press the key ▲, ▼ to set to display "Pr-".

B "Fn- AuT" automatic zero setting:

1. Press ▲, ▼ to select "Fn- " (optional function).
2. Press Enter to enter "Fn-JoG ".
3. Press ▲, ▼ to select "Fn- AuT" and set up zero automatically (Auto).
4. Press Enter to enter " Au1" (dynamic zero setting)
5. Or press ▲, ▼ to select "Au2 (static zero setting)"
6. Press Enter to enter "P"

C. Start the servo by ServoON and the drive starts to automatically set up zero.

(II) Jog running

A. Enter the state "Pr- ":

1. Press Enter at the state " P" or " Err".
2. Press the key ▲, ▼ to set to display "Pr-".

B. "Fn-Jog" jog running:

1. Press ▲, ▼ to select "Fn- " (auxiliary function).
2. Press Enter to enter "Fn-JoG ".
3. Press Enter to enter "JoG" (JoG blinks).
4. Press Enter to enter "JoG" (JoG stops blinking).

C. Open the servo by enabling ServoON, press ▲ to rotate motor FWD and press ▼ to rotate motor REV.

	**Note:** The jogging speed of motor is set up via the parameter Pr-49.

(III) Zero drift correction of analog signal

A. Enter the state "Pr-":

1. Press Enter at the state "P" or "Err".
2. Press the key ▲, ▼ to set to display "Pr-".

B. "Fn- AdJ" zero drift correction:

1. Press ▲, ▼ to select "Fn-" (auxiliary function).
2. Press Enter to enter "Fn-JoG".
3. Press ▲, ▼ to select "Fn-AdJ", zero drift correction.
4. Press Enter to enter "Ad1" (correct analog voltage AD1, AD2, AD3)
5. Can also press ▲, ▼ to select "Ad2 (correct 3-phase current)".
6. Press Enter, the drive will automatically correct the zero drift and restart to enter "P"

⚠	**Note:** The zero drift correction must be performed at the state of P or ERR. After correction, the zero drift of analog voltage AD1, AD2 and AD3 or the 3-phase current will saved in the internal parameter. Before performing Ad1 operation, ensure the analog voltage input of drive is 0, and Ad2 can be directly executed at the state of P or Err.

(VI) Error checking

A. Enter the state "Pr-":

1. Press Enter at the state "P" or "Err".
2. Press the key ▲, ▼ to set to display "Pr-".

B. "Fn- Err" error checking:

1. Press ▲, ▼ to select "Fn-" (auxiliary function).
2. Press Enter to enter "Fn-JoG".
3. Press ▲, ▼ to select "Fn-Err", error checking
4. Press Enter to enter to check the error code.
5. Press ▲, ▼ to select viewing the error time and history error code and time.

(E) Resetting of drive

1. Press Enter at the state "P" or "Err".
2. Press the key ▲, ▼ to set to display "Pr-".
3. Press Enter to enter "Pr-000".
4. Press Enter to enter the password entry box "00 120".
5. Press the key ▲, ▼ to enter the password "00 150".
6. Press Enter to confirm the password entry and the drive will reset automatically.

5.2 Instructions of 8-key LED panel

The 8-key LED operation panel is provided with four status indicators, four unit indicators, eight keys and a 6-digit segment displays. The LED operation panel is connected with the main control board through an 8-core cable.

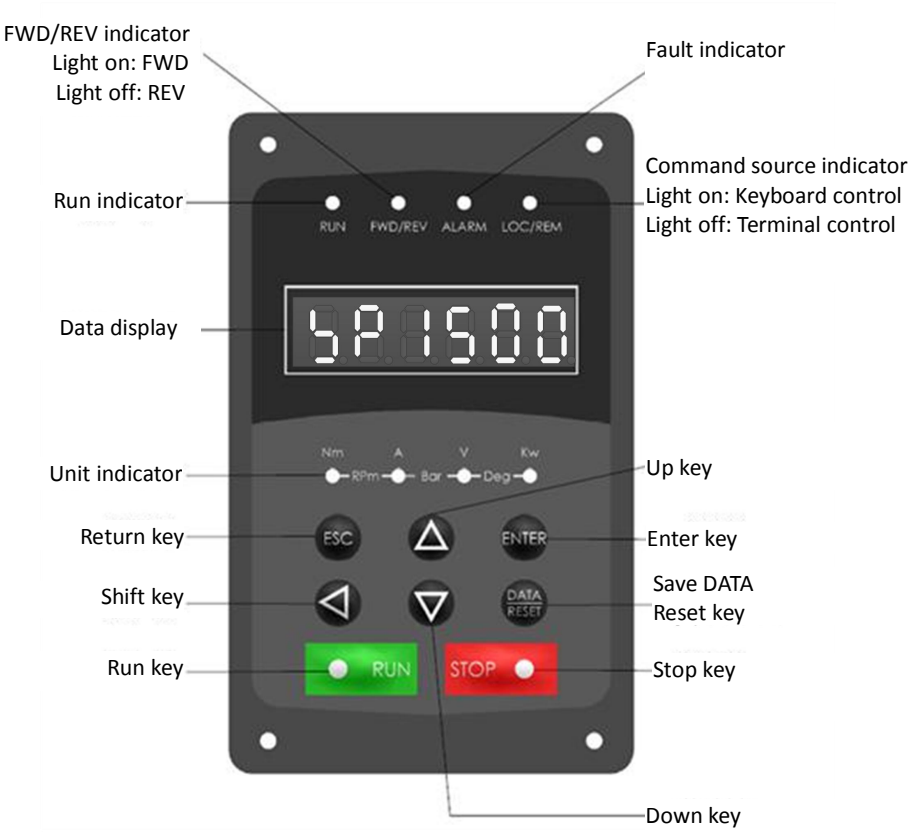


Fig 5-5 Outside view of 8-key LED operation panel

5.2.1 Operation status indicators and unit indicators

The operation panel has 4 operation status indicators:

- **RUN**: Run indicator, On represents that the motor is running and Off represents that the drive is stopped.
- **FWD/REV**: FWD/REV indicator, On: in a reverse state; Off: in a stopped or forward state.
- **ALARM**: fault indicator, On represents being in a fault or alarm state.
- **LOC/REM**: command source indicator, On: key control; Off: IO port line remote control.

The operation panel has 4 unit indicators (●: Light on ○: Light off):

●—○—○—○: Nm Unit of torque

○—●—○—○: A Unit of current

○—○—●—○: V Unit of voltage

○—○—○—●: kW Unit of power

●—●—○—○: rpm Unit of speed

○—●—●—○: Bar Unit of pressure

○—○—●—●: Deg Unit of temperature

5.2.2 Usage of keys

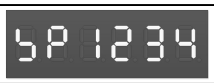
Eight keys are available on the operation panel to perform the functions such as modifying data, and starting and stopping the drive.

Key	Name	Function
	ESC key	Back to the previous menu
	Enter key	Enter the next menu, or confirm functions and parameters
	Up / Down key	Ascending or descending of data or function code
	Shift key	Switch the parameters displayed in the LED during running; To modify a parameter, select the digit of the parameter (for example, the unit, decade and hundred) to modify.
	Data/reset	Restart the drive or save modified parameters in a non-running state.
	Run key	When panel enabling is active, start the drive.
	Stop key	When panel enabling is active, stop the drive.

Table 5.1 Description of the functions of the keys on the operation panel

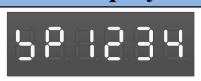
5.2.3 LED segment displays

Layer-0 display interface: Status display layer

	Ready	In readiness for serving
	Self-locking	The motor is self-locked or automatic zero setting state
	Running	The motor is running with monitoring data displayed.
	Fault	The servo drive has faults and the number is a fault code.

Where: the running state has over ten types of monitoring data can be switched through the shift key  .

Once power is on, the LEDs will display that the digits are counted down from 9~1 to 0 and enter the readiness state. If the digits cycle between 5 and 1 and the 6-digit segment displays cannot enter the readiness state, it indicates that the zero drift of 3-phase current is too high, re-correct of the zero shift is needed.

Display	Name	Function
	Motor speed	The real-time motor speed, in rpm
	Output current	The rms value of the output current of the drive, in A
	Output power	The real-time output power of the drive, in kW
	Output torque	The real-time output torque calculated as per motor parameter, unit: N.m
	DC Bus voltage	The real-time busbar voltage of the drive, in V

Layer-1 display interface: Function selection layer

dP-	Data monitoring	Includes dP-00~dP-25 and has 26 monitored variables in total. The function of data monitoring can be enabled in any status.
Pr-	Parameter setting	Includes Pr-000~Pr-131 and has 132 user parameters in total. Viewing parameters can be directly done in any status. Modifying parameters can be done in a stopped status only. Need input the parameter protection password Pr-000 before modifying parameters.
Fn-	Auxiliary functions	The next layer includes four auxiliary functions: Jog, Aut, Adj and Err. The auxiliary functions can be used in a stopped status only.
EE-	Parameter storage In EEPROM	The next layer includes two parameter storage functions: SAV and dEF. The parameter storage can be used in a stopped status only. The operation of saving parameters is valid when modified parameters have been confirmed. Need input the parameter protection password Pr-000 before restoring factory settings.

Table 5.2 Function selection layer

Layer-2 display interface: Data monitoring

dP- 00	Data monitoring	Display the value of monitored objects through Enter key to select a monitored object. Change monitored objects through ▲, ▼ key. Change the digit position to be modified through the ◄►key (flickering digit is valid)

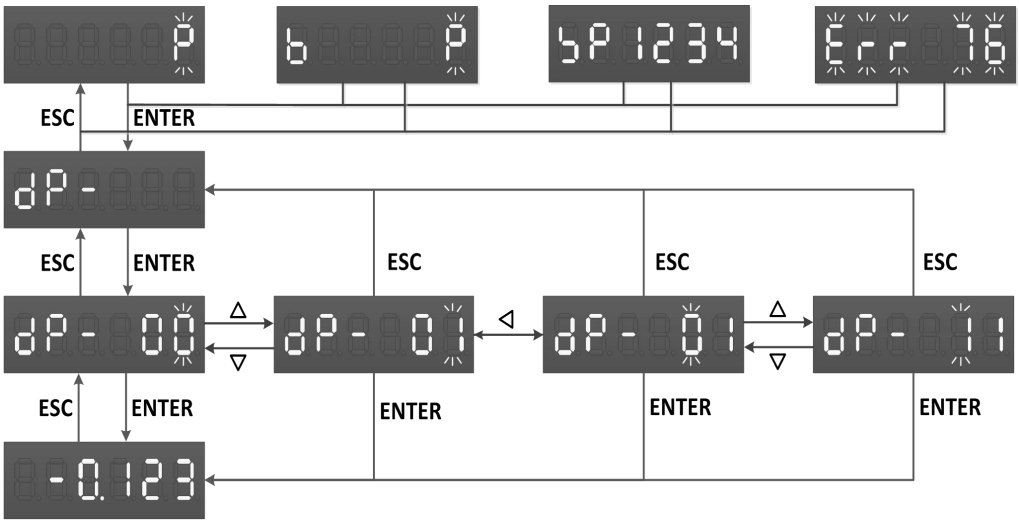


Fig. 5-6 Operation procedure of monitoring data

Layer-2 display interface: Auxiliary functions

Display	Name	Function
	Jog running	Start the jog function in any control mode. Press ▲ to enable running at a forward jogging speed Press ▼ to enable running at a forward jogging speed
	Automatic zero setting	Automatically find the zero position of the encode, including dynamic and static zero setting.
	Zero drift correction	Automatically correct the zero drift of AD1, AD2, AD3, and 3-ph current
	Fault recording	View the internal error records and time

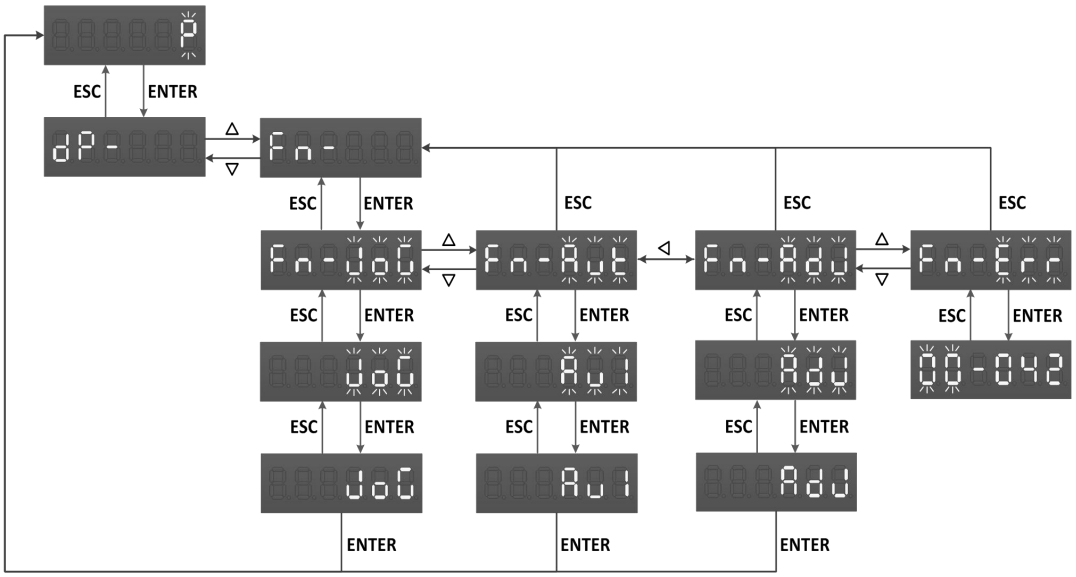


Figure 5-7 Operation procedure of auxiliary functions

Layer-2 display interface: Parameter storage

Display	Name	Function
	Save parameters	Parameters are saved to EERPOM after modification
	Restore factory settings	User parameters are restored to factory settings

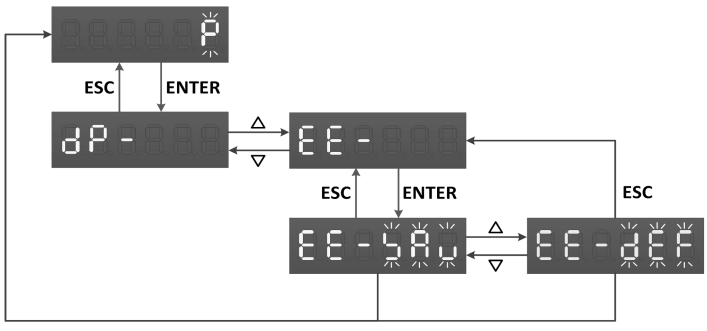


Figure 5-8 Operation procedure of parameter storage

Layer-2 display interface: Parameter setting

Display	Name	Function
Pr-000	Parameter setting	View and modify drive parameters. Modification of the parameters requires entering parameter passwords.

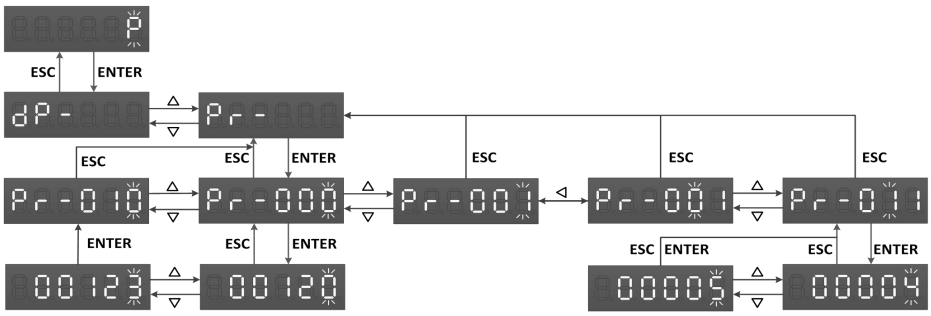


Figure 5-9 Operation procedure of parameter setting

When operating the menu, in the third layer, press the ESC key or the ENTER key to return to the second layer. The difference is that press ESC, it will cancel the modification of a parameter and return to the second layer, while press ENTER, it will save modified parameters as variables and return to the second layer.

5.2.4 Examples of operation

Example 1: Dynamic zero setting

⚠	**Note:** Usually, it needs not to set the zero specifically for the system provided by Synmot. If it needs to set up the zero indeed, please separate the motor and the load. The motor shaft cannot carry any load, otherwise, the zero position of the encoder after zero setting will have a big error.

First ensure the motor has no load; at the state P, press Enter; press ▲, ▼ to adjust to display 'Fn-', then press Enter; press the key ▲, ▼ to adjust to display 'Fn-AUt', then Enter. Press ▲, ▼ to display "AU 1" and press Enter. The display returns to "P" automatically. Connect ServoON signal, automatic zero setting will begin.

Example 2: Parameter modification

Press Enter at the state of 'P' or 'Err'; press ▲, ▼to adjust to display 'Pr-' and press Enter; display 'Pr-000', then press Enter; press ▲ to change the displayed content '00120' to '00123' and press Enter; press ▲, ▼to adjust to display 'Pr-***' and press Enter; press ▲, ▼ and change the value，and press Enter; press the key DATA/RESET to save the parameter and restart up the drive.

Example 3: Jog running

Press Enter at the state of 'P' or 'Err'; press▲, ▼ to adjust to display 'Fn-' and press Enter; press ▲, ▼ to adjust to display 'Fn-Jog' and press Enter to display ' Jog' blinks, press Enter to stop the blinking and the function is enabled. Connect ServoON signal, and the drive will enter a jog running status. Only in the Layer-3 interface, press ▲ to make the motor jog forward, and press ▼ to make the motor jog reversely. If ESC is pressed, it will return to Layer-2 interface, the jog running function will be closed and the drive will restore to the original control mode. （Please stop ServoON signal first before escape）

Example 4: Panel enabling

Where Pr-100=1, panel enabling is active (the command source indicator is on), the startup and stopping of the drive is controlled by the RUN and STOP keys.

5.3 Instructions of 9-key LED panel

The operation panel of drive LCD, as shown in Figure 8, consists of 4 status indicators, 9 keys and 1 LCD displayer. The operation panel is connected to the main control panel of the drive via a 8-core network cable.

The drive software can simultaneously support two types of operating display panels of LCD and LED. Before ex-factory, the application parameters are used to set the display mode. If set to the LED display mode, the drive will only identify LED panel.

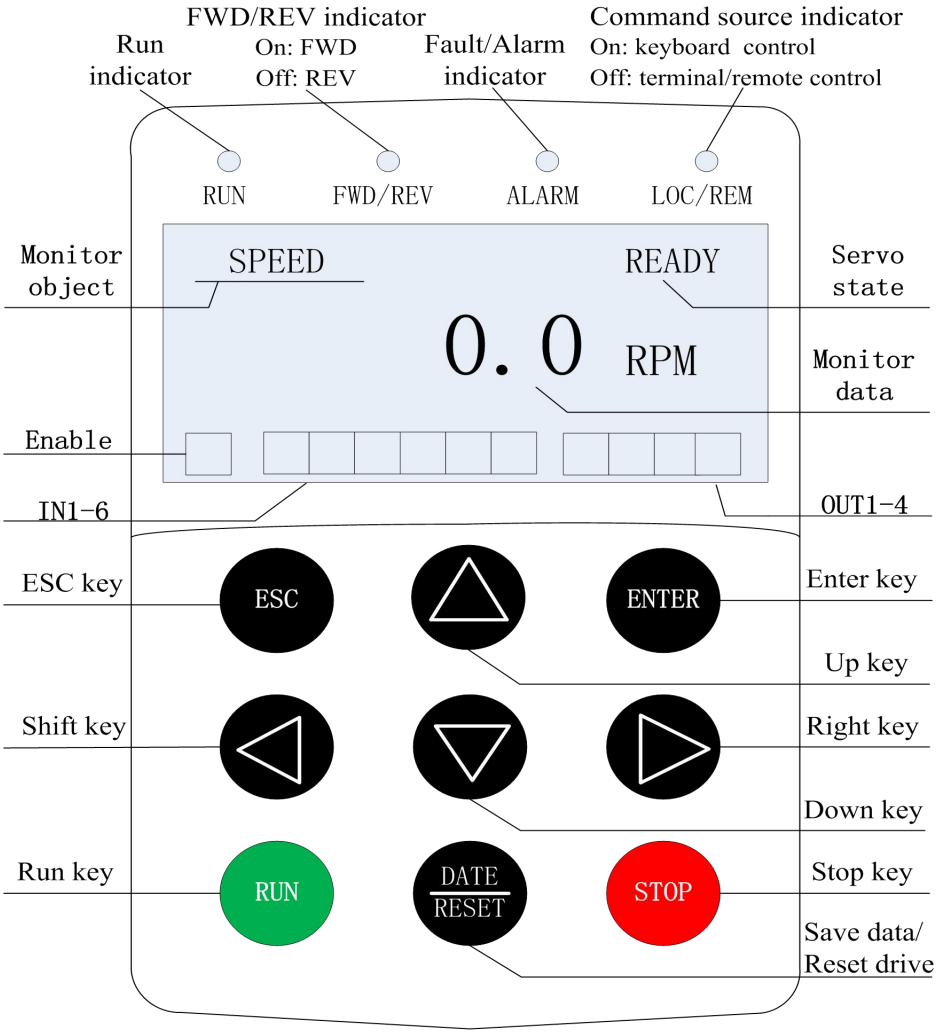


FIG. 5-10 LCD operating panel

5.3.1 Operation status indicators and IO status indicators

Operation status indicators

O RUN	run indicator, On: the drive is running; Off: the drive is stopped.
O FWD/REV	FWD/REV indicator, On: in a reverse state; Off: in a stopped or forward state.
O ALARM	fault indicator, On represents being in a fault state.
O LOC/REM	command source indicator, On: key control, Off: IO port line remote control;

IO status indicators

The LCD consists of 11 status indications of digital inputs and output lines to display the real-time status of IO line. The black represents the valid input/output, the white represents the invalid input/output and there are three portions from the left to the right:

Portion 1： 1st indicate the Enabling signal: ServoON or ServoOFF;

Portion 2： 2nd – 7th indications state of the digital input IN1-IN6;

Portion 3： 8th -11th indications state of the digital output OUT1-OUT4;

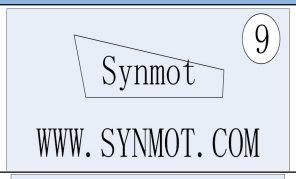
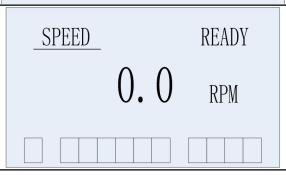
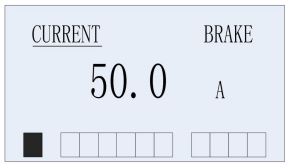
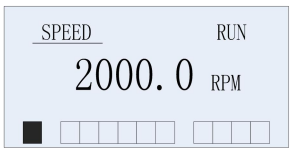
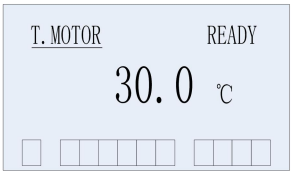
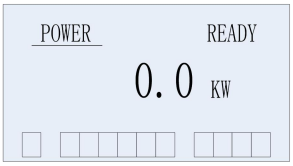
5.3.2 Usage of keys

Key	Name	Function
	ESC key	Back to the previous menu
	Enter key	Enter the next menu, and confirm functions and parameters
	Up key	Ascend data or function code
	Down key	Descend data or function code
	Left key	For Layer-0 menu or Layer-4 menu, switch LCD display parameter via the shift key Select the digit positions of a parameter to be modified through the shift key.
	Right key	
	Save / reset	Restart the drive or save modified parameters in a stopped state.
	Run key	Active when panel is enabled, start the drive.
	Stop key	Active when panel is enabled, stop the drive.

5.3.3 LCD display

LCD display can display the contents of drive status, parameters and monitored data. There is Chinese or English optional to display.

Layer-0 display interface: Status and monitoring data display layer

Display interface in Chinese	Description of screen content
	Power-on startup screen
	Readiness: state of serving preparation
	Self-lock: the motor is in a self-locked or automatic zero setting state
	Operation: the state of motor running
	Malfunction: the state of servo malfunction
 ……  …… 	In Layer-0 menu, the  **and**  can cyclically switch the object to monitor data. (Cannot switch at the ERR state)

Item	Displayed	Description
1	Motor speed	The real-time running speed of the motor, in rpm
2	Output current	Output current of the drive, in A, rms
3	DC Bus voltage	The real-time busbar voltage of the drive, in V
4	Motor temperature	Motor real-time temperature in ℃
5	Driving temperature	Drive real-time temperature in ℃
6	Output power	The real-time output power of the drive, in kW
7	Position error	Position error in PPR
8	Input pulse number	Number of pulse inputted by user in PPR
9	AD1	Analog voltage AD1 in 0.001V
10	AD2	Analog voltage AD2 in 0.001V
11	AD3	Analog voltage AD3 in 0.001V

Layer-1 display interface: Function selection layer

Display interface	Description of screen content
* * MENU. MAIN * * >> 1:DATA. MON 2:PARA. SET	**Data monitoring** Can view three data simultaneously selected from 13 monitoring variables in D01 -D13
* * MENU. MAIN * * >> 2: PARA. SET 3: FUNC. AUX	**Parameter setting** View and modify user parameters.
* * MENU. MAIN * * >> 3: FUNC. AUX 4: LANGUAGE	**Auxiliary functions** automatic zero setting zero drift correction jogging running factory setting restoration
* * MENU. MAIN * * >> 4: LANGUAGE 1: DATA. MON	**Language setting** Chinese and English language can be displayed on the panel

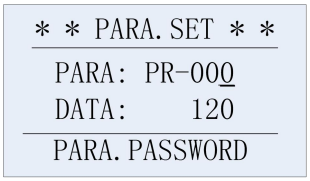
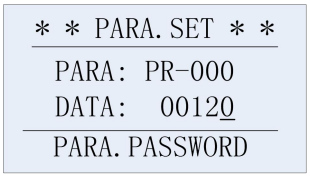
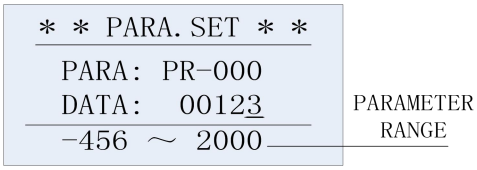
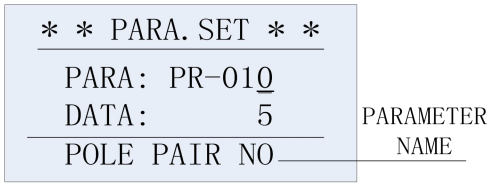
Layer-2, 3, 4 display interfaces: Application layers

1: Operating data display

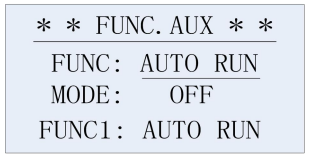
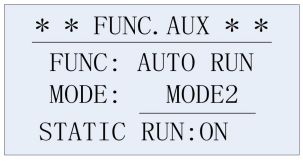
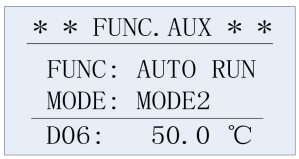
<table>
<tr><th>Display interface</th><th>Description of screen content</th></tr>
<tr><td>Layer-2
Setting of monitoring object
* * DATA. MON * *
> D00:SPEED. M
D01:SPEED. S
D02:CURRENT

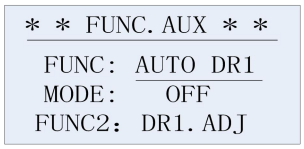
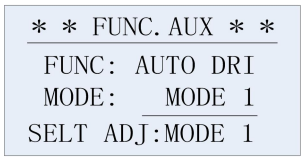
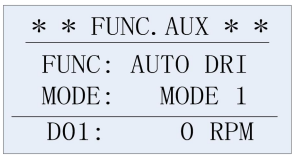
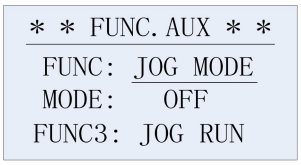
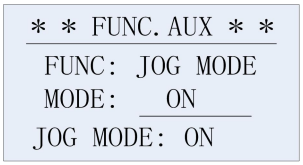
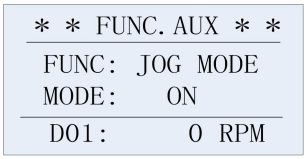
Layer-3
Display operating data
* * DATA. MON * *
SPEED. M: 50
SPEED. S: 50
CURRENT: 10. 6</td><td>Select monitoring object: monitor three sets of data simultaneously. Switch the group via Up and Down. Switch each group of monitoring object via the left / right shift key with the monitoring object as follows:
<table><tr><th>Item</th><th>Monitoring object</th></tr><tr><td>D00</td><td>Motor's real-time speed</td></tr><tr><td>D01</td><td>Motor's set speed</td></tr><tr><td>D02</td><td>Output current</td></tr><tr><td>D03</td><td>Output power</td></tr><tr><td>D04</td><td>Output torque</td></tr><tr><td>D05</td><td>Drive temperature</td></tr><tr><td>***</td><td>More monitoring variable
See details: 5.4.2</td></tr></table>After selection, press the key Enter to enter Layer-3 display interface and display the monitoring data.</td></tr>
</table>

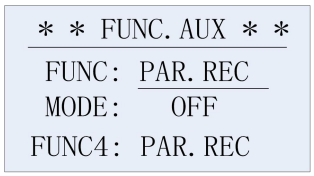
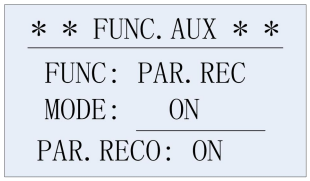
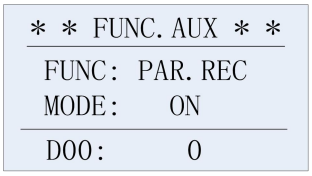
2. Set parameters

Display interface	Description of screen content
Layer-2: Setting of parameter number  Layer-3: Setting of parameter data  	**View / modify parameter**: To modify a parameter, it needs to input the parameter password. Select the parameter number, press Enter to enter Layer-3 display interface to display the parameter value. Use the key Up and Down to modify the value as the following Figure  Press Enter again to save the parameter value and return to Layer-2 display interface as shown below (Note: Pr-000 is the parameter password, if the password is entered properly, press the key Enter to return to Layer-2 and the parameter Number is directly jumped to Pr-010)  After the parameter is modified, long press the key DATA/RESET. The drive will save the parameters and automatically restart.

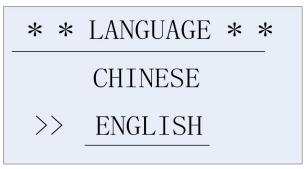
3. Auxiliary functions

Display interface	Description of screen content
Function I: Automatic zero setting	
Layer-2: Function selection  Layer-3: Mode selection  Layer-4: Function use  	In Layer-2 screen, select the function of automatic zero setting via the key Up / Down. Press Enter to enter Layer-3 In Layer-3 screen, press the key Up / Down to select the zero setting mode. Can select Mode1 - dynamic zero setting and Mode2 -static zero setting. Then press the key Enter to enter Layer-4 to enable the function Layer-4 function enabling, after ServoON， enter the automatic zero setting. **Note:** The zero setting must be conducted in the screen. Return to last layer, the zero setting is automatically closed. In Layer-4, press the shift key can switch the monitoring variable as shown in Figure to D06.

Display interface	Description of screen content
Function II: Zero drift correction	
Layer-2: Function selection 	In Layer-2 screen, select the function of zero drift correction via the key Up / Down. Press Enter to enter Layer-3
Layer-3: Switch selection 	In Layer-3 screen, press the key Up / Down to select Mode I (correction AD1, AD2 and AD3) or Mode II (correction 3-phase current). Then press the key Enter to enter Layer-4 to enable the function
Layer-4: Function use 	Layer-4 function is turned on. The drive automatically corrects AD1, AD2 and AD3 or 3-phase current zero drift and restart the drive.
Function III: Jog running	
Layer-2: Function selection 	In Layer-2 screen, select the function of jogging running via the key Up / Down. Press Enter to enter Layer-3
Layer-3: Switch selection 	In Layer-3 screen, press the key Up / down and then press Enter to enter Layer-4 using function
Layer-4: Function use 	Layer-4 function opening, open ServoON. Press the key Up to run at forward jogging speed Press the key Down to enable running at a reverse jogging speed. Note: It needs to close the enabling. Then press ESC to exit Layer-4 interface to close the function of jogging running.

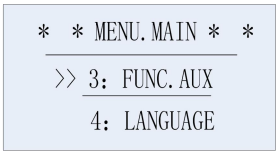
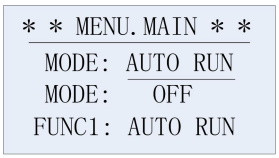
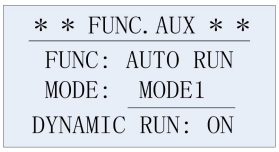
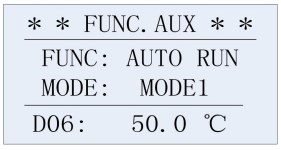
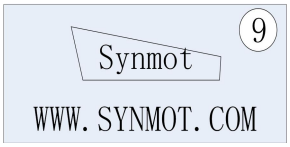
Display interface	Description of screen content
Function IV: Restore factory settings	
Layer-2: Function selection 	In Layer-2, select the function of factory setting restoration via the key Up / Down. Press Enter to enter Layer-3
Layer-3: Switch selection 	In Layer-3, press the key Up / down and then press Enter to enter Layer-4 opening function
Layer-4: Function use 	Layer-4 opening function, restore the factory settings and the drive restarts automatically.

4. language selection

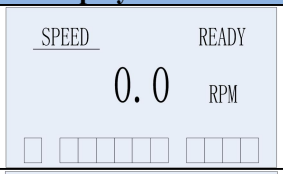
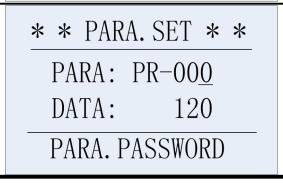
Display interface	Description of screen content
Layer: Language selection 	In Layer-2, select Chinese or English via the key Up / Down. Press Enter to enter Layer-3 to open the function
Layer: Language use 	The language is switched to English mode.

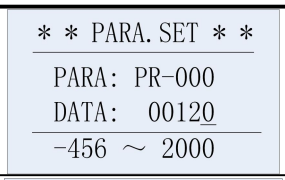
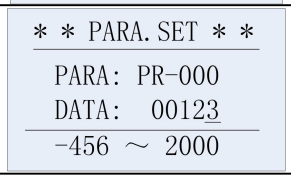
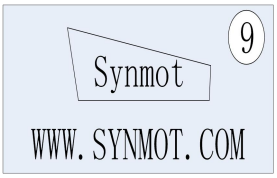
5.3.4 Operating example of LCD

Example 1: Dynamic zero setting First disconnect the motor from the load， or fully release the overflow valve in case of hydraulic system to ensure the motor is not loaded.

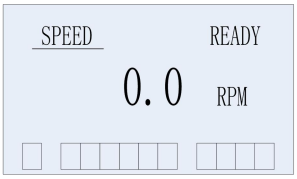
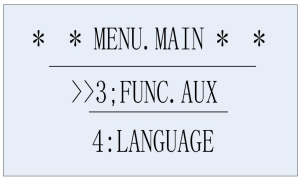
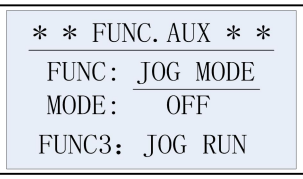
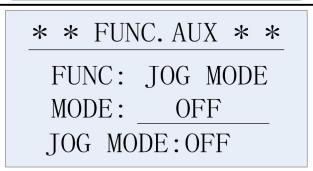
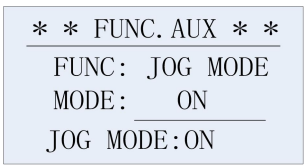
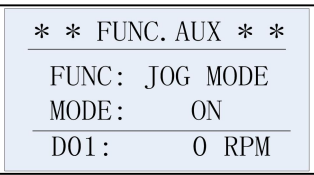
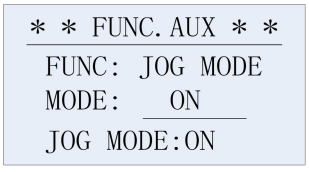
Display interface	Description of screen content
	1: At the readiness state of drive
	2: Enter the main menu to select the auxiliary function
	3: Enter the auxiliary function menu， and select Auto zero/Auto tune
	4: Select Mode I - dynamic zero setting in the auxiliary function menu mode
	5: Press the key Enter to enter Layer-4 to start the function.
	6: Conduct ServoON signal to start up the automatic zero setting. After the zero setting is successful, it will restart automatically.

Example 2: Parameter modification

Display interface	Description of screen content
	1: At the state of readiness or alarming in Layer-0 menu
	2: Enter the main menu to select the parameter setting
	3: First set up the parameter number

	4: Press the key Enter to set up the parameter value
	5: Press the key Enter, then the modification of parameter takes effect and it returns to the parameter number setting.
	6: The above are for the modification of password. The modification of application parameter is identical to the procedure above. After the modification of parameters are completed, press the key DATE/RESET to save the parameter and restart up the drive.

Example 3: Jog running

Display interface	Description of screen content
	1: The state of readiness in Layer-0 menu is as shown in Figure
	2: Press the key Up △ to select the auxiliary function.
	3: Press the key Up △ to select the jogging running function.
	4: Press Enter ENTER to enter Layer-3.
	5: Press the key Up △ to select ON as shown in Figure
	6: Press Enter ENTER to enter Layer-4 to open the function.
	7: Open the enabling and press ▲to accelerate the running or press ▼ to decelerate the running. Close the enabling and press ESC to exist Layer-4 to close the jogging running function. **Note:** The enabling must be closed firstly, then press ESC to close the jogging running function.

5.4 Others related to display

5.4.1 Password

To modify the parameter, save the data and automatically tune etc the password must be entered firstly and the following is the standard password:

123 -- allow to modify the user parameters and allow operating EEPROM

-456 -- allow to modify the internal parameters and allow operating EEPROM

125 -- allow load the drive factory settings

150 -- allow drive reset

-112 -- allow read drive alarm codes

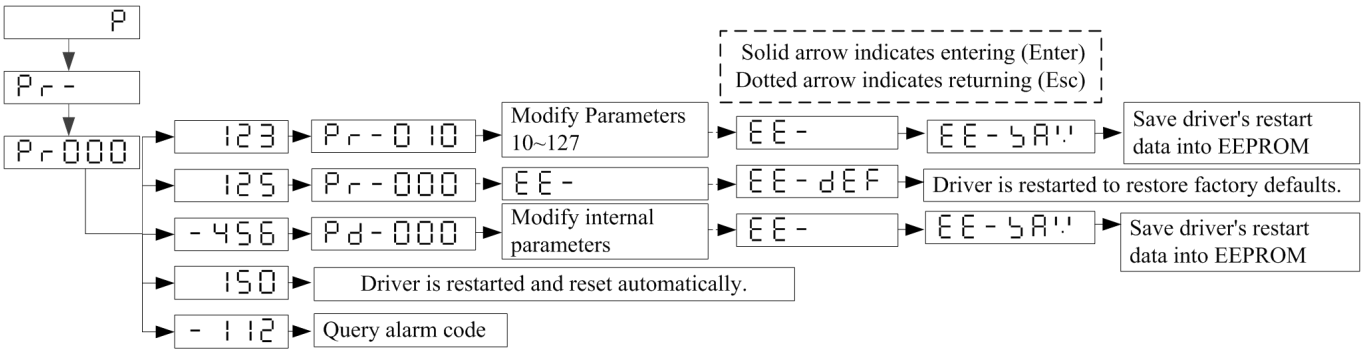


Figure 5.1 Diagram of password operation

5.4.2 Monitoring code

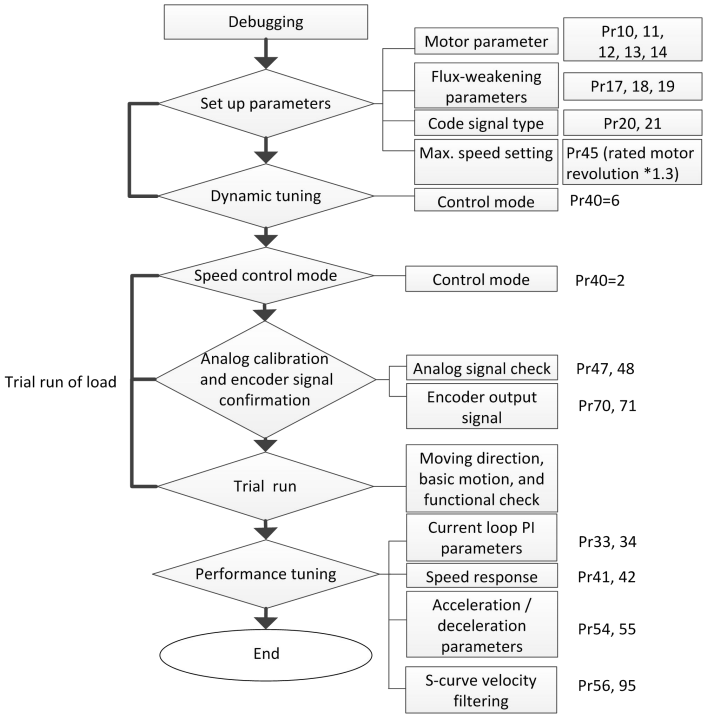
Monitoring code	Name	Precision		Monitoring code	Name	Precision
dP-00	Motor speed	1 RPM		dP-15	Output terminal status	—
dP-01	Speed setting	1 RPM		dP-16	Cumulative working time	1 H
dP-02	Output current	0.1 A		dP-17	Cumulative power-on time	1 H
dP-03	Output power	0.1 kW		dP-18	Analog output of DAC1	0.001 V
dP-04	Output torque	0.1 Nm		dP-19	Analog output of DAC2	0.001 V
dP-05	Drive temperature	0.1 DEG		dP-20	AD1 (corrected)	0.001 V
dP-06	Motor temperature	0.1 DEG		dP-21	AD2 (corrected)	0.001 V
dP-07	DC bus voltage	0.1 V		dP-22	AD3 (corrected)	0.001 V
dP-08	Output voltage	0.1 V		dP-23	Position error	1 ppr
dP-09	AD1 (before correction)	0.001 V		dP-24	Low 16-digit of input pulse number	1 pulse
dP-10	AD2 (before correction)	0.001 V		dP-25	High 16-digit of input pulse number	1 pulse
dP-11	AD3 (before correction)	0.001 V		dP-26	CAN communication status	-
dP-12	Electrical angle	0.1°				
dP-13	Rotor position	0.1°				
dP-14	Input terminal	—				

Chapter 6 Operation and Testing

6.1 Trial operation

6.1.1 Procedure of trial operation

Note: Please conduct the trial operation after the wiring is completed!

Procedure	Item	Content	Example of speed mode control setting
1	Inspection	Inspection before trial operation and precautions	
2	Wiring	Check the connection and status of input signals	
3	Before and after power-in	Switch on the power supply. Please use the panel to check whether there is any abnormality.	
4	No-load run	Jogging run	
5	Check of no-load signal	Trail run via the command of upper controller	
6	Trial run of load	Trial run with speed control	

6.1.2 Method of no-load trial run

1) Trail run of JOG

Conduct the trial run of jogging running directly on the panel. Connect the servo enabling terminal of CN2 and the motor. After powered on, the panel displays that the state “P” blinks, set the control mode Pr-40=2 (speed control) and set Pr-49=50 (jogging speed). Enter the jogging mode via 5.3.3, the panel displays "Jog" and set ServoON signal. Press UP or DOWN to jog forward or reversely.

2) Trial run of motor during zero setting

⚠	**Note:** Usually, it needs not to set the zero for the system provided by Synmot. Nevertheless, if it needs to set up the zero indeed, please separate the motor and the load. The motor shaft cannot carry any load, otherwise, the zero position of the encoder after automatic setting will have a big error.

After the motor is connected and powered on, the panel displays that the state “P”blinks, set Pr-40=6 or Fn- AuT, enter the zero setting mode (see details in **5.3.3**). After the ServoON signal is set, the panel displays "bBBBBP". If the zero setting is proper, the motor will rotate for 40 seconds at the speed of 500rpm. After automatic restart, the zero value will be automatically written into EPPROM.

6.2 Setting of basic functions

6.2.1 Setting of motor rotating direction

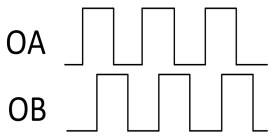
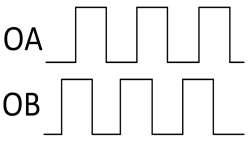
1) Setting of functional parameters

The basic function is a function set to match the upper controller and the relevant function codes are as follows:

Parameter code / encoding	Name	Set range	K ratio	Setting	Setting take effect	Control mode
Pr-60	Definition of forward direction	0~1	1	0	ServoOFF	P, S, T
Pr-61	Direction of rotation	0~2	1	0	ServoOFF	P, S, T
Pr-22	Motor zero position	0.0~359.9	10	3300	Automatic	P, S, T
(DI) FunIn.3	Dir. Control	0~24	1	3	ServoOFF	S
(DI) FunIn.20	CCW_Run_Enable	0~24	1	20	ServoOFF	S
(DI) FunIn.21	CW_Run_Enable	0~24	1	21	ServoOFF	S

Note: Control mode: P (position control), S (speed control), T (torque control)

2) Output direction of encoder feedback pulse

Motor rotating direction	Setting of function codes	Description	Output direction of encoder feedback pulse	Remarks
	Pr60=0 (Default)	Forward direction: CCW; Motor power lines: U, V and W	 Phase A is lead Phase B by 90	Facing shaft end CCW
	Pr60=1	Forward direction: CW; Motor power lines: U, W and V	 Phase B is lead Phase A by 90°	Facing shaft end CW

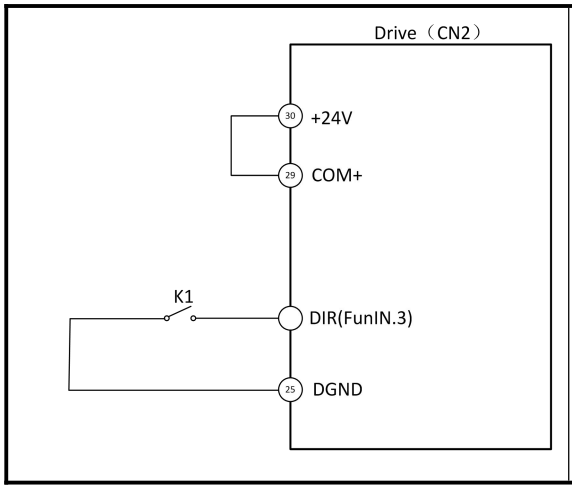
3) Change rotating direction

Method 1: Change the direction via FWD definition parameter,

Set the ServoON signal active and send out the command of low speed to check the rotating direction of motor. If the rotating direction is opposite to the expected, the value of parameter Pr-60 need be changed. Meanwhile, change the 3-phase connection wire from U, V, W to U, W, V. Then change the motor zero position from 330º (internal: 3300 to 30º (internal: 300). *The motor zero value can also be obtained through automatic zero setting.*

Method 2: Switch the direction via DI terminal (single-line type operating mode 1)

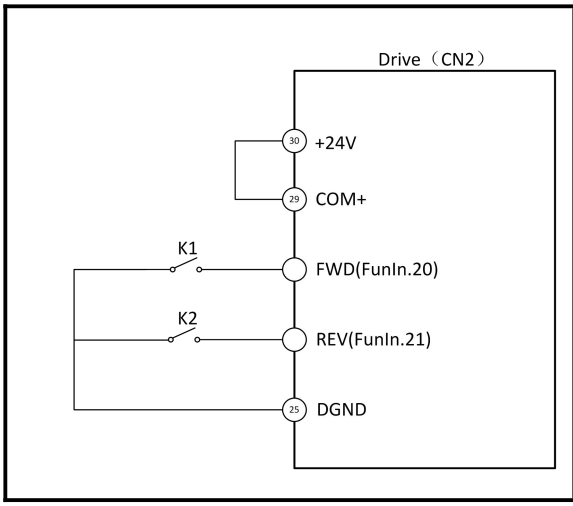
a. Set the ServoON signal active, and send out the command of low speed to check the rotating direction of motor. If it needs to change the direction, set the DI terminal corresponding to FunIn.3 to low level and check whether the direction is changed.



K1	Operating command
0	Forward direction
1	Reverse direction

0: the switch is open (Open)
1: the switch is closed (Close)

b. DI terminal CCW Enable and CW Enable (two-line type operating mode 2)



K2	K1	Operating command
0	0	Stop
0	1	Forward dir.
1	0	Reverse dir.
1	1	Undefined

0: the switch is open (Open)
1: the switch is closed (Close)

Method 3: Using the external analog voltage AIN1 changes the direction

Set the ServoON signal active, and send out the command of low speed. View the voltage polarity and voltage value in the monitor A1. If it is a positive voltage, the motor rotating direction should be the forward direction. Then, if a negative command voltage is input by the upper controller, the direction will be changed to the negative direction, vice versa.

6.2.2 Brake Control

If the servo motor is used to drive the vertical mechanical load, a servo motor with brake is often used to prevent the load from moving due to gravity when the power supply of the servo unit is off. As shown in Figure 6-1, it can also be used to reduce the large amount of heat generated due to the continuous high locking force outputted by the servo motor. The electromagnetic brake is controlled by the programmable output function FunOut.6. The user can utilize the parameter Pr-67 to set up the delay time. The control sequence is as shown in Figure 6-2.

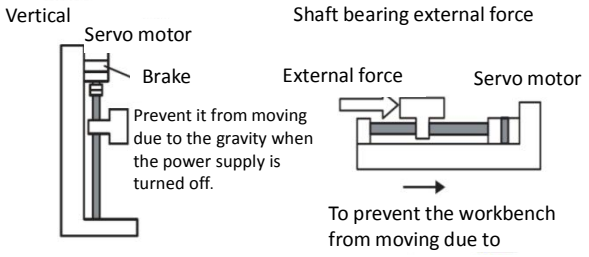


Figure 6-1 Case needing brake

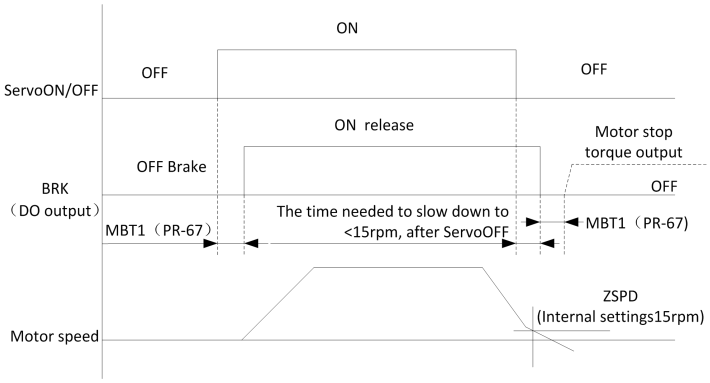


Figure 6-2 Control sequence of brake

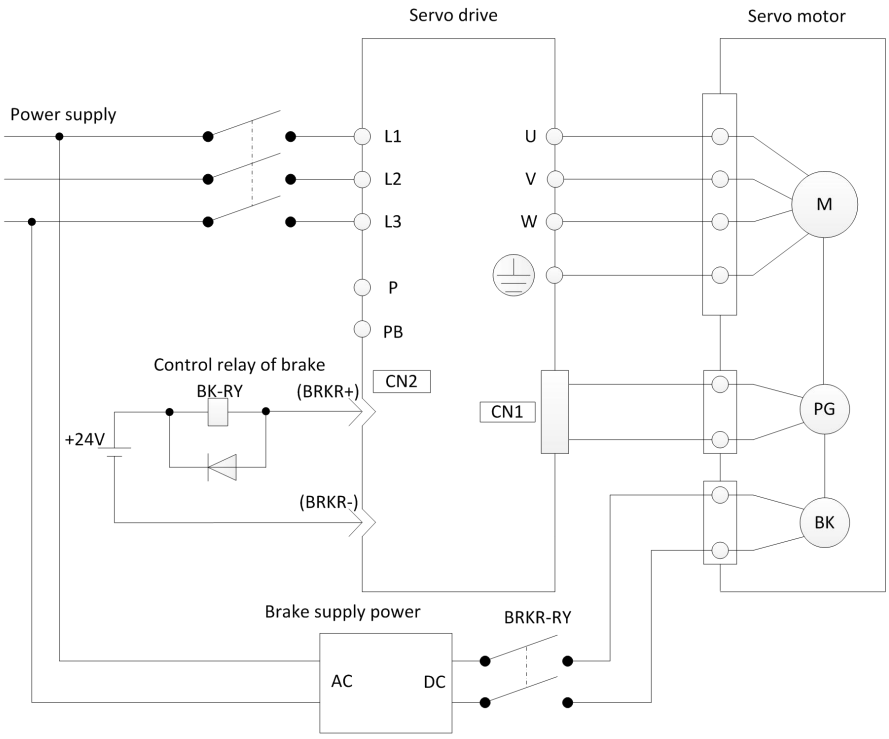


Figure 6-3 Wiring diagram of brake

Code	Name	Function name	Description of setting	Meaning
(DO) FunOut.6	Brake Release	Brake output signal	OUT=L level	Brake is released
			OUT=H level	Brake is locked
When the servo motor with brake is used, the FunOut.6 control signal can control the operation of the brake.				

Note: The brake built in the servo motor is an electrically-release type brake and cannot be used for dynamic braking operation. Please only use it when the servo motor is at the state of stop.

6.2.3 Stop mode

The reasons for motor stop include: ServoOFF, fault and distance overrun. As per various reasons for motor stop, the corresponding stop function codes can be set, different stop mode can be selected.

1） The normal motor stop methods when the servo is OFF including:

Select via the function code Pr-64. The stop methods is set by the function code Pr-64 is:

Function code	Set value	Stop mode	Realization method
Pr-64	0	Free stop, all referred to as free run stop	-
	1	The motor slows down as per the set deceleration and enter the state of free stop	Self-locking time Pr-66=0 Deceleration time Pr-65＞0
	1	The motor slows down as per the set deceleration. Once stopped, the motors will self-lock some time before stopping the torque output. The locking time is defined by the self-locking time.	Self-locking time Pr-66＞0 Self-locking torque Pr-63 Deceleration time Pr-65＞0
			Realized by the function FunIn.2 of IO line Self-locking torque Pr-63 Deceleration time Pr-65＞0

2) Table of function code related to motor stop when ServoOFF

Function code / encoding	Name	Set range	Minimum unit	Set value	Setting take effect	Control mode
Pr-62	Motor self-locking mode	0~3	1	3	ServoOFF	P, S, T
Pr-63	Self-locking current	0~40	1	20	ServoOFF	P, S, T
Pr-64	Stop mode	0~1	1	1	ServoOFF	P, S, T
Pr-65	Stopping deceleration	0~300s	0.01	5	ServoOFF	P, S, T
Pr-66	Self-clocking time	Self-locking time after the motor stops, s	0	3	ServoOFF	P, S, T
(DI) FunIn.2	(DI) Braking Mode Stop then self-locking after ServoOFF	—	1	2	ServoOFF	P, S, T

6.3 Setting of control mode

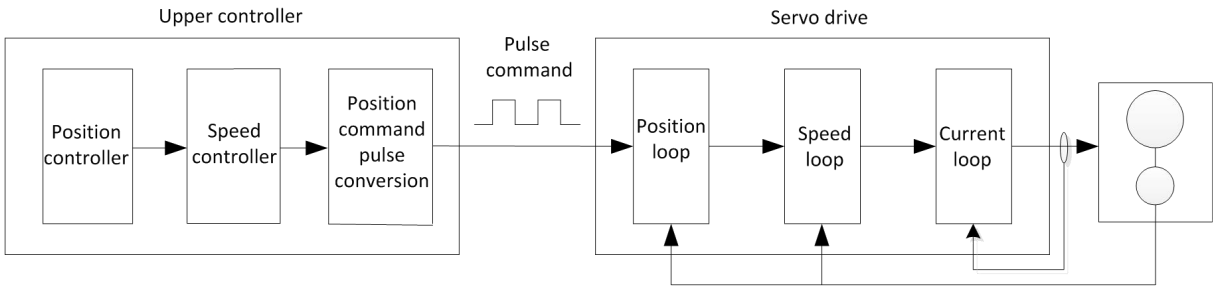
Synmot servo drive provide a diverse control mode to adapt to various applications of automation control. The control mode such as speed control, position control, and torque control, etc. can set and select via the function code Pr-40. Synmot servo drive can also dynamically change the control mode via the IO input signal provided by the user. at the state of P.

Parameter code	Name	Set range	K	Set value	Function description	Code
Pr-40	Control mode	1~11	-	1	Position control (pulse command)	CM1
				2	Speed control (0~10V)	CM2
				3	Speed control (-10~10V)	CM3
				4	Speed control (preset curve)	CM4
				5	Speed control (RS485/CAN2.0)	CM5
				6	Automatic zero setting of system, trial run	CM6
				7	Position control (preset curve)	CM7
				8	Position control (RS485/CAN/EtherCAT)	CM8
				9	Run of speed JOG	CM9
				10	Undefined mode - 2	CM10
				11	Special user control mode 1	CM11

6.3.1 Position control

1) Principle of position control

The pulse signal is normally used as position command. The servo motor is driven that the encoder pulse follows input command pulse. It is also referred to as semi-closed loop control.



2) Position command

The position control command most frequently used is: Pulse command is to conduct the position control to the servo motor in the form of burst. The form of pulse command includes: Differential drive output and open-collector output. It is recommended to use the differential output. It has a strong resistance to interference and the specific circuit refers to Section 4.3.5.

The pulse command form supports the forms of pulse + pulse and pulse + direction. The details see Table 4.3 - Signal description of digital / analog signal input terminals.

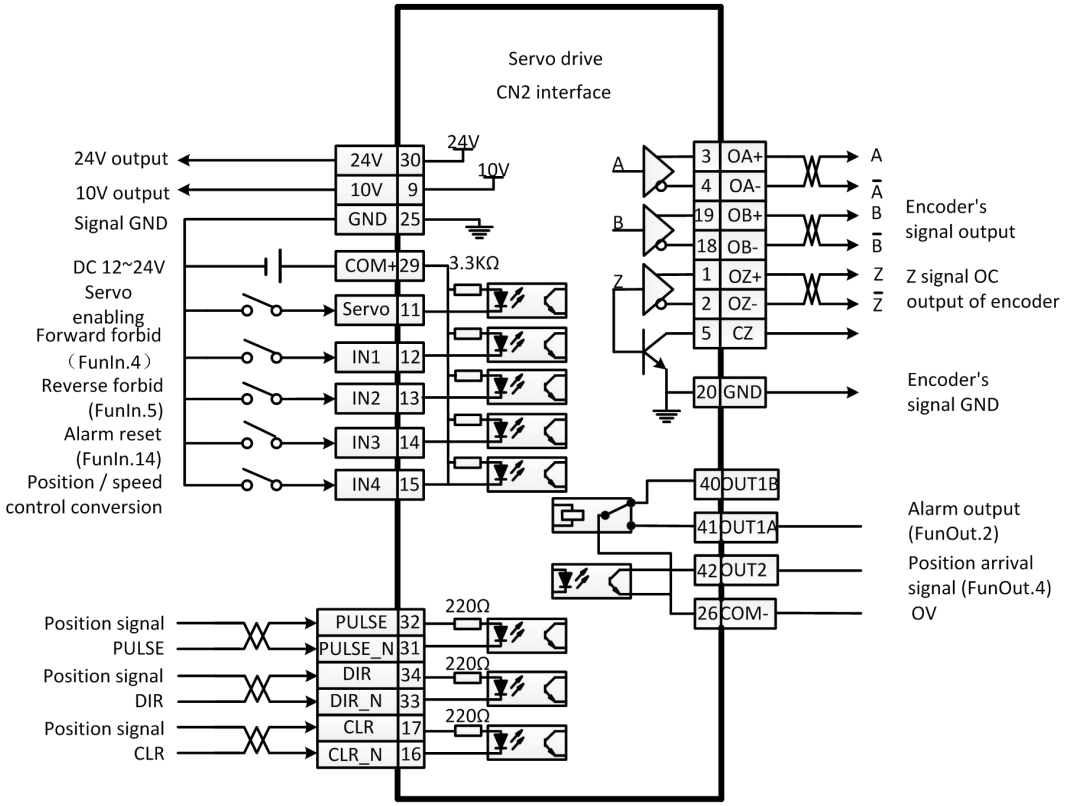


Figure 6.4 Simple wiring diagram of CN2 in position control method

3) Basic parameters of position control

Function code	Parameter name	Set range	K ratio	Set value	Control mode
Pr-40	Control mode	1~11	-	1	P
Pr-70	Encoder output waveform	1: Standard encoder output	1	1	P, S, T
Pr-71	Encoder output pulse frequency dividing ratio	Frequency dividing ratio 1~256	1	1	P, S, T
Pr-72	User input pulse waveform	1: Pulse ＋ Pulse 2: Pulse ＋ Direction 3: Pulse － Direction 4: A+B pulse (quadrature encoder)	1	1	P
Pr-73	Gear ratio A (denominator)	Parameter range: 1~20000 Recommended range: $\frac{1}{120} \le \frac{B}{A} \le 120$ Maximum range: $\frac{1}{1000} \le \frac{B}{A} \le 1000$	1	1	P
Pr-74	Gear ratio B (numerator)		1	1	P
Pr-62	Motor self-locking mode	Parameter range: 0~3 0- Disable: self-locking is not allowed 1-Self-locking mode I: the motor shaft is not allowed to rotate 2-Self-locking mode II: the motor shaft is allowed to rotate slowly; 3-Self-locking mode III: the self-locking current adapts automatically	1	3	P, S, T
Pr-63	Self-locking current (%)	Parameter range: 1~70% , default: 25% Adjust the locking force	1	25	P, S, T

4) Setting of electronic gear ratio

■ Definition of encoder resolution: the total number of encoder output pulse increments during one circle

Quadrature incremental encoder: encoder resolution＝Number of encoder lines ×4

for example, 2500-wire encoder, resolution =10000

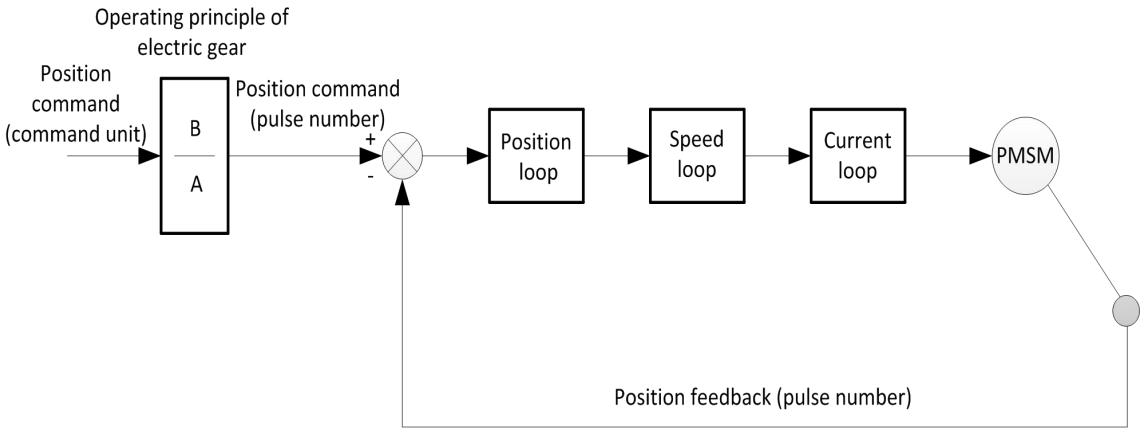
Serial encoder: encoder resolution＝2^n , n: encoder bit number

for example, 17-digit encoder, resolution =131 072

■ $$\frac{B}{A}=\frac{Pr-74}{Pr-73}=\frac{\text{Pulse count of motor encoder}*4}{\text{User pulse count}}=\frac{\text{Pulse of motor encoder}*4}{\text{Displacement after the rotates one cycle (command unit)}}\times\frac{m}{n}$$

■ Reduction ratio between the motor shaft and the load is m/n (motor rotates m circles and load rotates n circles), the range of parameter A and B: 1~20000, range of gear ratio: $\frac{1}{1000}\le\frac{B}{A}\le 1000$. If out of the range, the servo system cannot operate normally. Please change the mechanical structure or command unit. If the gear ratio B/A is selected to be close to 1, the system control precision will be better.

■ Operating principle of electric gear



■ Second and third electronic gear ratio

In the most applications, the user only needs one electronic gear ratio to satisfy the requirements of system. The electronic gear ratio is set via the parameter Pr-73 and Pr-74, also referred to as the first electronic gear ratio.

In some special applications, the user can also select the second and third electronic gear ratio via I/O function FunIn.18 and FunIn.19 (selecting the electronic gear). When the I/O function is invalid, the default is the first electronic gear ratio. If valid, it will be the second or third electronic gear ratio. The details are as shown below:

(DI) FunIn.18 (Gear_B_1)	(DI) FunIn.19 (Gear_B_2)	Gear ratio	Instructions
0	0	$\frac{B}{A}$	1. When ServoOFF or SP 00, the ratio can be switched effectively 2. The switching will be invalid when the motor is running.
0	1	$\frac{B}{10\times A}$	
1	0	$\frac{B}{100\times A}$	

0: switch opened; 1: switch closed

5) Gain parameters

- Setting of motor parameter (set before ex-factory and usually not modified);
- Adjustment drive gains

Parameter	Parameter name	Brief description	K
Pr-33	Kp-current loop	PI gain of current loop: Kp, Parameter range: 1~5000	
Pr-34	Ki-current loop	PI gain of current loop: Ki, Parameter range: 1~5000	-
Pr-41	Kp-speed loop	PI gain of speed loop: Kp, Parameter range: 1~5000	-
Pr-42	Ki-speed loop	PI gain of speed loop: Ki, Parameter range: 1~10000	-
Pr-77	Kp-Position loop	Position control gain Kp, parameter range: 0~5000	-
Pr-78	Ks-Position loop	Position control gain Ks, parameter range: 0~2000, it is not recommended to exceed 800	-
Pr-79	Ka-Position loop	Position control gain Ka, recommended value 25	-
Pr-54	Max. acceleration	Max. acceleration limit, the time taken from 0 to 1000rpm.	100
Pr-55	Max. deceleration	Max. deceleration limit, the time taken from 1000rpm to 0.	100
Pr-56	S-curve	S-curve control time, parameter range: 0~3s, default: 0	100
Pr-65	Stop deceleration	Max. deceleration during stop, time from 1000rpm to 0 rpm.	100

6) Gain parameter adjustment

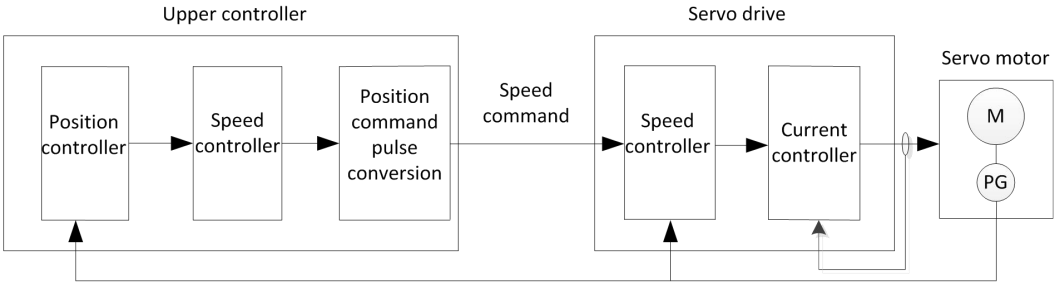
- Speed loop
  - Adjust the speed loop Kp. When ServoON and the motor stands still, adjust the parameter Pr-41 (speed loop Kp). When the motor produces no vibration, increases Kp value. If a vibration is generated, reduce this value to be stable. Then reduce the value by 50 - 100. If a vibration occurs when the motor runs, also need reduce the value.
  - Adjust the speed loop Ki. When the motor is running, if there is overshoot, the parameter Pr-42 (speed loop Ki) can be reduced. In the premise of no overshoot and vibration, the value should be improved as much as possible so as to achieve the best speed response. If an overshoot appears, the deceleration time of the drive command can be increased to solve this issue. When adjusting the parameter Pr-42, the adjustment range shall not be bigger than 50 each time.
- Position loop

  First, set the gain of the speed control loop manually. Then, set the proportional gain (Pr-77) and feed-forward gain (Pr-78) of the position control loop.
  - Kp proportional gain: increase the gain to improve the response bandwidth of the position control;
  - Ks feed-forward gain: it can be increased to reduce the phase lag error;
  - Ka feed-forward gain: it can be increased to improve the deceleration response and reduce the lag error;

6.3.2 Speed control mode

1) Speed control system

It is controlled that the motor speed will follow the servo command, i.e., the analog or digital speed command.



2) Speed command input

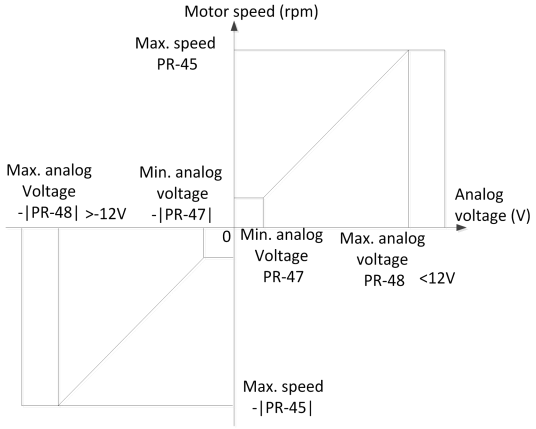


Figure 6-5a Bipolar signal

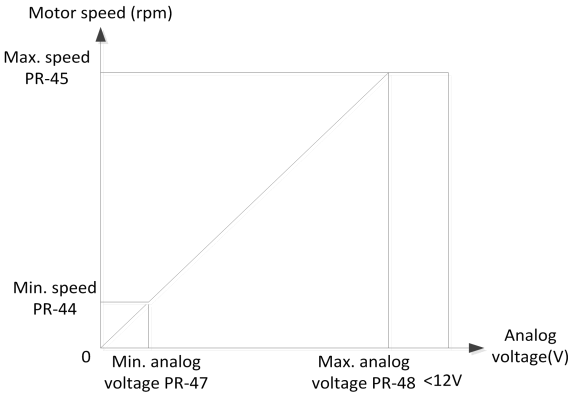


Figure 6-5b Unipolar signal

3) Basic parameters of speed control

Parameter code	Parameter name	Brief description (see details in Chapter 9 - Description of parameter functions)	K note
Pr-40	Control mode	2: Unipolar (0~10V) 3: Bipolar (-10~10V)	-
Pr-44	Lowest rotation speed	Motor lowest speed, rpm, default: 0 (only valid for 0 ~ 10V analog voltage control)	-
Pr-45	Max. speed	Motor highest running speed, rpm.	-
Pr-46	Over-speed limit	Motor over-speed protection limit, rpm >Maximum rotation speed ×120%	-
Pr-47	Min. analog voltage	Used to avoid the error caused by zero drift, default: 0.01V	100
Pr-48	Max. analog voltage	Analog voltage corresponding to maximum speed, default: 9.99V	100
Pr-64	Stopping mode	0: Free operation 1: Ramp+Brake deceleration	-
Pr-70	Motor pulse output	1: Pulse +Pulse ; 2: Pulse＋Direction; 3: Pulse - Direction 4: 2* Pulse＋Direction; 5: 2* Pulse - Direction; 6: No output Range: 1~6, default: 6	-
Pr-71	Frequency dividing ratio	Frequency dividing ratio of motor encoder pulse signal, 1~256	-

4) Wiring diagram of speed control (Bipolar) mode

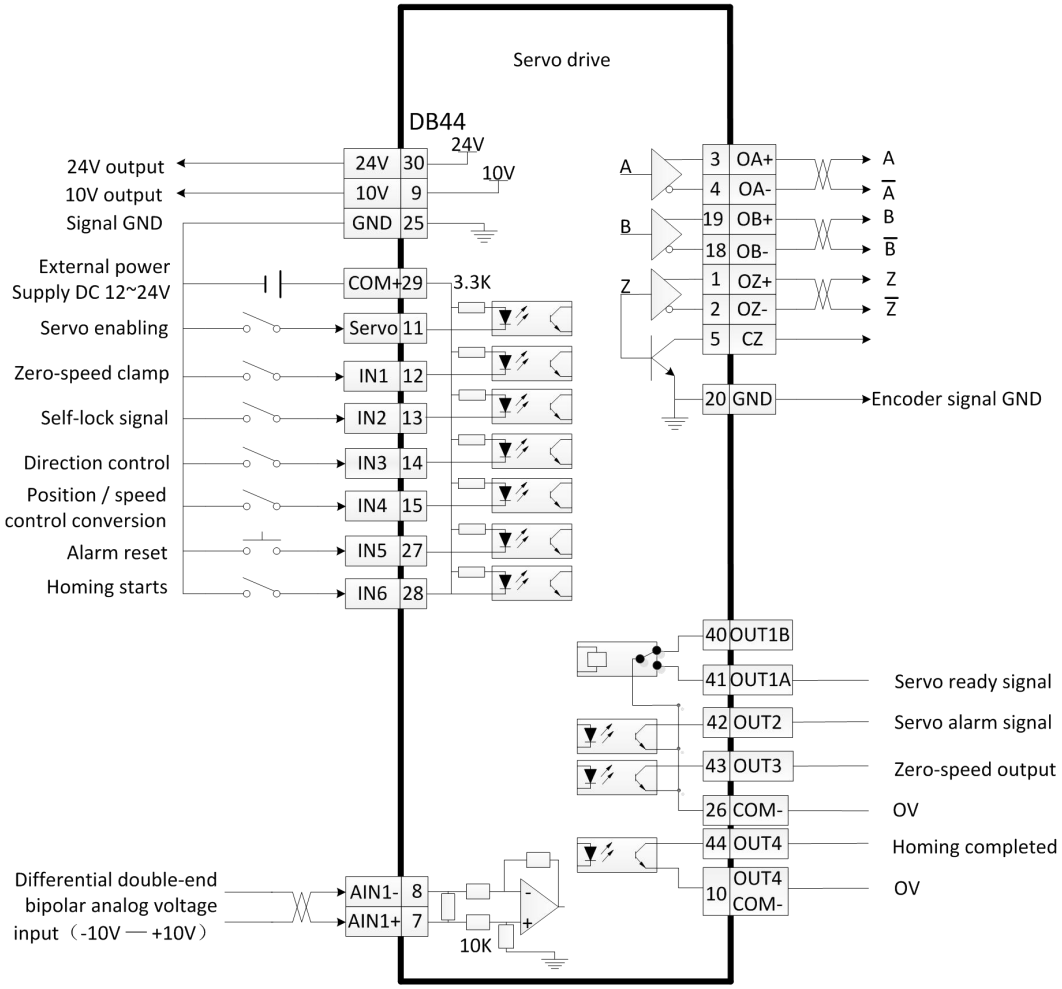


Figure 6.6 Simple wiring diagram of speed control (bipolar) mode

5) Trial operation with speed control

Procedure	Operation
1	Confirm the power and input signal circuit, connect the control power supply and main power
2	Set the servo enabling (ServoON) signal ON. Note: If the speed command is 0V, but the servo motor rotates slowly, please adjust the command until the servo motor will not rotate again
3	The speed command voltage starts to increase gradually from 0V
4	Confirm the speed command value via the speed command
5	Confirm the speed command value via monitor group menu
6	Confirm the values of procedure 4,5 are consistent
7	Change the speed command input voltage and confirm the speed command is consistent with the actual motor rotation speed
8	Confirm the motor rotating direction
9	Restore the speed command input to 0V
10	Allow the servo to OFF Thus, the trail run with speed control is completed

6) Zero-speed clamp

The Zero-speed clamp function means at the speed control mode, if zero-speed clamping (FunIn.1) signal is ON, then the speed command setting is forced to zero, when the corresponding motor speed is below 1rpm, the servo motor will stop immediately and enter the servo locking state.

After the motor stopped, the servo motor will be clamped within ±1 pulse at the position. Even it is rotated by an external force, it will return to the position of zero-speed clamp.

7) Parameters used to control speed

- Setting of motor parameter (set before ex-factory and usually not modified);
- Setting of speed control parameters Note: K is the amplification factor of parameters.

Parameter code	Parameter name	Brief description	K note
Pr-40	Control mode	2: Unipolar (0~10V) 3: Bipolar (-10~10V)	-
Pr-44	Lowest speed	Motor lowest running speed, rpm, default: 0	-
Pr-45	Max. speed	Motor highest running speed, rpm.	-
Pr-46	Over-speed limit	Motor over-speed protection limit, rpm >Maximum rotation speed ×120%	-
Pr-47	Min. analog voltage	Used to avoid the error caused by zero drift, default: 0.1V	10
Pr-48	Max. analog voltage	Analog voltage corresponding to maximum speed, default: 9.9V	10
Pr-64	Stopping mode	0: Free operation 1: Ramp+brake deceleration	-
Pr-71	Frequency dividing ratio	Frequency dividing ratio of motor encoder pulse signal, 1~256	-

8) Adjustment of speed control gain

Parameter code	Parameter name	Brief description	K note
Pr-33	Kp-current loop	PI control parameters of current loop: Kp, Parameter range: 1~5000	-
Pr-34	Ki-current loop	PI control parameters of current loop: Ki, Parameter range: 1~5000	-
Pr-41	Kp-speed loop	PI control parameters of speed loop: Kp, Parameter range: 1~5000	-
Pr-42	Ki-speed loop	PI control parameters of speed loop: Ki, Parameter range: 1~10000	-
Pr-54	Max. acceleration	Max. acceleration limit, the time taken to acc. from 0 to 1000rpm.	100
Pr-55	Max. deceleration	Max. deceleration limit, the time taken to dece. from 1000rpm to 0.	100
Pr-56	S-curve	S-curve control time, parameter range: 0~3s, default: 0	100
Pr-65	Stopping deceleration	Max. stopping deceleration limit, the time taken to dece. from 1000rpm to 0.	100

6.3.3 Spindle homing function

The Spindle homing function realizes the servo system to rotate to the home/zero point. It can be used in the CNC machine.

■ **Basic parameter setting**

Parameter code	Name	Set range	K	Set value	Setting take effect	Control mode
Pr-40	Control mode	0~11	-	3	ServoOFF	S, T
Pr-24	Stop position control	0~2	1	1	ServoOFF	P
Pr-25	Stop position angle	-359.9°~359.9°	10	-	ServoOFF	P
Pr-28	JOG speed	-10000~10000	1	100	ServoOFF	S, T
Pr-75	Min. position error	1~65000	100	3	ServoOFF	P
(DI)FunIn.17	GoStopPosition	-	-	17	ServoOFF	P

■ **Operating steps**

1. Refer to Figure 6.5 - Wiring diagram of speed control method.
2. Connect the main power supply, the drive displays P, and can enter the parameter layer Pr, set the parameters related to directional function.
3. Set dp-13 in the keypad panel, display the angle and monitor the real-time change of motor rotor position.
4. To save an accurate position information, turn off the drive by set the enabling signal to ServoOFF first. Manually rotate the motor shaft to be consistent with the position. If this position angle value is displayed as 315.4, write the angle value *K=3154 into Pr-26 and save.
5. Set the enabling signal to ServoON, meanwhile set the Spindle homing (FunIn.17) DI signal. The motor rotates to the stop angle (Pr-26) at the JOG speed (Pr-28). If the position error is smaller than the limit (Pr-75), the system will send out the position arrival (FunOut.4) signal and self-lock the motor shaft until the spindle homing (FunOut.17) DI terminal is disconnected.

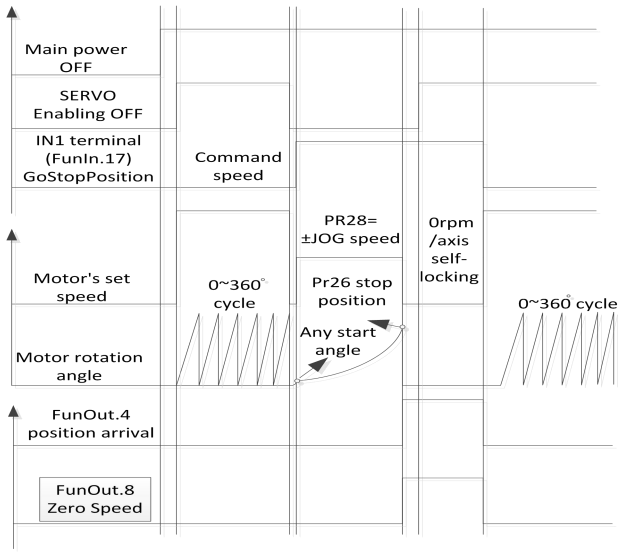


Figure 6-7 Sequence of homing control

6.3.4 Torque limit / torque control mode

In the torque control mode, the output torque of motor can be limited to protect the machine equipment. Synmot servo drive can realize the dynamic torque limitation, i.e., torque control, the output torque limitation varies with the change of AIN2 analog voltage. It can also trigger the torque limitation via IO line.

When the analog voltage signal is selected to control the torque, the unipolar analog voltage AIN2 corresponds to the torque limitation, the bipolar analog voltage AIN1 corresponds to the speed command. During the normal usage, the minimum voltage corresponds to the minimum torque output and the maximum voltage corresponds to the maximum torque output, in a proportional relation. The min. voltage can also correspond to the max. torque, showing an inversely proportional relationship. The specific parameter configuration is as shown in below Table.

Function code	Parameter name	Set range	K	Set value	Function description
Pr-40	Control mode	1~11	-	3	Speed control (-10~10V)
Pr-36	Forward torque limitation and adjust mode	-100~100%	1	-1	**IO port torque control:** Pr-36 > 0 Pr-36 and Pr-37 are respectively the forward and reverse torque limit value expressed as the percentage of the maximum torque. **Dynamic torque limit:** Pr-36= -1 or -100 The torque limit changes as the change of AIN2. Pr-36=-1 proportional adjustment Pr-36=-100 inversely-proportional adjustment
Pr-37	Reverse torque limit	0~100%	1	100	
(DI) FunIn.12	+Torque Limit	-	-	12	The maximum torque limit can start to limit the output torque only when the digital input line + / - Torque Limit is valid.
(DI) FunIn.13	-Torque Limit	-	-	13	

1) Principle of torque control

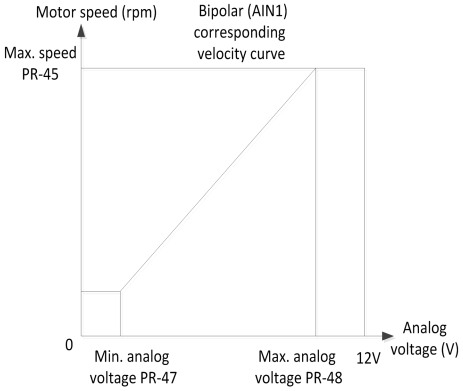


Figure 6-8a AIN1 and speed limitation

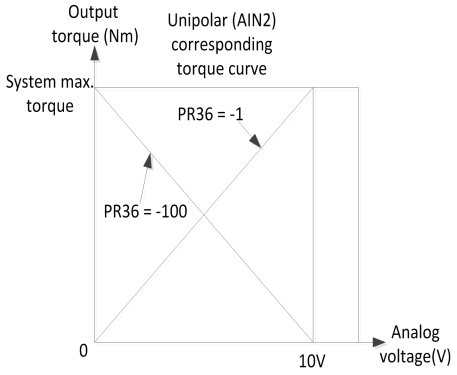


Figure 6-8b AIN2 and torque limitation

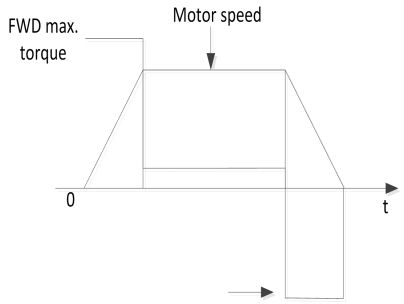


Figure 6-8c No-torque limitation

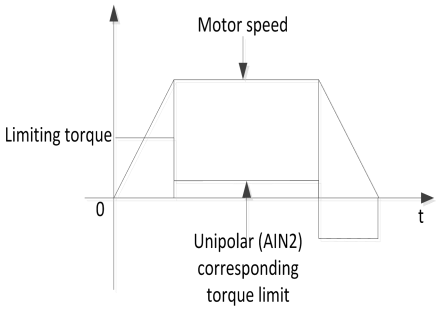


Figure 6-8d With torque limitation

2) Wiring used in dynamic torque limitation

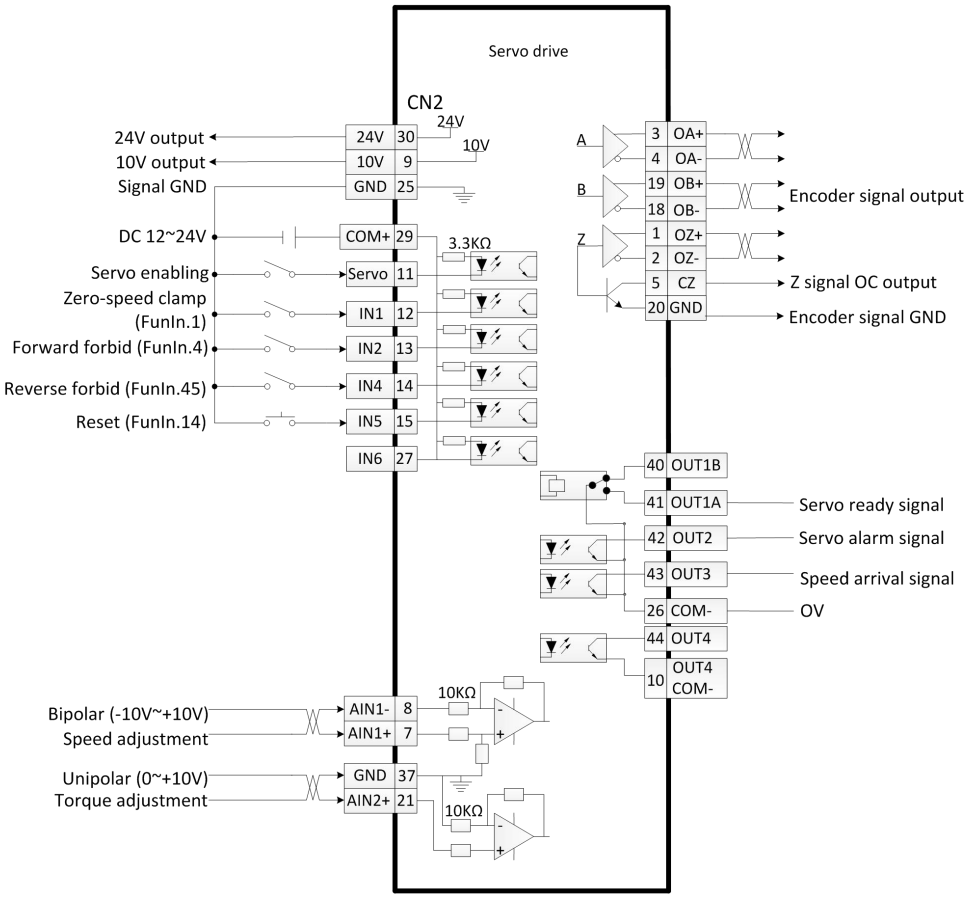


Figure 6.9 Wiring diagram in torque limitation (unipolar) mode

3) Wiring used in digital IO torque limitation mode

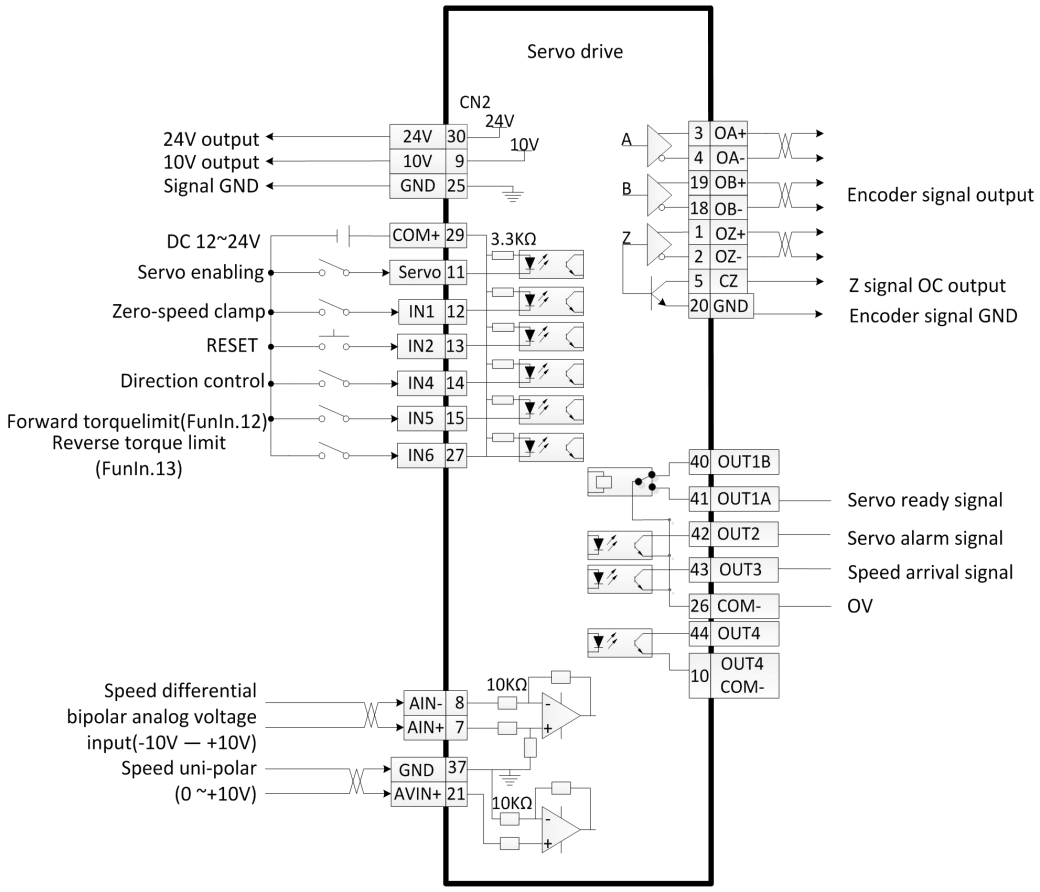


Figure 6.10 Wiring diagram in torque limitation (digital input) mode

Chapter 7 Fault diagnosis and maintenance

	Special notes
⚠	The chapter introduces the faults possible to happen during the setting operation and fault diagnosis in brief. ● The personnel attending the maintenance must possess the relevant professional knowledge and ability; ● The servo drive and servo motor can only be touched at least 5 min after the power is cut off in order to avoid electric shock or burns; ● Once the drive alarms for protection, the fault must be analyzed carefully based on the alarm/error code before the drive is used; ● After the check is completed and before the clear alarms, please confirm the enabling line is OFF in order to avoid the abrupt start-up resulting in accident; ● Any person not authorized by our company is forbidden to open the motor or drive to inspect the inside in order to prevent a safety accident; ● If a person not authorized by our company opens the motor or drive to inspect the inside that results in a damage, our company will not guarantee the warranty service.

7.1 Fault diagnosis

- Synmot servo drive were designed with comprehensive alarming protection function. When one of the protections is activated, the drive will cut off the power output and output the alarming prompt. Now, the drive must rest or power on again before being possible to exit the protection mode.
- Before power-on again, please ensure to carefully inspect the servo drive and servo motor as per the prompt of error codes in order to prevent the drive or motor from any damage due to repeated fault.
- The drive contains a large capacitor inside. Within 5 minutes after the drive is powered off, a high voltage may still exist inside. Thus, please ensure not to contact or connect a wire in this period for your safety.
- The alarm code, alarm name, operating status, possible alarm reason and handling method are as shown in **Appendix IV**.

7.2 Inspection of servo motor

Because the servo motor has no electric brush, it only needs a simple daily inspection. For the ordinary users, it needs to note specifically:

- Dust and cotton fiber etc. In the case of severe dust and cotton fiber, it needs to often inspect the cooling fans of the motor and drive to avoid a blockage;
- Liquid such as water and oil, etc.: Please do not clean and spray the motor or drive directly with water or oil;

The inspection times in below table are the rough standard. The users need judge the actual uses and using environments to determine the most appropriate inspection times.

Inspection items	Inspection times	Inspection and maintenance	Remarks
Confirmation of vibration and sound	Every day	Judge as per feeling and hearing	No increase compared with that as usual
Visual check	According to staining	Swab with cloth or clean with air	—
Measurement of insulation resistance	At least once every year	Disconnect the motor from the drive, use 500V megger to measure the winding insulation resistance. It is normal if the resistance exceeds 10MΩ	If it is below 10MΩ, please consult with the service department of our company.
Replacement of oil seal	At least once every 5000 hours, when used in humid environment	Dismantle the servo motor from the machine, then replace the oil seal.	Only for the servo motor with oil seal
Comprehensive examination	At least 20000 hours or once every 5 years	Please contact with the service department of our company.	The user do not disassemble the motor

7.3 Inspections of servo drive

At the normal environment, it needs not the daily inspection. But it shall be inspected at least once every year.

Inspection items	Inspection times	Inspection and maintenance	Remarks
Cleaning of main body and PCB	At least once every year	No rubbish, dust and oil stains etc	Swab with cloth or clean with air
Loosening of screw		The screws installing the connecting terminals are not allowed to loosen	Fix
Abnormal components		Discoloring, breakage caused by heat	Please contact with the service of our company.

After working under heavy duty and long time, the electric and electronic components may have a mechanical wearing and electric aging. In order to ensure the safety, please check it regularly.

The servo drive after overhaul by our company have been reset to the ex-factory setting of user parameters. Please be ensure to restore the user parameters for using before operation.

Name of component	Standard replacing year	Replacing method, etc	Service conditions
Cooling fan	5 ~ 6 years	Replaced with new fans	Environmental temperature: Averagely 30℃ annually Load rate: Less than 80% Operating ratio: Below 20 hours / day
Large electrolytic capacitor	7 ~ 8 years	Replaced with new capacitor s (determined after examination)	
Relays	—	Determined after examination	
Electrolytic capacitor on PCB	7 years	Replaced with new PCB (determined after examination)	

Chapter 8 Communication functions

The chapter mainly describes the communication control method of RS485.

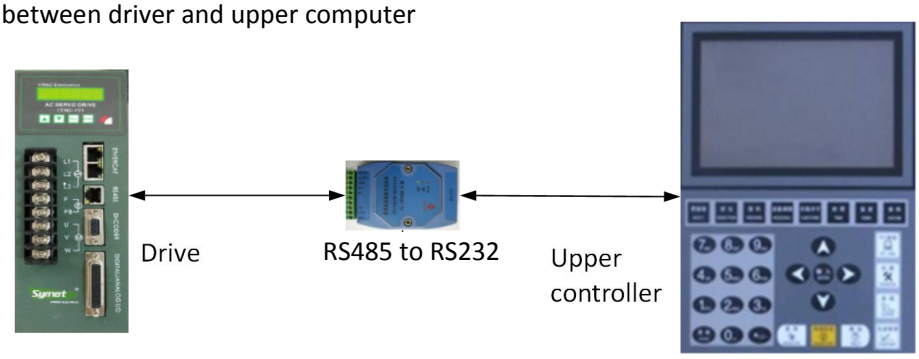
If you need to learn about CANopen or EtherCAT field bus control, please directly contact our company and request the instruction "Communication specification of CANopen/EtherCAT bus" or download its E-version from the website *www.synmot.com*.

8.1 RS485 communication connection

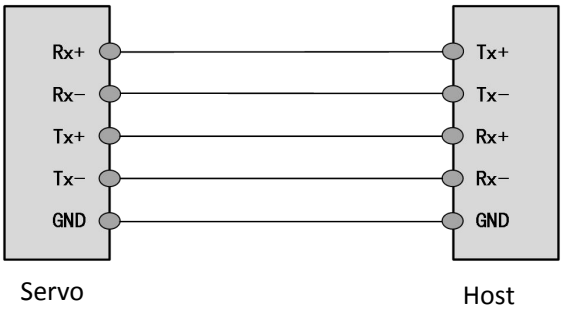
Synmot general-purpose servo drive supports RS485 serial communication. The communication functions can be used to read the operation parameters of drive and upload or download the user parameters. RS485 communication contains two protocols of the standard Modbus and the internal customization protocol, supporting multiple baud rates and can configure via the user parameters as necessary. The upper controller can directly connect with the drive via the serial port if it supports the 485 communication. If the upper controller only supports the RS232 communication, it will need a device to convert RS232 to RS485. The drive can support both 2-wire half-duplex and 4-wire full duplex. The change of connection method needs set the relevant configuration parameters as well.

The connection is illustrated as follow:

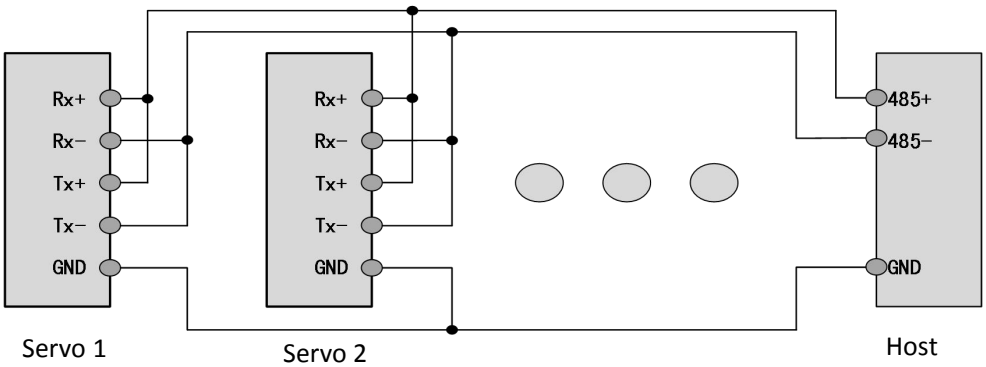
■ Connection between driver and upper computer



■ 4-wire connection



■ 2-wire connection



8.2 Setting of communication parameters

1) Setting of communication mode

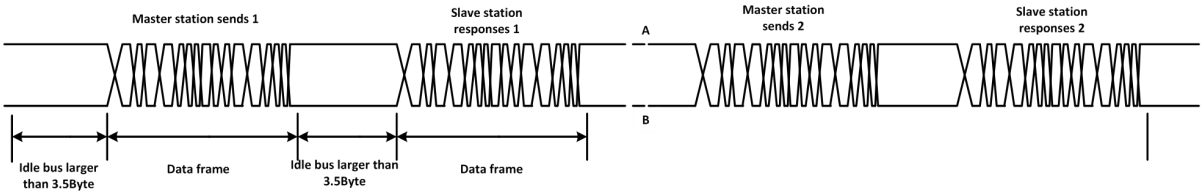
Parameter code	Name	Set range	K	Default	Description
Pr-130	Rs485 Node address	0~255	1	0	The parameter is used to set Modbus node address and select the serial port communication protocol. 0: Modbus is disable and the internal communication protocol is enabled. 1~255: Modbus is enabled and the internal communication protocol is disable. The node address is the parameter value.
Pr-131	RS485 communication mode	0~1000	1	0	The parameter is used to set up the serial port connection method, data format, and Modbus communication mode. Unit: connection method 0: 4-wire connection; 1: 2-wire connection. Decade: data format 0: 8 data bit, 1 stop bit and 0 parity bit. 1: 8 data bit, 2 stop bit and 0 parity bit. 2: 8 data bit, 1 stop bit and odd parity. 3: 8 data bit, 1 stop bit and even parity. Hundred: Modbus communication mode 0: RTU mode 1: ASCII mode. Thousand: Reserved

2) Setting of communication baud rate

Parameter code	Name	Set range	K	Default	Description
Pd-062	Setting of serial baud rate	0~1000	1	0	Parameters used to set the serial communication baud rate. Unit: RS485 communication Baud rate (bps) 0: 115200 1: 9600 2： 14400 3: 19200 4： 38400 5: 57600 6： 115200 Decade: Reserved Hundred: CAN communication Baud rate

	**Note:** The communication rate of the servo drive must be consistent with the communication rate of the upper controller, otherwise, the communication will not be possible.

8.3 Modbus communication protocol



Modbus communication needs the bus idle at least for 3.5-bytes time before the new transmission can start. The servo drive supports MODBUS RTU protocol and can perform the operation of reading (0x03), writing 16-bit data (0x06) and writing 32-bit data (0x10).

1、 Read function (0x03)

Request frame format:

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code, 0x03
DATA[0]	Parameter group number of initial point, for example, function code: 01-02, 01 is No. 01 group
DATA[1]	Parameter code offset of initial point, for example, function code: 01-02 where 02 is the 2nd digit of parameter of No. 01 group
DATA[2]	Quantity of read data (high 8-bit)
DATA[3]	Quantity of read data (low 8-bit)
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

Respond to frame format:

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code, 0x03
DATALENGTH	Number of bytes of data, equal to the number of read function codes*2
DATA[0]	Value of initial function codes (high 8-bit)
DATA[1]	Value of initial function codes (low 8-bit)
DATA[…]	
DATA[N*2-1]	Value of final function codes (low 8-bit)
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

2. Write 16-bit data (0x06)

Request frame format:

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code, 0x06
DATA[0]	Number of written function group, for example, function code: 02-04 where 02 is the second group of parameter
DATA[1]	Offset of written function code, for example, function code: 02-04 where 04 is the fourth digit of parameter of No. 02 group
DATA[2]	Write data (high 8-digit)
DATA[3]	Write data (low 8-digit)
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

Respond to frame format:

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code, 0x06
DATA[0]	Number of written function group, for example, function code: 02-04 where 02 is the second group of parameter
DATA[1]	Offset of written function code, for example, function code: 02-04 where 04 is the fourth digit of parameter of No. 02 group
DATA[2]	Write data (high 8-digit)
DATA[3]	Write data (low 8-digit)
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

3. Write 32-bit data (0x10)

Request frame format:

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code, 0x10
DATA[0]	Number of written function group, for example, function code: 03-01 where 03 is the third group of parameter
DATA[1]	Offset of written function code, for example, function code: 03-01 where 01 is the fourth digit of parameter of No. 03 group
DATA[2]	Reserved, 0x00
DATA[3]	Reserved, 0x00
DATA[4]	High 8-bit of high 16-bit of written data
DATA[5]	Low 8-bit of high 16-bit of written data
DATA[6]	High 8-bit of low 16-bit of written data
DATA[7]	Low 8-bit of low 16-bit of written data
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

Respond to frame format:

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code, 0x10
DATA[0]	Number of written function group, for example, function code: 03-01 where 02 is the third group of parameter
DATA[1]	Offset of written function code, for example, function code: 03-01 where 01 is the fourth digit of parameter of the third group
DATA[2]	Reserved, 0x00
DATA[3]	Reserved, 0x00
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

4. Error response frame

START	Equal to or larger than 3.5 byte idle time, indicating one frame starts
ADDR	Node address 0x01~0xF7
CMD	Command code 0x03/0x06/0x10
DATA[0]	0x80
DATA[1]	0x01
DATA[2]	High 8-code of error code
DATA[3]	Low 8-code of error code
CRCL	CRC check code (low 8-bit)
CRCH	CRC check code (high 8-bit)
END	Equal to or larger than 3.5 byte idle time, indicating one frame ends

Error code

Error code	Error description
0x0002	Command code is 0x03/0x06/0x10
0x0004	CRC check code of data frame received by the servo is not equal to the check code in the data frame
0x0007	The start point and data length of data read are unreasonable
0x0008	The function code accessed does not exist
0x0010	The value that a function code is written into exceeds the upper / lower limits of function codes.
0x0020	The function code written is read-only function code
0x0040	The length of the read data exceeds the allowable value
0x0060	The length of the read data is shorter than 1
0x0080	The written function code can only by modified at the state of servo stop and the servo is under the operating state now

5. Calculation of CRC value

- Preset one 16-digit register to 0FFFFH (total 1), being referred to as CRC register.
- Conduct XOR operation to the 8 bits of the first byte of the data frame and the low byte in CRC register and save the result back to CRC register.
- Move CRC register by one digit to the right, fill 0 in the highest bit and shift out the lowest bit to test.
- If the lowest bit is 0: Repeat the third step (next shift); if the lowest bit is 1: Conduct XOR operation to CRC register and one preset fixed value (0A001H).
- Repeat the third step and the fourth step until 8 times of shift. In this way, a complete 8 bits are processed.
- Repeat Step 2 to Step 5 to process the next 8 bits until all the bytes are processed completely.
- Finally, the value of CRC register is the value of CRC.

8.4 Modbus parameter group

Description of 01 group parameters (16-bit, read-only):

No.	Variable name	Description of variable	Magnification
01-01	DC Bus voltage (V)	The real-time busbar voltage of the drive	16
01-02	Pressure setting (MPa)	Pressure setting (used in hydraulic control mode)	10
01-03	Pressure feedback (MPa)	Pressure feedback(used in hydraulic control mode)	10
01-04	Id current adjustment (A)	Id current adjustment	1
01-05	Phase A current (A)	Output current of phase U of drive, Ia	Remark 1
01-06	Phase B current (A)	Output current of phase V of drive, Ib	Remark 1
01-07	Phase C current (A)	Output current of phase W of drive, Ic	Remark 1
01-08	Id current (A)	Id current	Remark 1
01-09	Iq current (A)	Iq current	Remark 1
01-10	Id current set (A)	Id* current	Remark 1
01-11	Iq current set (A)	Iq* current	Remark 1
01-12	Electrical angle (˚)	Electric angle of motor	8192/360
01-13	Rotor position (˚)	Mechanical angle of motor	8192/360
01-14	User zero degree (˚)	User zero degree (for special mode)	1
01-15	Ud set (V)	Ud*	16
01-16	Uq set (V)	Uq*	16
01-17	Drive temperature (℃)	Heatsink temperature of drive	32
01-18	AD1 voltage (V)	Voltage of analog input channel 1	512
01-19	Motor temperature (℃)	Winding temperature of motor	32
01-20	AD2 voltage (V)	Voltage of analog input channel 2	512
01-21	Digital input	State of digital input port: Unit: IN0; decade: IN1	1
01-22	Digital output	State of digital output port: Unit: OUT1; decade: OUT2	1
01-23	State of drive	1: Preparation; 2: Self-locking; 3: Operation; 4: Field-weakening; >10: error	1
01-24	Z signal error	Accumulated value of encoder Z signal error	1
01-25	Encoder signal error	Encoder pulse number every cycle is not consistent.	1
01-26	Motor speed (RPM)	Motor speed	4
01-27	Speed set(RPM)	Speed set	4
01-28	PWM count	PWM count	1
01-29	Motor speed (RPM)	Integer part of motor speed	1
01-30	Motor speed (RPM)	Decimal part of motor speed	32
01-31	Internal test value 5	Variable for internal test	1
01-32	Internal test value 6	Variable for internal test	1
01-33	Voltage of +24V power (V)	Voltage of +24V internal power	512
01-34	Voltage of +15V power (V)	Voltage of +15V internal power	512
01-35	AD3 voltage value (V)	Voltage of analog input channel 3	
01-36	Voltage of +5V power (V)	Voltage of +5V internal power	512
01-37	Cumulative input pulse number	(Input pulse number high16bit)	16

01-38	Cumulative input pulse number	(Input pulse number low16bit)	16
01-39	Cumulative error pulse number	(Error pulse number high16bit)	16
01-40	Cumulative error pulse number	(Error pulse number low16bit)	16
01-41	Pulse speed	Position pulse frequency corresponds to RPM value	4
01-42	Resolver angle (˚)	Angle information from resolver R2D IC	8192/360
01-43	Position error (ppr)	Position error	1
01-44	Internal test value 3	Variable for internal test	1
01-45	Internal test value 4	Variable for internal test	1
01-46	Phase current (A)	Drive output current	Remark 1
01-47	Output power (kW)	Output power of drive	1/6
01-48	Cumulative running time (h)	Cumulative running time of drive	1
01-49	Cumulative power-on time (h)	Cumulative power-on time of drive	1
01-50	Flow setting (V)	Flow setting in volate	512
01-51	AD1 (corrected) (V)	Voltage of analog input channel 1 minus zero drift	512
01-52	AD2 (corrected) (V)	Voltage of analog input channel 2 minus zero drift	512
01-53	AD3 (corrected) (V)	Voltage of analog input channel 3 minus zero drift	512
01-54	DAC1 output (V)	Voltage of DAC channel 1	512
01-55	DAC2 output (V)	Voltage of DAC channel 2	512

Remark 1: 256 (3kW and below), 128 (4kW or above), 64 (30kW or above) and 32 (45kW or above)

Description of 02 group parameter (16-bit):

No.	Variable name	Description of variable	Magnification
02-01	Resetting of the drive	0001: Resetting of the drive	1
02-02	Stop of drive	0001: Stop command	1
02-03	Start of drive	0001: Start command	1
02-04	Reverse running of motor	0001: Reverse running of motor	1
02-05	Position error clearing	0001: Position error clearing	1
02-06	Automatic zero setting of motor	0001: Automatic zero setting	1
02-07	Speed set	xxxx: Speed set	1
02-08			
02-09			

Description of 03 group parameter (32 bits):

No.	Variable name	Description of variable	Magnification
03-01	User pulse input	xxxxxxxx: Number of input pulses	1
03-02			
03-03			
03-04			

Appendix I Description of user parameters

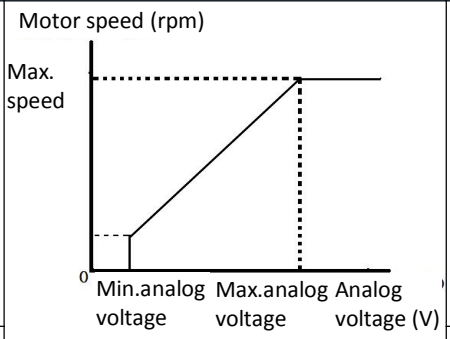
Parameter code	Parameter name	Function	K
Pr-000	Parameter password	Password for certain functions (The parameter cannot be saved.) 120: View the user parameters of drive ... (The specific description is as shown in 5.4.1) Range: -456~2000, default: 120	—
Pr-001	Hardware code	Drive hardware code (not allow to change)	—
Pr-002	Software version	Drive software version (not allow to change)	—
Pr-003	Software year	Year of drive software compiled (not allow to change)	—
Pr-004	Software date	Month/day of drive software compiled (not allow to change)	—
Pr-005	Month/year of drive manufactured	Month/year of drive manufactured (not allow to change)	—
Pr-006	Manufacturing number	SN number of the drive (not allow to change)	—
Pr-007	Rated voltage	Rated input voltage of the drive (V) (not allow to change)	—
Pr-008	Rated current	Rated output current of the drive (A) (not allow to change)	—
Pr-009	Peak current	Peak output current of the drive (A) (not allow to change)	—
Pr-010	Number of the pole pairs of the motor	Number of the pole pairs of the motor 1: 2 pole pairs, 2: 4 pole pairs, 3: 6 pole pairs, 4: 8 pole pairs, ... Range: 1~50pp, and set based on specific motor parameters	1
Pr-011	Line resistance (ohm)	Motor winding line-line resistance (twice phase resistance) If specific motor parameters are unknown, set it as 0 Range: 0~240 ohm, and set based on specific motor parameters	250
Pr-012	D-axis inductance Ld (mh)	Ld of the motor (generally half the motor line inductance) If specific motor parameters are unknown, set it as 0 Range: 0~120mH, and set based on specific motor parameters	500
Pr-013	Q-axis inductance Lq (mh)	Lq of the motor (generally half the motor line inductance) If specific motor parameters are unknown, set it as 0 Range: 0～120mH, and set based on specific motor parameters	500
Pr-014	Back-EMF (V/krpm)	Back-EMF constant (line voltage) If motor parameters are unknown, set it as 0 Range: 0~900 V/krpm, and set based on specific motor parameters	10
Pr-015	Inertia（g-m^2）	System total inertia (the parameters are not used in most application)	100
Pr-016	Motor protection temperature	Max. operating temperature of motor winding. The drive will give an alarm if the threshold is exceeded. Range: 50~160℃, default: 140 (Class-H) and 130 (Class-F)	1
Pr-017	Field-weakening control	Field-weakening control mode Must set the correct motor parameters (if the motor parameters are wrong, the function of weak magnetic will not be activated) 0: No field-weakening control 1: Field-weakening control level 1 2: Field-weakening control level 2 Range: 0~2, default: 2	—

Parameter code	Parameter name	Function	K
Pr-018	Field-weakening Kp regulation	Field-weakening Kp, proportional gain Range: 0~5000, default: 10	1
Pr-019	Field-weakening Ki regulation	Field-weakening Ki, integral gain Range: 0~5000, default: 0	1
Pr-020	Position feedback type	Type of rotor position feedback device 1: Encoder+ (incremental encoder, with 3-phase Hall signals) 2: Encoder (incremental encoder, without 3-phase Hall signals) 3: Resolver (one-pair-pole resolver) 4: Resolver-P (multi-pair-pole resolver) 5: ABS-1 (SmartABS interface absolute value encoder) 6: ABS-e (Endat interface absolute value encoder) 7: ABS-H (HiperfaceDSL absolute value encoder)	—
Pr-021	Number of encoder lines	Line number of encoder, range: 256~12000, default: 2500 Bit of resolver, range: 2~16, default: 12 Bit of absolute encoder encoder: range: 2~33, default: 17	1
Pr-022	Motor zero position	Encoder or resolver zero position expressed in electrical angle Can be automatically obtained by automatic zero setting Range: -359.9°~359.9°, default: 0	10
Pr-023	User zero degree angle	Rotor zero-position defined by users so that the drive can display rotor angle based on user's requirements (mechanical angle) Range: -359.9°~359.9°, default: 0	10
Pr-024	Stop position control	Parameter for special control mode. Please refer to the corresponding document of application. Range: 0~2, default: 0	-
Pr-025	Enable position (deg)	Parameter for special control mode. Please refer to the corresponding document of application. Range: -32000~32000, default: 0	1
Pr-026	Stop position (deg)	Parameter for special control mode. Please refer to the corresponding document of application. Range: -32000~32000, default: 0	1
Pr-027	Compensation	Compensation for special control mode. Range: -1000~1000, default: 0	-
Pr-028	Highest speed of homing function	The jog speed limit during the course of the homing function corresponding to (DI)FunIn.17	10
Pr-029	Resonance speed	The resonance frequency needing suppression corresponds to the actual motor speed. Range: 0rpm~max. speed, default: 0 (function disabled)	

Parameter code	Parameter name	Function	K
Pr-030	PWM frequency	Setting of PWM switching frequency 1: 4kHz, 2: 6 kHz, 3: 8kHz, 4: 10kHz, 5: 12kHz, 6: 14kHz, 7: 16kHz 10kHz and 12kHz provides the best control performance, 16k makes the motor generate the lowest noise, and 4k makes the drive have the highest efficiency. The current loop PI may need readjustment if PWM frequency is changed. Range: 1~7, default: 2 (above 10kW), 3(below 10kW)	—
Pr-031	Current (%)	To limit the max. output current of the drive (expressed by the percentage of the peak current) Range: 5%~100%, default: 100	1
Pr-032	Max. torque	The parameter does not have corresponding function, default: 0	-
Pr-033	Kp-current loop	PI control parameters of current loop: Proportional gain The greater the parameter is, the faster the current responses dynamically. Too great parameter will cause bigger current ripples, and even generate current oscillation. Adjust it to the maximum and then decrease it by 100. Range: 1~5000, default: 500	1
Pr-034	Ki-current loop	PI control parameters of current loop: Integral gain The greater the parameter is, the faster the current responses. Too large parameter may cause the current overshoot or even current oscillation. Too small parameter will not play the role of removing the static error. Adjust it to the maximum and then decrease it by 100. Range: 1~5000, default: 100	1
Pr-035	Current angle(degree)	Current angle. It is not recommended to be used in normal operation. Parameter range: -30~30°, default: 0	1024
Pr-036	Forward torque limit	Forward/reverse torque limit, expressed by the percentage of the maximum effective system torque. Parameter range: -100~100, default: 0 The specifics are as shown in Section 6.3.4	1
Pr-037	Reverse torque limit		
Pr-038	AD3 Min. voltage	AD3 voltage is used in hydraulic control mode. Range: 0~10V, default: 0.05V	100
Pr-039	AD3 Max. voltage	AD3 voltage is used in hydraulic control mode Range: 0~10V, default: 9.95V	100

<table>
<tr><th>Parameter code</th><th>Parameter name</th><th>Function</th><th>K</th></tr>
<tr><td>Pr-040</td><td>Control mode</td><td>
<table>
<tr><td>1</td><td>Position control (by position pulse)</td><td>8</td><td>Position control (RS-485/CAN2.0)</td></tr>
<tr><td>2</td><td>Speed control (0~10V)</td><td>9</td><td>Panel speed control</td></tr>
<tr><td>3</td><td>Oil pressure control (-10~10V)</td><td>10</td><td>Undefined</td></tr>
<tr><td>4</td><td>Speed control (preset curve)</td><td>11</td><td>Special mode 1</td></tr>
<tr><td>5</td><td>Speed control (RS-485/CAN2.0)</td><td></td><td></td></tr>
<tr><td>6</td><td>Automatic zero setting</td><td></td><td></td></tr>
<tr><td>7</td><td>Position control (preset curve)</td><td></td><td></td></tr>
</table>
Selection of drive control mode:
The user can use the digital IO input to change the predefined speed curve, RS485 control mode or switch between the position mode and the speed mode.
</td><td>—</td></tr>
<tr><td>Pr-041</td><td>Kp-speed loop</td><td>PI control parameters of speed loop: Proportional gain
The greater the parameter is, the faster the motor responses dynamically, but it easily generates speed oscillation. Adjust it to the maximum and then decrease it by 50-100.
Range: 1~5000, default: 500</td><td>1</td></tr>
<tr><td>Pr-042</td><td>Ki-speed loop</td><td>PI control parameters of speed loop: Integral gain
The greater the parameter is, the faster the motor responses dynamically, but it easily generates overshooting. Adjust it to the maximum and then decrease it by 50.
Range: 1~10000, default: 500</td><td>1</td></tr>
<tr><td>Pr-043</td><td>Reaching speed</td><td>The value the speed reaches, which is used with output of signals FunOut.5 at time of the speed reaching the value. When the speed reaches the value, the corresponding digital output port outputs.
Range: 10~15000, default: 1000 rpm</td><td>1</td></tr>
<tr><td>Pr-044</td><td>Lowest rotation speed</td><td>Lowest given rotating speed upon speed control and only effective in the unipolar speed mode.</td><td>1</td></tr>
<tr><td>Pr-045</td><td>Max. speed</td><td>It proportionally corresponds to the maximum analog input voltage. When the analog input is the maximum, the speed is the maximum speed. (Adjust Pr-46 over-speed protection if it is adjusted)
Range: 1~20000 rpm, default: 2100</td><td>1</td></tr>
<tr><td>Pr-046</td><td>Over-speed protection</td><td>Over-speed protection. When the running speed of the motor exceeds the over-speed limit, the drive will give alarm signals and the display outputs alarm ERR 61. (parameter ≥ max. speed ×120%).
Range: 1~20000, default: 3000</td><td>1</td></tr>
</table>

Parameter code	Parameter name	Function	K
Pr-047	AD1, AD2 Min. voltage	Users can use a segment of voltage in analog as the effective input. Setting an appropriate minimum analog voltage can avoid the voltage error caused by zero drift. Range: 0~10V. Default: 0.05V	100
Pr-048	AD1, AD2 Max. voltage	Users can use a segment of voltage in analog as the effective input. The parameter must be greater than the min. analog voltage. Range: 0~10V, default: 9.95V	100
Pr-049	Jogging speed	The speed of the motor in jogging mode (it is the negative speed corresponding to the value for reverse jogging). Range: 0~1000rpm, default: 50rpm	1
Pr-050	Starting mode	Starting mode in sensor less control (Only the designated software version has the function) 0: Open loop start, 1： Normal start mode I, 2: Normal start mode 2 Range: 0~2, default: 0	1
Pr-051	Starting current	Starting current in sensor less control (Only the designated software version has the function). Expressed by the percentage of rated current range: 0%~100%, default: 10	1
Pr-052	Starting time	Self-locking time before entry of normal operation (valid without position sensing or photoelectric Encoder) Range: 0~300 s, default: 0.02S	100
Pr-053	Starting acceleration	Not used, default: 0	
Pr-054	Max. acceleration	Max. acceleration limit, expressed by the time taken to accelerate from 0 to 1000rpm. The smaller the value is, the greater the acceleration is. The value of 0 means that there is no acceleration limit. Range: 0~300 s, default: 0.02s	100
Pr-055	Max. deceleration	Max. deceleration limit, expressed by the time taken to decelerate from 1000 rpm to 0 rpm. The smaller the value is, the greater the dece. is. The value of 0 means that there is no deceleration limit. Range: 0~300 s, default: 0.02s	100
Pr-056	S-curve	S-curve time. Used for smooth acceleration and deceleration to reduce system impact. The greater the value is, the better the effect is, but too great will affect the dynamic response of the system. If the value is 0, there is no S-curve control, range: 0~3s, default: 0.02s	100
Pr-057	Kd-speed loop	Internal PID compensation of speed loop, related with acceleration Range: 0~800, default: 50	1



Analog vs. Speed

Parameter code	Parameter name	Function	K
Pr-058	Low-speed compensation	Integral gain compensation of speed loop (valid for position mode and forced zero speed, in very low speed range) Range: 0~5000, default: 300	1
Pr-059	Parameter reserved	-	-
Pr-060	Definition of forward direction	CCW is forward, CW is reverse (definition of face-up motor shaft) 0: CW. The direction of rotation is CW; the connection of the servo drive's power lines is U, W and V 1: CCW. The direction of rotation is CCW; the connection of the motor power lines is U, V and W	—
Pr-061	Direction of rotation	Limit to direction of rotation, default: both 0: Both (allow the motor to run in the forward and reverse directions) 1: + only (allow the motor to run in the forward direction only) 2: - only (allow the motor to run in the reverse direction only)	—
Pr-062	Motor self-locking	Enabling of motor self-locking control. The parameter needs to be used with self-locking control input signals. 0: Not started (not allow self-locking) 1: Mode I (the motor shaft is not allowed to rotate) 2: Mode II (the motor shaft is allowed to rotate, and the torque of rotation is greater than that in an unself-locked status) 3: Mode III (automatic adjustment of self-locking current)	—
Pr-063	Self-locking current (%)	The current at the time of self-locking when power is on, expressed by the percentage of rated current. Range: 0~100%, default: 25%	1
Pr-064	Stopping mode	Deceleration and stopping mode of the motor after enabling is OFF 0: Free stop (the motor does not output torque and stops freely depending on inertia) 1: Brake stop (The motor slows down as per the set deceleration. Once stopped, the motor will self-lock for the time defined by the self-locking time.) Range: 0~1, default: 0	—
Pr-065	Stopping deceleration	Max. deceleration of stop, expressed by the time taken for the motor to dece. from 1000 rpm to 0 rpm. The smaller the value is, the greater the dece. is. The value of 0 means that there is no deceleration limit. Range: 0~300 s, default: 0.05s	100
Pr-066	Self-clocking time	The self-locking time after the motor is stopped through brake stop, see Figure 6-2. Range: 0~300 s, default: 0.05s	100
Pr-067	Time delay in brake release	Delay time of brake release signals, see Figure 6-2. Range: 0~300 s, default: 0.05s	100
Pr-068	Parameter reserved	-	-
Pr-069	Parameter reserved	-	-

Parameter code	Parameter name	Function	K
Pr-070	Motor pulse	1: Pulse +Pulse; 2: Pulse＋Direction; 3: Pulse - Direction 4: 2* Pulse＋Direction; 5: 2* Pulse＋Direction; 6: No output Range: 1~6, default: 6	1
Pr-071	Frequency dividing ratio of pulses	Frequency dividing ratio of pulses Range: 1~256, default: 1	1
Pr-72	User input pulse waveform	1: Pulse ＋ Pulse 2: Pulse ＋ Direction 3: Pulse - Direction 4: A+B pulse (Quadrature Encoder)	1
Pr-73	Gear ratio A (denominator)	Parameter range: 1~20000 Recommended range: $\frac{1}{120} \le \frac{B}{A} \le 120$, max range $\frac{1}{1000} \le \frac{B}{A} \le 1000$	1
Pr-74	Gear ratio_B (numerator)		1
Pr-075	Min. position error	The min. position error allowed by the position control system. If the position error value is small than this value, the position reaching signal is valid and the motor shaft is locked. The value is calculated as per the user pulse number rather than the encoder pulse number. Range: 1~32000, default: 10	1
Pr-076	Max. position error	The max. position error allowed by the position control system. If the position error is larger than this value, the system position error is exceeded and the drive alarms Err-70. The value is calculated as per the user pulse number rather than the encoder pulse number. Range: 1~32000, default: 1000	100
Pr-077	Position loop Kp	Position control loop: Proportional gain The bigger the parameter, the faster the system position responses and the smaller the position lag is. Too big parameter and poor speed loop response tend to increase the speed vibration. If the deceleration of position pulse signal is large, it is recommended to prevent this value from being too large to avoid a position overshoot. Range: 0~5000, default: 300	1
Pr-078	Position loop Ks	Position control loop: Feed-forward gain The bigger the parameter, the faster the system position responses and the smaller the position lag is. Too big parameter and pulse speed vibration tend to increase the speed vibration. If the deceleration of position pulse signal, it is recommended to prevent the value from being too large in order to avoid a position overshoot. Range: 0~2000, default: 300	1
Pr-079	Position loop Ka	Position control loop: Deceleration gain The parameter is valid at the stop mode of deceleration curve of position mode and used in combination with Pd-073. The bigger the deceleration gain constant is, the faster the speed decrease in the initial period is. The speed reduction is relatively slow in the end stage if the parameter is too small and may lead to slow speed. Range: 0~300, default: 10	1

Parameter code	Parameter name	Function	K
Pr-080	Digital input IN-1	Definitions of programmable digital input functions 0: Disable (not use the pin) 1: ZeroSpeed&CLR (zero-speed clamping) 2: Braking Mode (the motor shaft is locked) 3: Dir. Control (direction control) ... (See Section 4.3.1 for the details)	—
Pr-081	Digital input IN-2		
Pr-082	Digital input IN-3		
Pr-083	Digital input IN-4		
Pr-084	Digital input IN-5		
Pr-085	Digital input IN-6		
Pr-086	Digital output OUT-1	Programmable digital output of set values 0: Disable (not use the pin) 1: SERVO Ready (servo ready signal) ... (See 4.3.2 for the details)	—
Pr-087	Digital output OUT-2		
Pr-088	Digital output OUT-3		
Pr-089	Digital output OUT-4		
Pr-091	Selection of DAC-1	Definitions of the outputs of DAC-1 0: Function stopped 1: Motor speed (the max. forward speed corresponds to +10V) 2: Output torque (the max. forward torque corresponds to +10V) 3: Pressure feedback (the max. pos. pressure feedback corr. to +10V) 4: Pressure setting (the max. pressure setting corresponds to+10V) 5: Test voltage 1 (constant output +6V) 6: Test voltage 2 (constant output -6V) 7: Test voltage 3 (constant output 0V)	—
Pr-092	Gain of DAC-1	Scaling ratio of DAC-1 output signals (1%~200%) Parameter range: 1~200, default: 100	100
Pr-093	PWM mode	Selection of PWM modes 0: High-efficiency PWM (with high efficiency, but sensitive) 1: High-performance PWM (with best waveform, but low efficiency) 2: Variable frequency high- efficiency PWM 3: Variable frequency high-performance PWM It is recommended to use 1 : high-performance PWM	—
Pr-094	Speed filtering constant	Speed filtering constant. The smaller the constant is, the better the filtering effect, but dynamic response is slow. Range: 100~2048, default: 512	1
Pr-095	Pulse speed filtering constant	Pulse speed filtering constant. The smaller the constant is, the better the filtering effect, but dynamic response becomes slower. Range: 10~2048, default: 512	-
Pr-096	Analog signal filtering constant	Analog signal filtering constant. The smaller the constant is, the better the filtering effect, but dynamic response becomes slower. Range: 1~2048, default: 50	1
Pr-097	Pulse acceleration limit	The value is used to limit the acceleration / deceleration of pulse speed. The higher the parameter is, the weaker the limitation effect of acceleration is. A too small parameter will cause the slow change of pulse speed. Range: 1~2048, default: 512	1

Parameter code	Parameter name	Function	K
Pr-098	Torque filtering constant	The smaller the filtering constant is, the stronger the filtering effect, but dynamic response is slow. Range: 100~2048, default: 1024	
Pr-099	Parameter reserved	-	1
Pr-100	Enabling signal selection	Selection of drive starting signal sources 0: Digital IO enabled; 1: LED panel enabling (range: 0~1, default: 0)	-
Pr-101	Selection of ADC-2	Same as Pr-91	-
Pr-102	Gain of ADC-2	Same as Pr-92	100
Pr-103	Min. DAC-1 output	Setting an appropriate min. voltage can filter small zero drift. Range: 0~10V. Default: 0.03V	100
Pr-104	Min. DAC-2 output	Setting an appropriate min. voltage can filter the small zero drift. Range: 0~10V. Default: 0.03V	100
Pr-105	Parameter reserved	-	-
Pr-106	Parameter reserved	-	-
Pr-107	Parameter reserved	-	-
Pr-108	Parameter reserved	-	-
Pr-109	Parameter reserved	-	-
Pr-110	Analog input sampling value - 1	Sampling value of Point-1 of multi-point correction. Range: 0V~PR-112, default: 1V	10
Pr-111	Analog input correction value -1	Target value of Point-1 of multi-point correction. Range: 0V~10.00V, default: 1V	10
Pr-112	Analog input sampling value - 2	Sampling value of Point-2 of multi-point correction. Range: PR-110~PR-114, default: 3V	10
Pr-113	Analog input correction value -2	Target value of Point-1 of multi-point correction. Range: 0V~10.00V, default: 3V	10
Pr-114	Analog input sampling value - 3	Sampling value of Point-3 of multi-point correction. Range: PR-112～PR-116, default: 5V	10
Pr-115	Analog input correction value -3	Target value of Point-1 of multi-point correction. Range: 0V~10.00V, default: 5V	10
Pr-116	Analog input sampling value - 4	Sampling value of Point-4 of multi-point correction. Range: PR-114～PR-118, default: 7V	10
Pr-117	Analog input correction value -4	Target value of Point-1 of multi-point correction. Range: 0V~10.00V, default: 7V	10
Pr-118	Analog input sampling value - 5	Sampling value of Point-1 of multi-point correction. Range: PR-116~10V, default: 9V	10
Pr-119	Analog input correction value -5	Target value of Point-1 of multi-point correction. Range: 0V~10.00V, default: 9V	10
Pr-120	Bus communication node address	Used for switching CAN / EtherCAT modes, range: -8~255, default: 0 0: CAN/EtherCAT close; 1~255: Slave mode: Slave address -1~-8: Host mode: The number of slaves of host (CAN mode)	1

Parameter code	Parameter name	Function	K
Pr-121	Initial speed of the slave	CAN on-line mode, speed dead time set for the master. If the speed of the master is less than the value, speed command is set to zero. Range: 0~1000rpm, default: 100rpm	1
Pr-122	Min. slave input	CAN on-line mode, the min. adjusting speed set for the slave Range: 0rpm~PR-124, default: 200rpm	1
Pr-123	Min. slave input correspondence	CAN on-line mode, the speed corresponding to the min. adjusting speed set for the slave. Range: 0rpm~max. speed, default: 200rpm	1
Pr-124	Intermediate slave input	CAN on-line mode, the intermediate-point adjusting speed set for the slave. Range: Pr-122~Pr-126, default： 700rpm	1
Pr-125	Intermediate slave input correspondence	CAN on-line mode, the speed corresponding to the intermediate-point adjusting speed set for the slave. Range: 0rpm~max. speed, default: 700rpm	1
Pr-126	Max. slave input	CAN on-line mode, the max. adjusting speed set for the slave. Range: Pr-124~max. speed, default: 1200rpm	1
Pr-127	Max. slave input correspondence	CAN on-line mode, the speed corresponding to the max. adjusting speed set for the slave. Range: 0rpm~max. speed, default: 1200rpm	1
Pr-128	Parameter reserved	-	-
Pr-129	Parameter reserved	-	-
Pr-130	RS485 Node address	The parameters are used to set Modbus node address and switch the serial port communication protocol. 0: Modbus is disabled and the internal protocol is enabled. 1~255: Modbus is enabled and the internal protocol is disable. The node address is the parameter value.	0
Pr-131	RS485 communication mode	The parameter is used to set up the serial port connection method, data format, and Modbus communication mode. Unit: connection method 0: 4-wire connection; 1: 2-wire connection. Decade: data format 0: 8 data bit, 1 stop bit and 0 parity bit. 1: 8 data bit, 2 stop bit and 0 parity bit. 2: 8 data bit, 1 stop bit and odd parity. 3: 8 data bit, 1 stop bit and even parity. Hundred: Modbus communication mode 0: RTU mode 1: ASCII mode. Thousand: Reserved	0

Appendix II Description of internal parameters

Parameter code	Function name	Parameter range	Set range	Factory value	Proportion	Applicability
Pd-000	Parameter reserved	—	—	—	—	—
Pd-001	Parameter reserved	—	—	—	—	—
Pd-002	Manufacturing number	0~65535	0~65535	—	—	All
Pd-003	Month/year of drive manufacture	0~65535	0~65535	—	—	All
Pd-004	Software date	0~65535	Read-only parameter	—	—	All
Pd-005	Drive code	0~65535	Read-only parameter	—	—	All
Pd-006	Hardware code	0~65535	Read-only parameter	—	—	All
Pd-007	Software code	0~65535	Read-only parameter	—	—	All
Pd-008	Rated current	0~65535	0~65535	—	—	All
Pd-009	Peak current	0~65535	0~65535	—	—	All
Pd-010	Hardware information 1	0~65535	Read-only parameter	—	—	All
Pd-011	Hardware information 2	0~65535	Read-only parameter	—	—	All
Pd-012	Rated voltage	0~65535	Read-only parameter	—	—	All
Pd-013	Max. brake power	0~256	0~256	256	1	All
Pd-014	Parameter reserved	—	—	—	—	—
Pd-015	Built-in test mode	0~7	0~7	0	1	All
Pd-016	On-line PID test	0~3	0~3	0	1	All
Pd-017	Fixed Iq current	0~32000	0~32000	0	1	All
Pd-018	Fixed I current	0~32000	0~32000	0	1	All
Pd-019	Keypad display mode	0~1	0~1	0	1	All
Pd-020	Ia sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-021	Ib sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-022	Ic sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-023	Ia zero drift correction	-10%~10%	-1000~1000	—	10000	All
Pd-024	Ib zero drift correction	-10%~10%	-1000~1000	—	10000	All
Pd-025	Ic zero drift correction	-10%~10%	-1000~1000	—	10000	All
Pd-026	AD1 sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-027	AD2 sampling correction	-10%~10%	-1000~1000	—	10000	All

Parameter code	Function name	Parameter range	Set range	Factory value	Proportion	Applicability
Pd-028	AD2 zero drift correction	-4.88V~4.88V	-1000~1000	—	204.8	All
Pd-029	AD2 negative sampling coefficient correction	-10%~10%	-1000~1000	—	10000	All
Pd-030	Udc sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-031	+24V sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-032	+15V sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-033	-15V sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-034	+5V sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-035	T_motor sampling coefficient correction	-10%~10%	-1000~1000	—	10000	All
Pd-036	T_drive sampling coefficient correction	-10%~10%	-1000~1000	—	10000	All
Pd-037	AD1 zero drift correction	-2.44V~2.44V	-1000~1000	—	409.6	All
Pd-038	AD3 zero drift correction	-2.44V~2.44V	-1000~1000	—	409.6	All
Pd-039	AD3 sampling correction	-10%~10%	-1000~1000	—	10000	All
Pd-040	DAC1 output correction	-10%~10%	-1000~1000	—	10000	All
Pd-041	DAC2 output correction	-10%~10%	-1000~1000	—	10000	All
Pd-042	DAC1 zero drift correction	-1V~1V	-1000~1000	—	1000	All
Pd-043	DAC2 zero drift correction	-1V~1V	-1000~1000	—	1000	All
Pd-044	AD1 user zero drift value	-10V~10V	-5120~5120	—	512	All
Pd-045	AD2 user zero drift value	-10V~10V	-5120~5120	—	512	All
Pd-046	AD3 user zero drift value	-10V~10V	-5120~5120	—	512	All
Pd-047	Parameter reserved	—	—	—	—	—
Pd-048	Parameter reserved	—	—	—	—	—
Pd-049	Parameter reserved	—	—	—	—	—
Pd-050	Udc sampling filtering coefficient	1~2048	1~2048	200	1	
Pd-051	15V filtering coefficient	1~2048	1~2048	50	1	
Pd-052	Temperature sampling filtering coefficient	1~2048	1~2048	15	1	
Pd-053	Acceleration filtering coefficient	1~2048	1~2048	100	1	
Pd-054	Speed filtering coefficient	1~2048	1~2048	1000	1	
Pd-055	Resonance quality factor	10~1024	10~1024	10	1	
Pd-056	Resonance trapping depth	0~1024	0~1024	0	1	
Pd-057	Parameter reserved	—	—	—	—	—
Pd-058	Polarity of digital input level	00000~11111	00000~11111	0	1	

Parameter code	Function name	Parameter range	Set range	Factory value	Proportion	Applicability
Pd-059	Polarity of digital output level	0000~1111	0000~1111	0	1	
Pd-060	Definition of the forward direction of the encoder	0~1	0~1	0	1	
Pd-061	Dead-time compensation level	0~8	0~8	3	1	
Pd-062	RS485/CAN baud rate	0~206	0~206	6	1	
Pd-063	Display panel model	0~8	0~8	6	1	
Pd-064	Power on, enable, reset and restart	0~1	0~1	1	1	
Pd-065	Low-speed PID initial speed	0~1000	0~1000	128	1	
Pd-066	Ki_speed adjust. factor	0~10000	0~10000	1024	1	
Pd-067	Kp_speed adjust. factor	0~2000	0~2000	1024	1	
Pd-068	Acceleration at the first segment of S-curve	0~60	0~60	0	1	
Pd-069	Restart at under-voltage	0~111	0~111	0	1	
Pd-070	Pulse/speed FIFO filter	0~77	0~77	3	1	
Pd-071	Speed I/II switching point	0~64	0~64	8	1	
Pd-072	Low-speed compensation smooth transition	0~1	0~1	1	1	
Pd-073	Position-loop control function	0~111	0~111	100	1	
Pd-074	Position-loop over-speed limit	0.1%~100%	1~1000	100	1000	
Pd-075	Position-loop speed limit	1~1000	1~1000	100	1	
Pd-076	Position-loop error clearing	0~1000	0~1000	0	1	
Pd-077	Compensation-1	0~5	0~5	0	1	
Pd-078	Parameter reserved	—	—	—	—	—
Pd-079	Parameter reserved	—	—	—	—	—
Pd-080	Very low speed range	2~16	2~16	2	1	
Pd-081	Kp adjustment coefficient of very low speed range	1~8000	1~8000	512	1	
Pd-082	Torque fluctuation compensation parameter	0~32000	0~32000	0	1	
Pd-083	Speed fuzzy PI compensation coefficient	0~6464	0~6464	0	1	
Pd-084	Speed PI acceleration compensation coefficient	0~6464	0~6464	0	1	

Parameter code	Function name	Parameter range	Set range	Factory value	Proportion	Applicability
Pd-085	Position returning curve acceleration	10~100	10~100	20	1	
Pd-086	Parameter reserved	—	—	—	—	—
Pd-087	Parameter reserved	—	—	—	—	—
Pd-088	Parameter reserved	—	—	—	—	—
Pd-089	Parameter reserved	—	—	—	—	—
Pd-090	+24V no detect	0~1	0~1	1	1	All
Pd-091	Type of temperature sensor	0~1	0~1	1	1	All
Pd-092	Parameter reserved	—	—	—	—	—
Pd-093	Parameter reserved	—	—	—	—	—
Pd-094	Selection of multi-point correction channel	0~3	0~3	0	0	All
Pd-095	Pressure feedback adjustment coefficient	-10%~10%	-100~100	0	1000	All
Pd-096	Cumulative power-on time 1 (h)	0~65535	Read-only parameter	—	—	All
Pd-097	Cumulative running time 1 (h)	0~65535	Read-only parameter	—	—	All
Pd-098	Cumulative power-on time 2 (h)	0~65535	Read-only parameter	—	—	All
Pd-099	Cumulative running time 2 (h)	0~65535	Read-only parameter	—	—	All
Pd-100	First timing protection password	0~65535	0~65535	0	1	All
Pd-101	First timing protection time	0~65535 H	0~Pd-105	0	1	All
Pd-102	Second timing protection password	0~65535	0~65535	0	1	All
Pd-103	Second timing protection time	0~65535 H	Pd-103-Pd-107	0	1	All
Pd-104	Third timing protection password	0~65535	0~65535	0	1	All
Pd-105	Third timing protection time	0~65535 H	Pd-105-Pd-109	0	1	All
Pd-106	Fourth timing protection password	0~65535	0~65535	0	1	All
Pd-107	Fourth Timing protection time	0~65535 H	Pd-107~65535	0	1	All
Pd-108	Cumulative business timing time (h)	0~65535 H	0~65535	0	1	All

Parameter code	Function name	Parameter range	Set range	Factory value	Proportion	Applicability
Pd-109	Cumulative business timing time (s)	0~3600 S	0~3600	0	1	All
Pd-110	Parameter reserved	—	—	—	—	—
Pd-111	Parameter reserved	—	—	—	—	—
Pd-112	Error record-1 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-113	Error record-1 (time)	0~65535	Read-only parameter	—	—	All
Pd-114	Error record-2 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-115	Error record-2 (time)	0~65535	Read-only parameter	—	—	All
Pd-116	Error record-3 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-117	Error record-3 (time)	0~65535	Read-only parameter	—	—	All
Pd-118	Error record-4 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-119	Error record-4 (time)	0~65535	Read-only parameter	—	—	All
Pd-120	Error record-5 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-121	Error record-5 (time)	0~65535	Read-only parameter	—	—	All
Pd-122	Error record-6 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-123	Error record-6 (time)	0~65535	Read-only parameter	—	—	All
Pd-124	Error record-7 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-125	Error record-7 (time)	0~65535	Read-only parameter	—	—	All
Pd-126	Error record-8 (fault code)	0~65535	Read-only parameter	—	—	All
Pd-127	Error record-8 (time)	0~65535	Read-only parameter	—	—	All

Appendix III Business timing function

Parameter code	Parameter name	Function
Pd-100	1st timing protection password	Para.=0: No password is set, the 1st timing protection time can be set Para.>0: The password has set and the parameter value will not display. Input the password correctly to modify Pd-100 and Pd-101
Pd-101	1st timing protection time (h)	Para.=0: 1st timing protection time is not enabled Para.>0: Pd-108 is bigger than the parameter value, the drive alarms Err120 Upon alarming, input password Pd-100, then increase Pd-101 or set to 0
Pd-102	2nd timing protection password	Para.=0: No password is set, the 2nd timing protection time can be set Para.>0: The password has set and the parameter value will not display. Input the password correctly to modify Pd-102 and Pd-103
Pd-103	2nd timing protection time (h)	Para.=0: 2nd timing protection time is not enabled Para.>0: Pd-108 is bigger than the parameter value, the drive alarms Err120 Upon alarming, input password Pd-102, then increase Pd-103 or set to 0
Pd-104	3rd timing protection password	Para.=0: No password is set, the 3rd timing protection time can be set Para.>0: The password has set and the parameter value will not display. Input the password correctly to modify Pd-104 and Pd-104
Pd-105	3rd timing protection time (h)	Para.=0: 3rd timing protection time is not enabled Para.>0: Pd-108 is bigger than the parameter value, the drive alarms Err120 Upon alarming, input password Pd-104, then increase Pd-105 or set to 0
Pd-106	4th timing protection password	Para.=0: No password is set, the 4th timing protection time can be set Para.>0: The password has set and the parameter value will not display. Input the password correctly to modify Pd-106 and Pd-107
Pd-107	4th timing protection time (h)	Para.=0: 4th timing protection time is not enabled Para.>0: Pd-108 is bigger than the parameter value, the drive alarms Err120 Upon alarming, input password Pd-106, then increase Pd-107 or set to 0
Pd-108	Cumulative time(h) of business timing	After the timing function is enabled, the power-on time is cumulated. If the business timing function is closed, the cumulated value is restored to 0. The business timing time is not related to the cumulative power-on time of drive.
Pd-109	Cumulative time (s) of business timing	

Examples of usage:

The drive is set to the timing protection after operates for 200, 400 and 600 hours respectively, and the unlocking password is 1234, 3456, and 5678.

Setting method:

First set time: Set Pd-101 to 200, Pd-103 to 400 and Pd-105 to 600;

Then set password: Set Pd-100 to 1234, Pd-102 to 3456 and Pd-104 to 5678.

Alarm processing:

Time 1: When the cumulative business timing time is 200, the drive alarms Err120.

Enter Pd-100 and set to 1234, then set parameter Pd-101 to 0. Then 2nd timing protection is enabled.

Time 2: When the cumulative business timing time is 400, the drive alarms Err120.

Enter Pd-102 and set to 3456, then set parameter Pd-103 to 0. Then 3rd timing protection is enabled.

Time 3: When the cumulative business timing time is 600, the drive alarms Err120.

Enter Pd-104 and set the parameter value to 5678, then set parameter Pd-105 to 0.

Please contact the manufacturer if the timing protection time password is forgotten!

Appendix IV Fault codes

Fault code	Fault name	Fault description
Err 12	Over-current protection	The current is too high, or the hardware has faults. Please check the wiring of the motor and the parameter settings if errors are reported during running.
Err 13	IGBT protection	The hardware has fault if errors are reported when the power is turn on. Please check the wiring of the motor and the temperature of IGBT if errors are reported during running.
Err 14	Overload and locked rotor protection	The load is too heavy or the motor has locked rotor, or inaccurate zero position of the motor causes too high running current.
Err 15	Brake over-current protection	The hardware has faults if errors are reported when the power is turned on. The braking resistance is too low if errors are reported during running, or inappropriate acceleration/deceleration time is set.
Err 16	IGBT temperature protection	The IGBT is over-heated and detected by NTC. After resetting, the error continuously reported may be a fault caused by hardware circuit.
Err 19	Pressure sensor fault	Please check whether the pressure sensor is damaged, or it may be caused by the power supply and wiring of the pressure sensor.
Err 21	Software over-voltage protection	If it is reported that the sampling circuit of the bus voltage has faults.
Err 22	Software under-voltage protection	If it is reported that he sampling circuit of the bus voltage has faults.
Err 23	Hardware over-voltage protection	The hardware has faults if errors are reported when the power is turned on. Please check the braking resistor and adjust the acceleration and deceleration if errors are reported during operation.
Err 24	Hardware under-voltage protection	The hardware has faults when the power is turned on with the normal power supply voltage.
Err 25	Phase-lack protection	Please check if there is any phase lack in the 3-phase AC input. If normal, it may be a fault of hardware circuit.
Err 31	Internal+15V Over-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 32	Internal+15V Under-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 33	Internal-15V Over-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 34	Internal-15V Under-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 35	Internal+5V Over-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 36	Interna+5V Under-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.

Err 37	Internal+24V Over-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 38	Internal+24V Under-voltage	The hardware has faults. Please check whether there is external high voltage interference if errors are reported during start and stop.
Err 41	Drive over-heat protection	The drive is over-heat, or the temperature sensor is failed. Please check the cooling passages and fan of the drive if errors are reported during running.
Err 42	Motor overheat protection	The motor is over-heated, or the temperature sensor is failed. Please check the heat dissipation and temperature protection of the motor if errors are reported during running.
Err 61	Over-speed protection	The encoder has faults or there exists electromagnetic interference. Please check the motor and overspeed protection parameters if errors are reported during running.
Err 71	Position feedback error	Z signal detection is abnormal. Resolver signals may be heavily interfered or resolver chips are damaged.
Err 75	Encoder error protection	The encoder circuit may be damaged, causing UVW signals are all low voltage level. (Only Encoder+)
Err 76	Encoder error protection	The encoder may not be wired or its circuit may be damaged, causing UVW signals are all high voltage level. (Only Encoder+)
Err 77	Resolver error protection	Resolver angle reading is abnormal. The resolver chips may be damaged or the resolver may be damaged.
Err 78	Resolver error protection	Resolver angle reading is abnormal. The resolver chips may be damaged or the resolver may be damaged.
Err 81	Automatic zero setting error	Automatic zero setting cannot find encoder Z signals.
Err 82	Automatic zero setting error	UVW wire sequence may be not correct, or may not match the settings of the parameters defined for the forward/reverse directions.
Err 83	Automatic zero setting error	The settings of the motor polar and encoder parameters are not correct, or the encoder is damaged or motor overload causes a locked rotor.
Err 84	Automatic zero setting error	The zero position of the motor is found, and the speed during the test running fluctuates too much. Please check the loads of the motor, and set an appropriate PI gain.
Err 99	Error in the communication of the master	The master detects that the setting of the communication address of the slave is not correct. Please make sure that the communication address of the slaves does not repeat.
Err100	Error in the communication of the slaves	The slave cannot detect the CAN commands from the master. Please check that the CAN communication lines of the slave are properly connected.
Err10X	Error in the communication of the master	The master cannot detect that the Xth drive's signals or the slave reports errors. Please check the status and the communication line of the slave.
Err120	Business timing protection	Business timing time limit arrived. Please enter the timing password to clear the timing protection.

User record

Product warranty

Customer	Entity name			
	Address			
	Contact person		Tel.	
Agent □ OEM □	Entity name			
	Address			
	Contact person		Tel.	
Product information	Product model			
	Bar code			
Operating conditions	Equipment type			
	Technique requirements			
Fault analysis	Fault description			
The products are manufactured under Synmot strict quality management and inspection. The warranty period is generally 12 months from the date of installation.				

✧ Free services

Where any fault occurs during normal use within the warranty period, the machine can be sent to the licensed store or appointed service center for free repair service.

✧ Paid services

The machine cannot have free warranty service in the following situations:

■ Faults occur or damages are made due to deliberate or inadvertent behavior.

■ Faults occur or damages are made due to use of abnormal voltage or incorrect plugging/unplugging.

■ Faults occur or damages are made due to force majeure such as natural disasters (e.g. fire, flood and earthquake).

■ Faults occur or damages are made due to installation, repair, change or dismounting carried out by people other than those of the company's authorized bodies (licensed store).

■ Products without the brand of

■ Products have exceeded the warranty period.

Customer Orientation
High-standard Service

——————— Hot service line：(86)574-87645000 ———————

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