RT20 Bus Series 380V AC Servo Drive

User Manual

A&TS

A&TS TECHNOLOGY CORPORATION LIMITED

www.a-ts.cn

DECLARATION

The information provided in this publication will be updated regularly, and any necessary corrections will be implemented in subsequent releases. Suggestions for improvement are welcome at any time.

Version	Product	Release Date	Note
V-23-01	RT20	23.03.2023	N/A
V-23-02	RT20	10.05.2023	N/A

Forward

The RT20 series ac servo is provided by the A&TS Technology Co., Ltd. in China.

To have a thorough understanding, please read this manual carefully and follow all safety precautions before moving, installing, operating and maintaining the servo.

This manual provides guidance on safety precautions, product specifications, installation and wiring, keyboard operation, parameter settings, alarms, trouble-shooting, routine maintenance etc. It doesn't include all the security matters or considerations.

Local laws and regulations

All the local laws, regulations, and codes of practice should be obeyed first, besides the instructions in the manual.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described.

Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Thank you for choosing A&TS.

A&TS, automation technologies, at your services.

In this document, the following symbols may appear. The represented meaning is as follows.

Symbol	Instructions
⚠ DANGER	Attention, please! If there is improper operation, it may cause serious consequences such as personal safety, equipment safety or environmental safety.
⚠ WARNING	Be careful! If there is improper operation, it may cause major accident, such as equipment damage or physical injury.
⚠ ATTENTION	If there is misoperation, it may cause bad effects or cannot be operated normally. Generally speaking, the issues caused could be solved.
INSTRUCTIONS	It is widely used. It reminds the instructions and prompts.
EXAMPLE	For the better understanding of the users, to show a brief example
NOTE	It indicates small functions and tips unnoticeable that are very convenient to use.

Contents

1 Safety Precautions

1.1 General precautions

This manual provides guidance on safety precautions, product specifications, installation and wiring, keyboard operation, parameter settings, alarms, trouble-shooting, routine maintenance etc. It doesn't include all the security matters or considerations.

When installing, operating, and maintaining the RT20 series ac servo, please follow all the safety instructions in this manual, especially where there is safety symbols. All the safety symbols are the tips to the safety precautions. It doesn't include all the security matters or considerations.

For any injury or loss caused by improper operation, the A&TS technology will not take the responsibility. The A&TS technology is not legally bound in any manner either.

Basic installation requirement

- Only qualified or strictly trained engineers are allowed to install, operate and maintain equipment.

- Only qualified professionals are allowed to dismantle devices and repair equipment.

- Replacing or changing hardware & software must be carried out by the authorized engineers.

- The operator shall report the failure or error to the person in charge in time promptly.

Grounding requirement

The following requirements are for devices that need to be grounded only.

- Before installing the equipment, grounding first. When removing the equipment, keep the grounding until the end.

- It is forbidden to damage the grounding conductor.

- It is forbidden to operate equipment without the grounding conductor.

- The equipment shall be grounded always. Before operating, make sure the electrical connection is fine and reliable.

Equipment safety

- Before operation, the equipment should be fixed in the electric cabinet or on other stable objects firmly, such as the table or floor.

- When the system is running, make sure the air vent is unobstructed.

- When installing the equipment, to tighten the screws, use the tool.

- After complete the installation, please take all the empty packing materials area away.

2 Product Information

2.1 Product introduction

RT20 series servo is all digital ac servo drive, with high reliability, performance and cost effectiveness.

- High voltage servo, working at three phases 380V AC, with high voltage motor.

- Supports position control, speed control and torque control mode.

- Supports ABZ incremental encoder, absolute encoder including Tamagawa, BISS, and Nikon, and Magnetoelectricity encoder (ME).

- EA series supports the EtherCAT industrial fieldbus interface. The bus series product supports to extend the internal I/O to the PLC I/O interface.

- Supports internal speed mode and demonstration running mode.

2.2 Order number

RT20 – EA 035 H – E02 – ☐☐☐

RT20 series ac servo drive   Series   Power level   Voltage   Encoder type   OEM code

Code	Series
EA	EtherCAT bus higher type

Code	Peak current
010	6.7A
015	10.1A
025	16.8A
035	23.5A
050	33.6A
075	50.4A

Code	Voltage level
H	High voltage, three-phase 380V

Code	Incremental	ABZ incremental	Absolute encoder type			
			BISS	Tamagawa	ME	Nikon
E00	●	●	×	×	×	×
E01	●	●	●	×	×	×
E02	●	●	×	●	●	×
E03	●	●	×	×	×	●

Figure 2-1 RT20 series AC servo drive order number

<div style="border:1px solid black; padding:10px;">

<mark>INSTRUCTIONS</mark>

● Support this function.

× Don't support this function.

</div>

2.3 Technical specifications

Table 2-1 RT20 series AC servo drive technical specification

Model		RT20 series AC servo drive					
RT20-EA□□□H-E02		010	015	025	035	050	075
Power supply		Three-phase AC380V (-15%)-440V(+10%), 50/60Hz					
Rated current (rmsA)		3.5	5.0	7.5	12.0	15.5	22.5
Maximum current (rmsA)		6.7	10.1	16.8	23.5	33.6	50.4
Peak current (o-pA)		9.5	14.3	23.8	33.3	47.5	71.3
Environ ment	Temperature	Working 0-55°C (If the ambient temperature is between 45°C and 55°C, the average load should not exceed 80% of the rated load.) Storage -20°C-65°C					
	Humidity	Working 40%-80% (No condensation) Storage Less than 93% (No condensation)					
Protection grade		IP20					
Control method		PWM sine wave vector control					
Regenerative braking		Optional, built-in or external					
Feedback		ABZ incremental encoder, standard incremental encoder, and absolute encoder					
Fieldbus		EA series supports the EtherCAT industrial fieldbus interface. It supports to extend the internal I/O to the PLC I/O interface.					
Control mode		Position/Speed/Torque/Origin return(homing)					

Control input		Up to 9 input terminals (optoelectronic isolation). Servo-enable, alarm clearance, CWL, CCWL, forward torque limitation, reverse torque limitation, zero speed clamp, internal speed selection 1, internal speed selection 2, mode switch 1, mode switch 2, forward jog, backward jog, torque command direction setting, speed command direction setting, electronic gear selection 1, electronic gear selection 2, positional deviation clearance, pulse input prohibition, origin return(homing) trigger, origin return(homing) reference point, probe, external handwheel pulse generator
Control output		Up to 4 output terminals (optoelectronic isolation). Servo Ready(S-RDY), alarm, zero speed, positioning complete, speed reached, torque reached, electromagnetic brake, servo in operation, location nearby, positioning, torque in limitation, speed in limitation, origin return (homing) complete, Z phase frequency division, Encoder frequency division A\B\Z phase.
Position	Command source	Internal position command, Bus command
	Electronic gear ratio	Numerator, 1-32767 Denominator, 1-32767
Speed	Command ACC/DEC	Parameter setting
	Command source	Internal speed command, bus command
Torque	Speed limitation	Parameter setting
	Command source	Internal torque command, bus command

Special function	Probe, Origin return(homing), gain switch, mechanical resonance notch filter
Monitoring function	Rotation speed, current position, position deviation, motor torque, motor current, etc.
Protection function	Over speed, over voltage, over current, over load, braking abnormal, encoder abnormal, position out of tolerance, etc.

3 Installation and Wiring

3.1 Installation

When installing, operating and maintaining the RT series ac servo drive, please follow the instructions in the manual.

3.1.1 Installation environment

- Working temperature   0-55°C

- Working humidity   below 80% RH (no condensation)

- Storage temperature   -20°C-65°C

- Storage humidity   below 80% RH (no condensation)

- Vibration   below 4.9 m/s^2

- Altitude   below 2000m

- Install in a well-ventilated place with little humidity and dust

- Install in the place without corrosive gas, flammable gas, pyrophoric gas, oil gas, cutting fluid, cutting powder, or iron powder etc.

⚠️ **WARNING**

- **When in a vibration environment, to prevent transmitting vibration to the servo drive, please install the anti-rattle device on the mounting surface of the servo drive.**
- **When it has to be used in a corrosive gas environment, please try to keep corrosive gas out of the devices. The corrosive gas will cause the aging of electronic components and circuit boards.**

3.1.2 Products appearance and dimensions
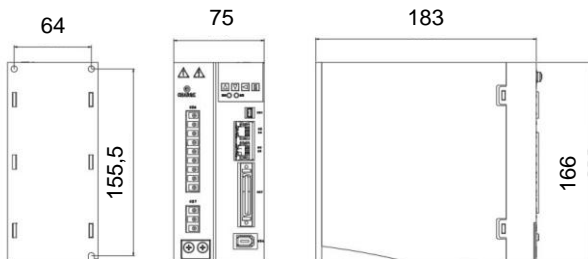
Figure 3-1 RT20-EA010/015H Appearance and dimensions (Unit, mm)
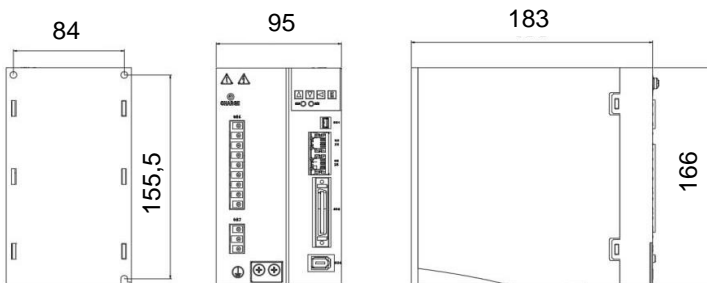
Figure 3-2 RT20-EA025/035H Appearance and dimensions (Unit, mm)
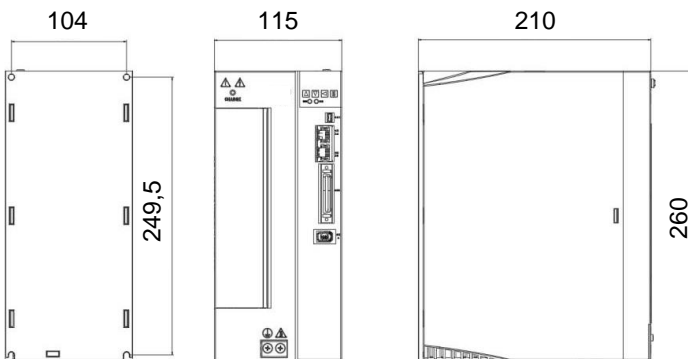
Figure 3-3 RT20-EA050/075H appearance and dimensions (Unit, mm)

3.1.3 Installation direction

Install the servo drive as the figure below. Good ventilation and heat dissipation must be ensured.
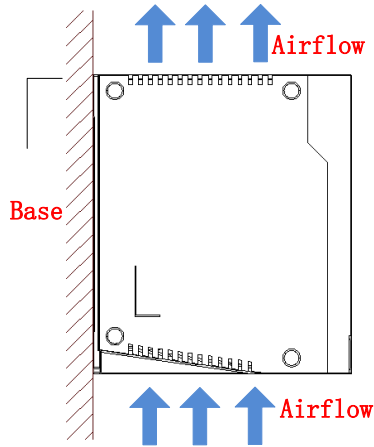
Figure 3-4 RT20 series AC servo drive installation direction (Unit, mm)

INSTRUCTIONS

- ● The drive should be mounted vertically on the base.
- ● Use natural convection or fan to cool the drive.
- ● Use M4 screws for the installation.

3.1.4 Installation space

Reserve enough space as shown in Figure 3-5. Make sure that the air flows from bottom to top, good for heat dissipation.
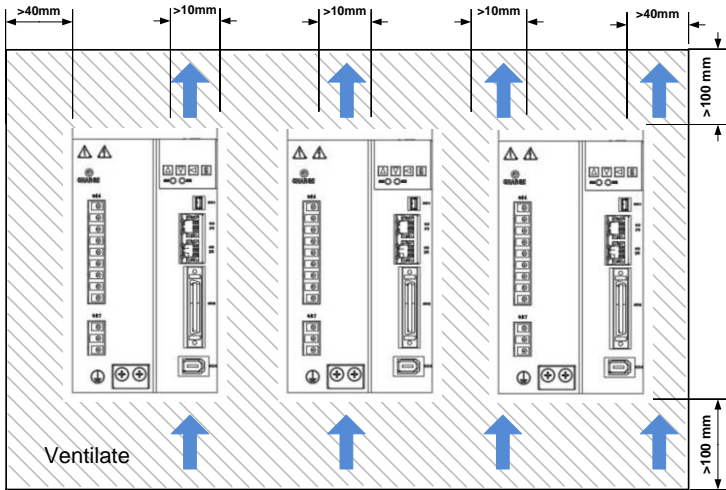
Figure 3-5 RT20 series AC servo drive installation space

➢ The working temperature should be below 45°C, to make sure the reliable performance.

➢ If the working temperature keeps above 45°C, please place the drive in the place with good ventilation. If it is installed in an electric cabinet, make sure that the size and ventilation is good enough inside the cabinet to avoid overheating.

➢ Make sure to ground the terminals, otherwise it may cause electric shock or interference that may cause danger due to misoperation.

➢ When wiring the drive, please route the cable downwards to prevent liquid from flowing into the drive when it is attached to the cable.

3.2 Wiring and terminals

3.2.1 Wiring diagram

Power Supply
three phase,AC380V

Air Circuit Breaker
To protect the power circuit, make sure to use a proper air circuit breaker as the protection device.

Noise Filter
Prevent external Interference, and reduce the interference by servo for other devices.

Magnetic Contactor
Turn the power supply on or off. It works with the coil surge absorbers.
· Strictly prohibit to use the magnetic contactor to operate or stop the motor !

Resistor
The braking resistor is optional. By default, the B2 and B3 are shorted, the internal resistor is used. When the internal resistor is not big enough, disconnect the B2 and B3, and connect external resistor between the B1 and B2.

RT20 AC Servo System

Bus Interface IN/OUT

Debugging Cable

Power cable

CN1
CN2A
CN2B

I/O Cable

CN3

When it is bus mode, it can be used as system I/O

CN4

Motor Power Cable

Encoder Cable

Figure 3-6 RT20-EA bus series AC servo drive wiring diagram

⚠ **DANGER**

● **Wiring operation should be performed by professional technicians.**

● **In order to avoid electric shock, after turn off the power, wait for more**

than 5 minutes, and then disassemble the drive.

● **Please connect the servo drive and servo motor after completing the installation, otherwise it may cause electric shock.**

● **Do not damage the cable, apply excessive pressure to it, hang heavy objects or squeeze, etc., otherwise it may cause electric shock.**

● **To avoid electric shock, please insulate the power terminal wiring.**

● **The specifications and installation methods of external wiring must be complied with all the local regulations.**

● **Make sure to ground the entire system.**

⚠ **ATTENTION**

● Please wire correctly and carefully, otherwise it will cause abnormal operation of the servo motor and may cause injury.

● Do not make mistakes in the connection terminals, otherwise it may cause cracks and damage.

INSTRUCTIONS

➢ RT-STP is the RT Servo Tuning Program. It's a debugging software provided by the A&TS Technology. For more details, please contact with us at https://www.a-ts.cn./

3.2.2 Strong electricity terminals

1. RT20-EA010/15/25/35 strong electricity terminals.
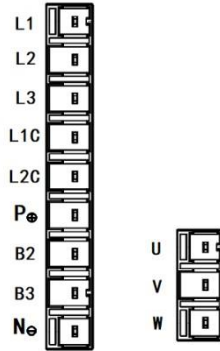
Table 3-1 RT20-EA010/15/25/35 servo drive strong electricity terminals

Terminal labels	Name	Specifications
L1C	Control power input terminals	Connect to single-phase 380V AC power 380V (-15%) - 440V (+10%)
L2C		
L1	Main power supply input terminals	Connect to three-phase 380V AC power 380V (-15%) - 440V (+10%)
L2		
L3		
B1/P(+)	Braking resistor terminals, common DC bus terminal	When using internal braking resistor, short circuit B2 and B3. When using external braking resistor, disconnect B2 and B3, and connect the braking resistor between P and B2. When using a common DC bus, P/N terminals are connected to positive/negative voltage respectively.
B2		
B3		
N(-)		
U	Motor power terminals	It must be connected with the U, V, W, PE terminals of the motor correspondingly. (Note, the PE is the terminal on the metal
V		
W		

| PE | | heat sink of the drive) |

 WARNING

L1/L2/L3 cannot be connected to single-phase 380V, but must be connected to three-phase 380V. Short-circuit L1C and L1, L2C and L2.

2. RT20-EA050/75 strong electricity terminals.
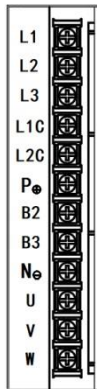
Table 3-2 RT20-EA050/75 servo drive strong power terminals

Terminal labels	Name	Specifications
L1C	Control power input terminals	Connect to single-phase 380V AC power 380V (-15%) - 440V (+10%)
L2C		
L1	Main power supply input terminals	Connect to three-phase 380V AC power 380V (-15%) - 440V (+10%)
L2		
L3		
B1/P(+)	Braking resistor	When using internal braking resistor, short

B2	terminals, common DC bus terminal	circuit B2 and B3. When using external braking resistor, disconnect B2 and B3, and connect the braking resistor between P and B2. When using a common DC bus, P/N terminals are connected to positive/negative voltage respectively.
B3		
N(-)		
U	Motor power terminals	It must be connected with the U, V, W, PE terminals of the motor correspondingly. (Note, the PE is the terminal on the metal heat sink of the drive)
V		
W		
PE		

 WARNING

L1/L2/L3 cannot be connected to single-phase 380V, but must be connected to three-phase 380V. Short-circuit L1C and L1, L2C and L2.

3.2.3 IO terminal CN3

In the CN3 port, a high-density 14-pin plug is used. The definition is described as below.

1. High-density 14-pin plug
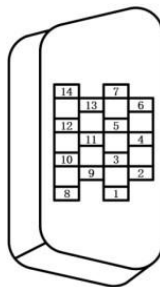
Figure 3-7 CN3 terminal 14-pin plug

This version of the IO terminal includes digital (on-off) input pins, digital (on-off) output pins, and encoder feedback output pins. Among them, there are 7 digital (on-off) input pins and 5 digital (on-off) output pins. The functions can be configured according to actual needs. The input function is configured by parameters Fn00-Fn06, and the output function is configured by parameters Fn10-Fn14. The pin numbers and functions of each pin are as follows.

Table 3-3 IO Terminal CN3 Definition

Signal Name			Pin No.	Signal Description
Digital input signal	DI1	SRV-ON	1	Servo enable input
	DI2	A-CLR	2	Clear alarm input
	DI3	Touch probe1	3	Touch probe input
	DI4	Touch probe2	4	Touch probe input
	DI5	M1-SEL	5	Mode switch 1 input
	DI6	M2-SEL	6	Mode switch 2 input
	DI7	P-ATL	7	Forward torque limit input
	COM	COM	8	The common terminal of the digital (on-off) input optocoupler, according to the digital (on-off) input active low or active high. The 24V or 0V is provided externally.

Digital output signal	DO1	S-RDY	9	Servo ready output
	DO2	ALM	10	Servo alarm output
	DO3	AT-POS	11	Position reached output
	DO4	BRKOFF	12	Motor brake release output, single-ended output
	DO5	AT-SPD	13	Speed reached output, single-ended output
	GND	GND	14	Digital (on-off) IO output common ground

INSTRUCTIONS

- By the parameter PA55 and PA56, the digital (on-off) input signal is set as valid or NOT (negation).

- By the parameter PA53 and PA54, the digital input terminals can be set to be compulsorily valid. When it is compulsorily valid, the terminals are not controlled by external input electrical level any more.

- By the parameter PA57, the digital output signal is set as valid or NOT (negation).

EXAMPLE
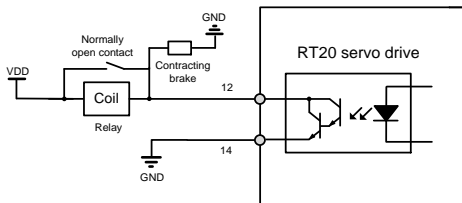
Figure 3-8 Contracting brake wiring diagram

3.2.4 Encoder terminals CN4/CN5

The RT20-EA series drive supports two encoder interfaces. The user can choose to use them according to the actual situation, or the encoder failure alarm may appear.

1) CN4 definition

This terminal is used to input the servo motor encoder signal and can be connected to absolute encoders only.
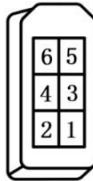
Table 3-4 Absolute encoder definition

Pin No.	Signal Name	Description
1	EC-5V	Encoder power output, 5V±5%
2	EC-GND	Encoder power/signal ground, 0V
3	CLK+	Serial clock (used when connecting to Nikon/Biss/Endat encoder)
4	CLK-	
5	SDATA+	Bidirectional Serial Data
6	SDATA-	
Shell/ housing	PE	Shield ground/protective earthing

2) CN5 definition

This terminal is used to input the servo motor encoder signal and can be connected to standard incremental, and ABZ incremental encoders only. The schematic diagram of encoder terminal pins is below.
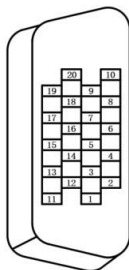
- It is recommended to use the original accessory cable of the RT20 AC servo drive.
- The encoder terminal is MDR/SCSI-20 core plug. Please confirm the pin sequence according to the solder side shown in the diagram above.

Table 3-5 Standard incremental encoder signal input terminals

Pin No.	Signal Name	Description
1	EC-5V	Encoder power output, 5V±5%
2	EC-GND	Encoder power / signal ground, 0V
7	A+	Encoder phase A signal input
8	A-	
9	B+	Encoder phase B signal input
10	B-	
19	Z+	Encoder phase Z signal input
20	Z-	
13	U+	Encoder phase U signal input. Don't connect it when using the ABZ incremental encoder.
14	U-	
15	V+	Encoder phase V signal input. Don't connect it when using the ABZ incremental encoder.
16	V-	

17	W+	Encoder phase W signal input. Don't connect it when using the ABZ incremental encoder.
18	W-	
11	PE	Shield ground/protective earthing

⚠️ **DANGER**

Without the permission or authorization by A&TS Technology, no motor or motor encoder shall be matched with RT20 servo drive. Otherwise, it may cause damage to the motor, or even danger to personal safety.

INSTRUCTIONS

● When using an absolute motor, choose the encoder terminal CN4.

● Terminal CN5 supports standard incremental and ABZ incremental encoder.

● When the encoder cable is longer than 10 meters and the signal cable diameter is not greater than 24AWG, two power signal cables must be connected in parallel.
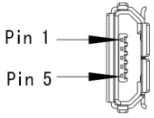
3.2.5 USB debugging port CN1 definition

This port is mainly used for the upper machine software communication debugging, and MCU firmware updating.

Doing the MCU firmware updating, it uses the USB communication, by the standard USB2.0 cable.

When communicating with upper machine, the serial communication is used. The communication cable is an optional accessory, and is the standard USB3.0 cable specially made. Only the 5 /6 / 7 pins need to be welded as below.

Table 3-6 USB pin definition

Pin No.	Signal name	Description	Port definition
1	-	-	
2	USB_D-	USB data-	
3	USB_D+	USB data+	
4	-	-	
5	DGND	USB power/signal ground, 0V	
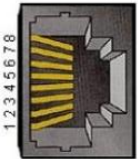
⚠ **WARNING**

When updating the program, do not connect USB3.0 cable to the drive directly, or it may cause damage to the drive or PC port.

3.2.6 EtherCAT communication port CN2A, CN2B definition

This terminal is the standard RJ45 interface for EtherCAT bus communication. CN2A is for the input, and CN2B is for the output.

The pins are defined as below.

Pin No.	Signal Name	Description	Port Definition
1	TX+	data transmission +	
2	TX-	data transmission -	
3	RX+	data receive +	
4	-	-	

5	-	-	
6	RX-	data receive -	
7	-	-	
8	-	-	

⚠ **ATTENTION**

➢ The display state of the network state indicator. First check the FPGA version of the driver software. Enter the 2.2dSU interface of the dP menu, and then press the up key to view.

➢ If it is the software version starts with '4', such as 4.01.38, when neither the yellow nor the green light is on, it indicates that there is no connection. When yellow light flashes and green light always, it indicates that it is connected or data is in transmission.

➢ If it is the software version starts with '5', such as 5.00.08, when the yellow light is off and the green light is always on, it indicates that there is no connection. When yellow light flashes and green light always, it indicates that it is connected or data is in transmission.

3.2.7 Standard wiring

➢ The RT20 series servo drive can be connected to the external handwheel encoder. When using it, the IO input of the CN3 port is used as the shaft selection and spindle override, and the A/B signal & 5V output of the CN5 code port can be used as the the A/B & 5V signal source of the handwheel pulse generator. At this time, only CN4 port could be used as the encode port interface in the drive.
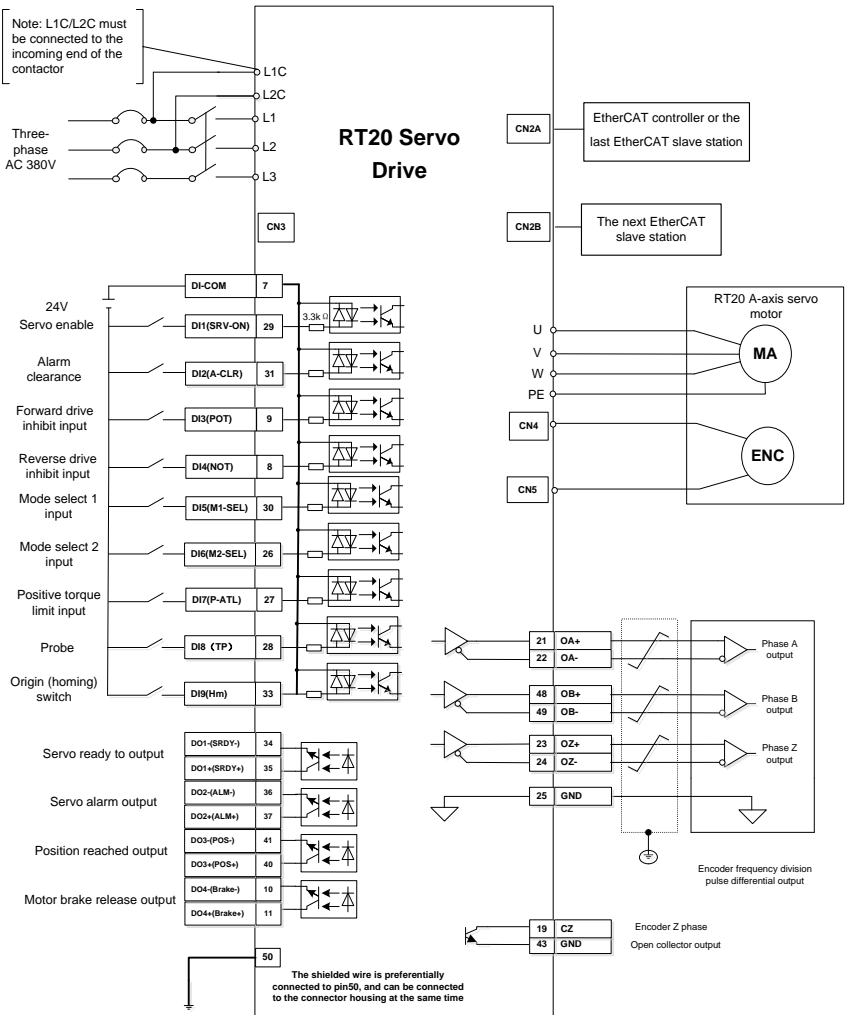
Figure 3-10 RT20-EA series control wiring connection diagram

4 Display and Keyboard Operation

4.1 Basic operation

The operator panel adopts five LED tubes, two LED indicators, and four keys, as shown in the Figure 4-1.
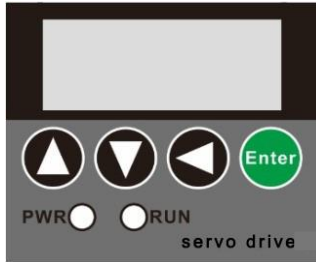
Figure 4-1 Operation panel

Five Led tubes

LED works to display the states and parameters of the servo drive.

If the decimal point of the rightmost eight-segment LED flashes, there is alarm.

Numeric display

It adopts 5 LED tubes to display numeric values. Some display items have prefix characters. If the decimal point of the eight-segment digital tube on the far right flashes, it means the servo drive alarms.

If the displayed value is negative, the decimal point of the displayed value will be lit up. And when the decimal value is greater than -10000, the highest digit displays a negative sign '-'. For example, $\boxed{12345}$ indicates positive number 12345. $\boxed{12.345}$ indicates negative number -12345. $\boxed{-2.345}$ indicates negative number -2345.

Four keys

⬆ Page up, to display page, increase serial number or value.

⬇ Page down, to display page, decrease serial number or value.

◀ Return key, Return or cancel.

(Enter) Enter key, Enter or OK.

Two LED indicator

PWR, it indicates that the drive main circuit is powered on.

RUN, it indicates that the drive has already been enabled, and the motor is powered on.

NOTE

➤ Keep pressing the page up or page down keys, the serial number (or value) will be increased or reduced continuously. And the longer the keep pressing is, the faster the increase or decrease is.

EXAMPLE

If you need to modify a parameter from 0 to 3000, please follow steps below.

Step one, keep pressing the page up key. The value increases from 0 continuously.

Step two, the value increases continuously, until the value reaches near the 3000, releasing the page up key.

Step three, press the page up or page down key discontinuously, to adjust the value until it reaches 3000.

4.2 Menu level one

The menu level one is used to select operating mode. Pressing the page up or page down key, it cycles between the 7 operation modes. Press Enter key to enter the menu level two, and press the return key back to the menu level one, as shown in the Figure 4-2.
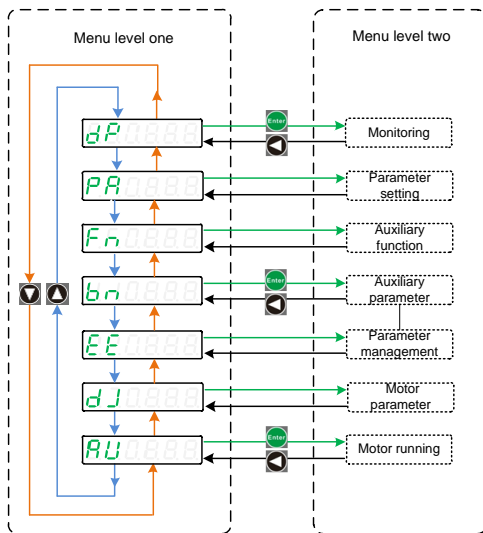
Figure 4-2 Menu level one

4.3 Menu level two

Enter the menu level two by selecting the different menu level one. Access the corresponding menu level two through a different menu level. This section introduces the monitoring mode monitoring, motor parameter, jog run, run test, parameter management, auxiliary function, and parameter setting etc.

4.3.1 Monitoring

Select $\boxed{dP}$ in the menu level one, press the Enter key to enter the monitoring mode. Press the Page up or Page down key to select the parameters that need to be monitored, and then press the Enter key to show the value. Press the Return key to return.

Display	Description	Display	Description
0.0 5Pd	Motor speed r/min	r 1000	Motor speed 1000 r/min
0.1 PoS	Current position pulse	2345 / 12	Current position 1202345
0.2 PoS	Current position high 5-bit (×100000 Pulse)		
0.3 CPo	System position command pulse	345	System position command 345
0.4 CP1	Servo internal position command pulse	17.345	Servo internal position command pulse -17345
0.5 EPo	Position deviation pulse low five-bit	345 / 12	Position deviation 1200345
0.6 EPo	Position deviation high five-bit (×100000 pulse)		
0.7 tr9	Motor torque %	173	Motor torque 17.3%
0.8 .1	Motor phase current Arms	1 0.0	Motor phase current 0.8Arms
0.9 L5P	Reserved	88888	Reserved
10.Cnt	Control mode	0	Control mode 0
11.Fr9	Position command pulse frequency kHz	F 157	Position command pulse frequency 157kHz
12. CS	Speed command r/min	r 1000	Speed command 1000 r/min
13. Ct	Torque command %	180	Torque command 18.0%
14.APo	Rotor absolute position	10607	Rotor absolute position 10607
15. In	Input terminal	״׳״״	Input terminal
16.oUt	Output terminal	o ״״׳״	Output terminal
17.Cod	Encoder UVW signal display	Cod 4	Encoder UVW signal display
18. rn	Running status	Cn on	Running status, running
19.Err	Alarm symbol	Err 6	Alarm No. 6
20. Jr	Load inertia-ratio	3 12.0	Load inertia-ratio 3.12 times
21.tEP	Out of range parameter number	8	Parameter No. 8 out of range
22.dSu	Software version	6.02.40	Software version 6.02.40
23.rE1	Reserved	0	Reserved
24. dc	Bus voltage	312	Bus voltage 312V
25.2oF	Encoder null offset	0	Reserved
26. r3	Reserve	0	Reserved
27.oF1	Reserve	0	Reserved
28.oF2	Reserve	0	Reserved
29. oL	Average load rate	oL 10	Average load rate 10%
30. EU	Multi-turn position	218	Multi-turn position 218
31.dEC	Frame errors (for BUS)	0	Frame errors 0
32.SAr	Slave station set address (for BUS)	1005	Slave address 1005
33.ALS	Slave station bus status (for BUS)	8	Bus status 8
34.CIA	CIA402 status(for BUS)	16	CIA status 16
35.rSu	Dynamic monitoring items	0	Display content set by PA38

Figure 4-3 Menu level two

33

4.3.2 Parameter setting (Pa/Fn parameter)

In the menu level one, select $\boxed{PR\square\square\square}$ or $\boxed{Fn\square\square\square}$ and press the Enter to go to the parameter setting mode.

Use the Page up or Page down key to select the parameter number, and press the Enter key to display the parameter value. Then use the Page up or Page down key to modify the parameter value. The value will be modified by pressing Enter key, and it will be valid in the servo control.

Press the Return key to return.

NOTE

● When the parameter value is being modified, the decimal point of the rightmost digital tube is lit, and press the Enter key to set the modified value valid. At this time, the lit decimal point will go out. Then pressing the Page up or Page down Key to continue to modify parameters.

● To cancel the modification, don't press the Enter key, and press the Return key. The parameter will not be modified, and the menu returns back to the previous menu.

● There are many PA parameters. When modifying, you can press the Page up or Page down key to select the nearest one. If you modify PA5, press the Page up key. If you modify PA84, you can press the Page down key.

● In the RT20 series servo, the PA menu only displays parameters up to parameter 99 by default. If it is old version, change the PA0 to 527, it will display all the parameters.
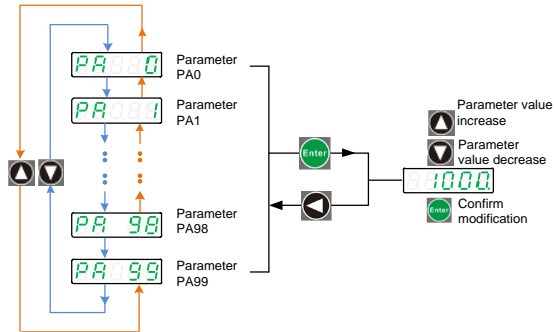
Figure 4-6 PA parameter setting menu

4.3.3 Parameter management

Parameter management mainly handles the operation between the parameter table and EEPROM.

In the menu level one select $\boxed{E E \ \ \ \ }$ and press the Enter key to go to the parameter management mode. Use the Page up or Page down button to switch between the three parameter management options. Press and hold the Enter key for more than 3 seconds to complete the parameter management command. Press the return key to return.

① Parameter save $\boxed{E-5Et}$

Write the parameters in the parameter table to the EEPROM parameter zone.

When the parameter is modified, it only changes the parameter values in the parameter table. If the servo is powered off and then powered up, and the original parameter value will be restored by default again. If you want to change the parameter value permanently, you need to perform parameter save operation and write the parameters in the parameter table to the EEPROM.

② Reset to factory defaults $\boxed{E\text{-}dEF}$

The factory values of all parameters are read to the parameter table and written to the EEPROM parameter area. After power cycle, the factory default values of all parameters are applied.

When the parameter configuration is disordered, you can use this operation to recover the system.

③ System soft reset $\boxed{E\text{-}r5t}$

It resets the MCU processor in the servo drive. It is equal to the drive does power cycle. After save the parameter, we could use this operation to avoid power the drive off and power it on again.

After the parameter modification, usually the drive needs to be restarted. There are two ways to restart the drive. One is to power off and restart directly. The second is soft reset. Which way to choose, it depends on the situation.

Parameter management mainly includes parameter save, restoring factory value and system soft reset. Each parameter management performs read-write operation in the MCU memory and the EEPROM.

	POWER ON:	RAM ⇐ EEPROM PKW
Parameter save	$\boxed{E\text{-}5Et}$:	RAM ⇒ EEPROM PKW
Restore defaults	$\boxed{E\text{-}dEF}$:	Parameter default value ⇒ RAM EEPROM PKW
System soft reset	$\boxed{E\text{-}r5t}$:	System reset is equal to the drive power up again
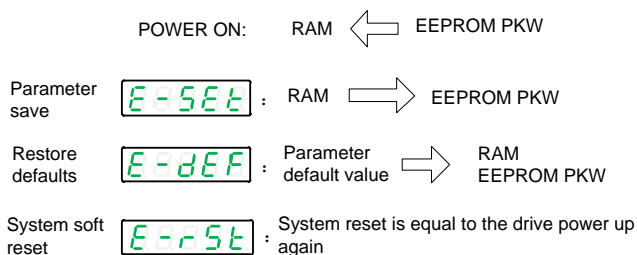
Figure 4-7 Parameter management menu

EXAMPLE

Example, Parameter save, Reset to factory defaults, System soft reset

Step 1. Select $\boxed{E\text{-}5Et}$, $\boxed{E\text{-}dEF}$, or $\boxed{E\text{-}r5t}$ and press the Enter key.

Step 2. Keep pressing the Enter key and hold for 3 seconds above. Digital tube will display $\boxed{5 t R r t}$, which indicates that the parameter is being written to the EEPROM.

Step 3. Wait 1- 2 seconds. If the operation succeeds, it will display $\boxed{donE}$, otherwise it will show $\boxed{Error}$.

⚠ **ATTENTION**

● **Before doing the Reset to factory defaults operation, please change the PA0 value to 0.**

4.3.4 Speed test run

Set the control mode PA4 to 2, save and restart. After the restart, change the PA53 to 1.
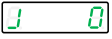
In the menu level one select $\boxed{5r088}$ and press the Enter key to go to the speed test run mode.

The prompt of speed test run is $\boxed{\quad 0.0}$, and the numeric unit is r/min. The system is in the speed control mode. The speed command is provided by the keys, and changed by the Page up and Page down keys. The motor runs at a given speed.

4.3.5 JOG running

Set the control mode PA4 to 5, save and restart. After the restart, change the PA53 to 1.

In the menu level one select ⬚, and press Enter key to enter JOG mode.

The prompt of the JOG running is ⬚, and the Numeric unit is r/min.

The system is in the speed control mode, and the speed command is set by parameter PA21.

Press Page up key and hold, and the motor runs at the speed set by PA21. Release the key, and motor stops.

Press Page down key and hold, and the motor reverse runs at the speed set by PA21. Release the key, motor stops.

- When it is in the Speed test run or JOG running, please do keep the motor in no-load condition.

- If we don't know whether the drive and motor matches or not, please use a slow speed when doing the speed trial operation and JOG running operation.

5 Commissioning and Running

Trial running without load

The purpose of trial running is to confirm whether the following items are correct.

- The servo drive power supply wiring
- The servo motor wiring
- Encoder wiring
- The servo motor running direction and speed

5.1 Set the motor type

1) Power on

After the power is up, the PWR indicator is lit. If an alarm occurs, please check the wiring.

2) Check the motor type

Check the parameter PA1 value, and find the motor type corresponding to this parameter in the motor selection guide. Check whether the motor type connected to the drive is in accord with the one above. If they are the same, go to the next step. If not the same, please modify the motor type.

INSTRUCTIONS

The RT20 series servo drive can identify motor parameters for some manufacturers' motors automatically, and need to identify motor parameters through codes for other manufacturers' motors. In the case that the two methods are not compatible, the motor parameters can only be identified through the user-defined method.

Commissioning steps to automatic identification motor parameter

```
┌──────────────┐    ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│ Set PA0 to   │ →  │ Set PA1 to   │ →  │ Set PA61 to  │ →  │ E-SET save   │
│ 310 or 385   │    │ U-dEF        │    │ 2            │    │ the settings │
└──────────────┘    └──────────────┘    └──────────────┘    └──────────────┘
```
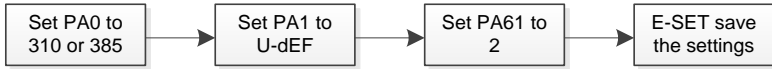
Commissioning steps to identify motor parameters by code

```
┌──────────────┐    ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│ Set PA0 to 310│ → │ Set 00UEd in the│→│ Set PA1 to the│→ │ Set PA61 to the│
│ or 385        │   │ dJ menu to the  │ │ corresponding │  │ corresponding  │
│               │   │ corresponding   │ │ motor code    │  │ encoder model  │
│               │   │ manufacturer code│ │               │  │                │
└──────────────┘    └──────────────┘    └──────────────┘    └──────────────┘
                                                                    │
                                                                    ↓
                                                            ┌──────────────┐
                                                            │ E-SET save   │
                                                            │ the settings │
                                                            └──────────────┘
```
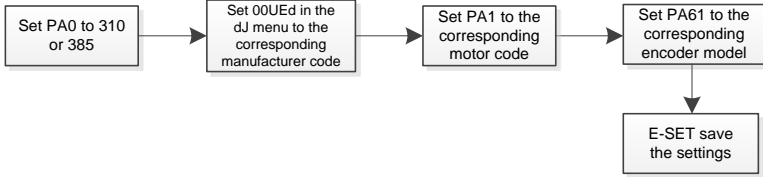
⚠ **ATTENTION**

- **Set PA61 to the corresponding encoder type (0 is incremental, 1 is ABZ incremental, 2 is absolute)**

Commissioning steps for user-defined parameters

```
┌──────────────┐    ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│ Set PA0 to   │ →  │ Set PA1 to   │ →  │ Set PA18 to  │ →  │ Set PA61 to the│
│ 310 or 385   │    │ U-dEF        │    │ 00001        │    │ corresponding │
│              │    │              │    │              │    │ encoder model │
└──────────────┘    └──────────────┘    └──────────────┘    └──────────────┘
                                                                    │
┌──────────────┐    ┌──────────────┐    ┌──────────────┐    ┌──────────────┐
│ E-SET save   │ ←  │ Fill in the motor│← │ Set PA0 to  │ ← │ Save the     │
│ the settings │    │ parameters into │  │ 310 or 385   │   │ settings and │
│              │    │ the dJ          │  │              │   │ restart      │
│              │    │ parameter table │  │              │   │              │
└──────────────┘    └──────────────┘    └──────────────┘    └──────────────┘
```
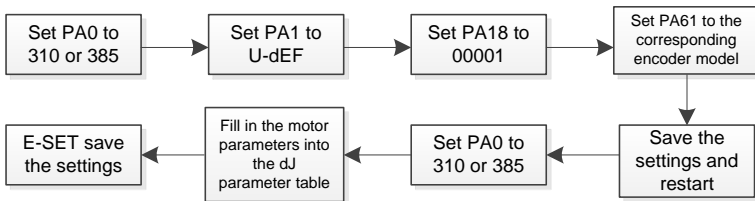
NOTE

- If the motor encoder is equipped with a battery, set PA18 to 00001, otherwise set it to 00000.

3)   Modify the motor type code

Follow the steps below to modify the motor type

- Change the PA0 parameter password to 310 or 385, and press the Enter key to save.

- Set $\boxed{00 \cup Ed}$ in $\boxed{dJ}$ as the specified motor manufacturer, and press the Enter key to save.

- Find the motor type code in the motor selection guide, and set the PA1 parameter Motor type to this type code. If there is no type code matching the motor, it is the user-defined motor. Just change parameter PA1 to $\boxed{U-dEF}$.

- Save the modified parameters in $\boxed{EE088}$.

- Select $\boxed{E-SEt}$ in the menu level two , and press the Enter key. Keep pressing the Enter key for more than 3 seconds, and it will display $\boxed{StArt}$, which indicates that the parameter is being written to the EEPROM. Then wait 1- 2 seconds, if the operation is successful, it will display $\boxed{donE}$, otherwise display $\boxed{Error}$.

5.2 Inertia identification

The servo drive needs to drive the motor as fast as possible, and to track the commands from the upper machine or internal settings. To achieve it, the servo gain shall be adjusted reasonably.

The servo gain is set by a combination of multiple parameters (position loop, speed loop gain, current loop, load rotation ratio of inertias, etc.), and they affect each other. Therefore, the servo gain setting must take the balance of each parameter value into the consideration.

The general procedure for adjusting the servo gain is as follows.
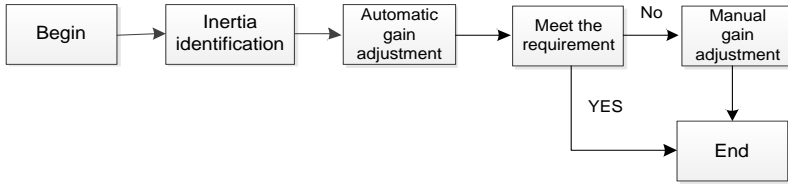
Figure 5-1 Gain adjustment flowchart

> **Load inertia ratio = Total rotational inertia of mechanical load / Motor rotational inertia**

The load inertia ratio is an important parameter of the servo system, and the setting the proper load inertia ratio helps to complete the commissioning quickly.

Before inertia identification, confirms the items below.

① Between the mechanical limit switch, there are forward and reverse 10 circles movable stroke.

② Servo drive with the motor can work normally.

③ The motor and the load has been connected.

The inertia identification process is as below.

Figure 5-2 Inertia identification flowchart

⚠ **ATTENTION**

➢ **After the inertia identification is completed, please be sure to set Fn69 to**

0, otherwise normal servo operation will be affected.

➢ **After the inertia recognition, the drive can recognize the field condition better. However, the gain parameters cannot be generated automatically, so the rigidity class (PA33) or gain parameters such as PA5 and PA6 need to be set.**

➢ **The dP-20Jr value is generally set to be about 300. If the value is too large, such as over 1000, or is negative (with a decimal point below each number), it indicates that the driver has failed to correctly identify the inertia. In the case of uneven load in general conditions (such as gear drive, belt drive, etc.), the inertia may not be recognized by the drive.**
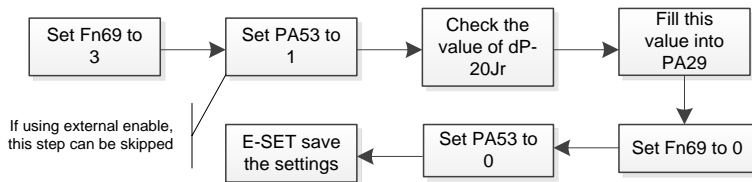
➢ **If the inertia recognition is not completed, it will not affect the normal use of the drive.**

5.3 Automatic gain adjustment

After the inertia identification, set the servo stiffness grades through PA33. Automatically the servo drive will generate a set of matched gain parameters to meet the requirements of speediness and stability. And it is the automatic gain adjustment.

Below is the stiffness grade description. When it is set to 0, the stiffness grade parameter is invalid. When it is grade 1, the stiffness is the weakest. When it is grade 31, the stiffness is the strongest. According to different load types, the following experience values are for reference.

Table 5-2 Rigidity grade reference

Recommended stiffness grade	Load mechanism type
Grades 4 to 8	Large machinery and equipment

Grades 8 to 15	Machines with low stiffness such as belts
Grades 15 to 20	Machines with strong stiffness such as ball screws and linear

⚠️ **ATTENTION**

➢ **Before using the automatic gain adjustment function, make sure to acquire the load inertia ratio correctly.**

➢ **If the gain parameters obtained by setting PA33 cannot fully meet the field requirements, you can set PA33 to an appropriate fixed value, and then manually adjust PA5, PA6, PA9, and Fn40.**

➢ **When inertia recognition and automatic gain parameters are not implemented, the gain parameters can be adjusted manually.**

5.4 Manual gain adjustment

1) Purpose of the gain adjustment

For commands from the upper controller, the servo drive makes the motor to work as instructed as possible without delay. In order to make the motor work as the commanded with the optimal mechanical performance, the servo gain adjustment is required.

To adjust the servo gain manually, before adjust each servo gain one by one, please understand servo components and features. In most cases, if one parameter is changed significantly, the other parameters shall be adjusted again.

The servo unit is composed of three feedback loops (position loop, speed loop, current loop), the more inner the loop is, the more need to improve its responsiveness. If the principle is not followed, it will cause poor responsiveness or vibration.

2) **Gain adjustment method**

① Increase the current loop bandwidth (Fn40) as much as possible, as long as there is no motor squeal.

② As long as the machine does not vibrate, increase the speed loop gain (PA5) as much as possible, and decrease the speed integral time constant (PA6) at the same time.

③ In the position control, increase the position proportional gain (PA9) as long as the machine does not vibrate.

5.5 Resonance suppression

Notch filter. The mechanical system has a certain resonance frequency. If the servo gain is set too high, resonance may occur near the mechanical resonance frequency. In this case, consider using a notch filter. The notch filter achieves the purpose of suppressing mechanical resonance by reducing the gain of a specific frequency. Therefore, the gain can be set higher. The Fn45-Fn47 are the detailed explanation of the parameter setting of the related notch.

RT20 series servo drive supports a set of parameter settings for the notch filter, frequency, width level and depth level. When the frequency is the default value 1000HZ, the notch filter is actually invalid. If a notch filter is used to suppress resonance, use a manual notch filter, and the frequency is collected by the debugging software RT-STP (Servo Tuning Program). Set the width level of the notch filter, usually the default value is fine. When the notch depth level is 0, the input at the center frequency is completely suppressed. When the notch filter depth level is 100, the input at the center frequency can pass completely. Therefore, the larger the parameter is, the smaller the depth of the notch is, and the weaker the effect of suppressing mechanical vibration. However, if the setting is too large, the system becomes unstable, so please be careful when using it.

The parameters of the notch are as follows.

No.	Name	Parameter range	Factory default	Unit	Applicability
Fn45	Notch filter center frequency	0-1000	1000	Hz	All
Fn46	Notch filter width	0-20	0	/	All
Fn47	Notch filter depth	0-100	2	/	All

5.6 Speed trial running

1) Power on

After the power is up, the PWR indicator is lit. If an alarm occurs, please check the wiring.

2) Parameter setting

Set parameters according to the following table, save the setting and restart the servo.

| Set PA4 to 2 | → | Set PA53 to 1 | → | Save and restart | → | Set to AU mode |

| Motor runs | ← | Press page up and down key | ← | 00Sr |

Parameter	Name	Set value	Factory value	Parameter description
PA4	Control mode	2	0	Speed of trial running control mode

PA53	Lower 5 digit input	00001	00000	Drive enable

3) Running

First confirm there is no alarm or any abnormal condition. The motor is enabled at zero speed.

Select $\boxed{5r\ 0\ 0\ 0}$ in the menu level one, and press the Enter key to go to the speed trial running mode.

The prompt of speed trial running is $\boxed{0.0}$, the unit value is r/min. The speed commands are provided by the keyboard, and use the Page up key or Page down key to change the commands. The motor runs at the given speed.
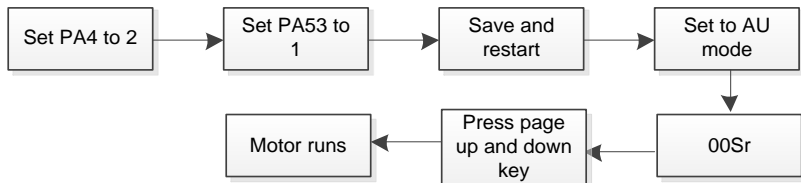
5.7 JOG trial running

1) Power on

After the power is up, the PWR indicator is lit. If an alarm occurs, please check the wiring.

2) Parameter setting

Set the parameters according to the table below.
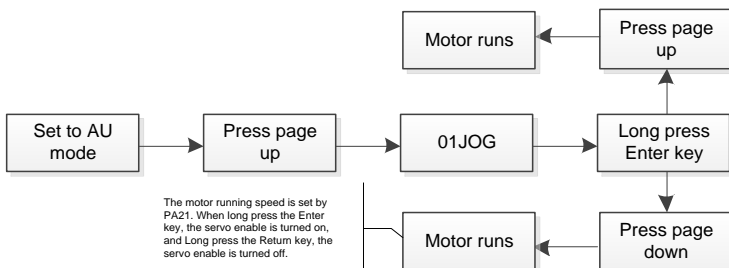
Parameter	Name	Set value	Factory value	Parameter description
PA4	Control mode	5	0	JOG control
PA21	JOG running speed	Appropriate value	300	JOG speed
PA53	Lower 5 digit input terminal forced ON	00001	00000	Drive enable

3) Running

First confirm there is no alarm or any abnormal condition. The motor is enabled at zero speed.

Select $\boxed{Jr080}$ in the menu level one, and press the Enter key to go to the JOG trial running mode.

Press the Page up key and hold , the motor runs at JOG speed (PA21) CW. Release the Page up key, the motor will stop and keep at zero speed.

Press the Page down key and hold, the motor runs at JOG speed (PA21) CCW.

5.8 Position control

Table 5-3 Parameter table related to position command

Parameter	Name	Set value	Description
PA4	Control mode	8	In bus mode, the default value is 8
PA12	Electronic gear	Appropriate	Valid when both

	numerator	value	PA81 and PA84 are 0
PA13	Electronic gear denominator	Appropriate value	
PA14	Position command input pulse method	3	In bus mode, the default value is 3
PA52	Position command smoothing time constant	Appropriate value	Position command smoothing time
PA81	The low order 5 digits of the command pulse number per motor revolution	Appropriate value	Pulses per motor revolution = PA84*10000 + PA81
PA84	The high order 5 digits of the command pulse number per motor revolution	Appropriate value	

6 Communication

6.1 EtherCAT overview

The connection form of EtherCAT is a network system that connects the master station (FA controller) and multiple slave stations linearly (Other connection form, please consult the A&TS company directly).

The number of nodes that the slave station is allowed to be connected to the master station depends on the processing or communication cycle capability (the number of bytes transferred, etc.) of the master station. Please check the master station specifications to confirm.

The master station generates EtherCAT Network Information (ENI) based on EtherCAT Slave Information (ESI) (using Configuration tool) provided by the A&TS company, and uses ENI to form an EtherCAT network.
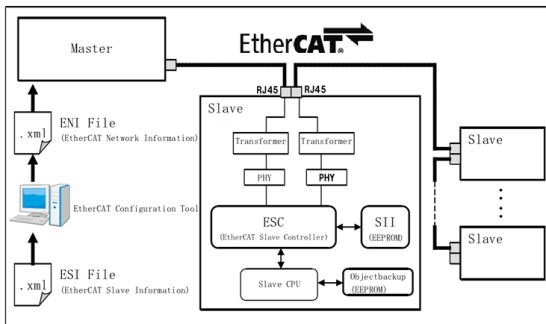
Figure 6-1 EtherCAT network

6.2 EtherCAT communication principle

6.2.1 EtherCAT frame structure

EtherCAT is based on Ethernet. It is an industrial communication protocol that can be controlled in real time. It only expands the IEEE 802.3 Ethernet specification, and does not make any changes to the basic structure. So it

can transfer the standard Ethernet data frames.

Because the EtherType of the Ethernet Header is 0x88A4h, the subsequent Ethernet Data is handled as an EtherCAT frame. The EtherCAT frame is composed of the EtherCAT frame header and at least one EtherCAT sub-message. Further, subdivide the EtherCAT sub-messages. Only EtherCAT frames with the Type=1 frame header are processed according to the ESC.

6.2.2 ESM (EtherCAT State Machine)

The state of EtherCAT application layer (ESM state) is shown in the figure below.
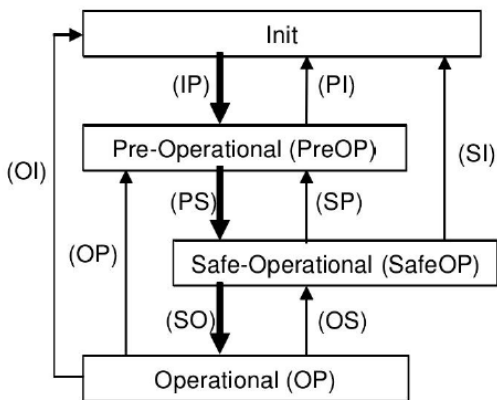
Figure 6-3 EtherCAT state transition diagram

EtherCAT must supports 4 states, to coordinate the relationship between the applications of the master station and slave station in the initial state and running state.

The bus state machine can be viewed through 3.3.ALS in dp mode.

Table 6-1 Drive state mapping table

No.	Bus status	3.3.ALS values

1	Initial state	1
2	Pre-Operation	2
3	Safe-Operation	4
4	Operation	8

6.3 Drive mode

6.3.1 Servo state machine
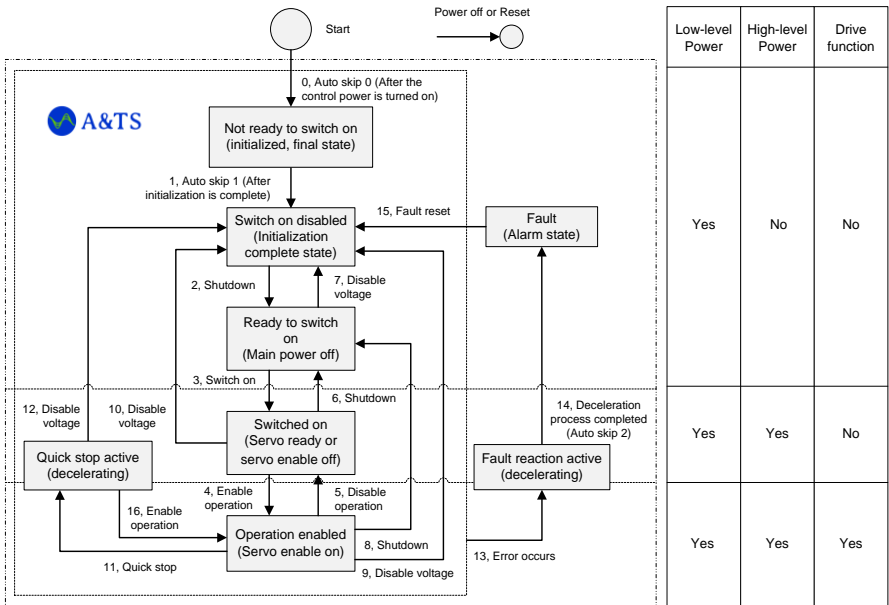
The condition of the servo ready state is that the High-level power (main power) is ON. If the high-level power (main power) is in the OFF state, it means that it is not in the servo ready state, and it cannot be switched to the Switched on state. After switching to Operation enabled (servo enable

is ON), wait for more than 100ms, and then input the action command.

The running state machine is switched through the control word 0x6040 and viewed through the status word 0x6041.

The bus state machine can be viewed through 3.4.CIR in dp mode, and the corresponding relationship table is as follows.

Table 6-4 Drive state machine corresponding table

No.	Servo running state	3.4.CIR values
1	Not ready to switch on (initialization final state)	1
2	Switch on disabled (Initialization complete state)	2
3	Ready to switch on (Main power OFF)	4
4	Switch on (Servo ready)	8
5	Operation enabled (Servo enable ON)	16
6	Fault (Alarm state)	128

6.4 Control mode

6.4.1 Servo mode introduction

RT20 series supports 4 kinds of servo modes. The control mode can be confirmed by 6502h.

Index	Sub-Index	Name/ Description			
6502h	00h	Supported drive modes			
		Value	Operation display	Abbr.	Suppo

		mode		rt
		6	Homing position control mode	hm	Yes

	6	Homing position control mode	hm	Yes
	8	Cyclic synchronous position control mode	csp	Yes
	9	Cyclic synchronous velocity control mode	csv	Yes
	10	Cyclic synchronous torque control mode	cst	Yes

Servo pre-operation mode can be set by 6060h. The current servo running mode can be checked by 6061h.

1. 6060h

Index	Sub-Index	Name/ Description			
6060h	00h	Modes of operation			
		Value	Operation display mode	Abbr.	Support
		-128-1	Reserved	/	/
		0	No mode change/no mode assigned	/	Yes
		1	Profile position control mode	pp	No
		2	Speed control mode	vl	No
		3	Profile speed control mode	pv	No
		4	Profile torque control mode	tq	No
		6	Homing position return control mode	hm	No

7	Interpolated position control mode	ip	No
8	Cyclic synchronous position control mode	csp	Yes
9	Cyclic synchronous velocity control mode	csv	Yes
10	Cyclic synchronous torque control mode	cst	Yes
11-127	Reserved	/	/

2. 6061h

Index	Sub-Index	Name/ Description			
6061h	00h	Modes of operation			
		Value	Operation display mode	Abbr.	Support
		-128-1	Reserved	/	/
		0	No mode change/no mode assigned	/	Yes
		1	Profile position control mode	pp	Yes
		2	Speed control mode	vl	No
		3	Profile speed control mode	pv	Yes
		4	Profile torque control mode	tq	Yes
		6	Homing position return control mode	hm	Yes
		7	Interpolated position control mode	ip	No
		8	Cyclic synchronous	csp	Yes

			position control mode		
		9	Cyclic synchronous velocity control mode	csv	Yes
		10	Cyclic synchronous torque control mode	cst	Yes
		11-127	Reserved	/	/

⚠️ **ATTENTION**

- **The control mode can be switched by changing the value of 6060h (operation mode).**

- **Please confirm the current servo drive control mode at 6061h (operation display mode).**

- **When switching the control mode, please update the RxPDO object related to the control mode synchronized with 6060h.**

- **In the changed control mode, the value of the unsupported object is uncertain.**

- **It takes 2ms from when the control mode switch is started to when the switch is completed. During this period, 6061h and the object value of TxPDO related to the control mode is uncertain.**

- **The performing of the control mode switch should be more than 20ms. When the control mode is continuously switched, if the interval is shorter than 20ms, it will cause an exception.**

- **The control mode must be switched while the motor is stopped. The operation of the control mode switching during motor operation (including home return operation and deceleration stop) cannot be guaranteed.**

- **In the state of 6060h=0 and 6061h=0, if the PDS state is changed to Operation enabled, an abnormal error action will occur.**

- **After 6060h is set to a value other than 0, if 6060h=0 is set, the previous control mode is maintained**.

6.4.2 Object Dictionary 6000h Assignment List

Index	Sub-index	Name	Unit	Type	Access	pdo
6040h	00h	Control word	-	U16	rw	RxPDO
6041h	00h	Status word	-	U16	ro	TxPDO
6064h	-	Position actual value	Command unit	I32	ro	TxPDO
606Ch	-	Velocity actual value	Command unit/s	I32	ro	TxPDO
6071h	-	Target torque	0.1%	I16	rw	RxPDO
6077h	-	Torque actual value	0.1%	I16	ro	TxPDO
607Ah	-	Target position	Command unit	I32	rw	RxPDO
60B0h	-	Position Offset	Command unit	I32	rw	RxPDO
60B1h	-	Velocity Offset	Command unit/s	I32	rw	RxPDO
60B2h	-	Torque Offset	0.1%	I16	rw	RxPDO
60FFh	-	Target velocity	Command unit/s	I32	rw	RxPDO
6098h	00h	Homing method	-	I8	rw	RxPDO
6099h	-	Homing speed	-	-	-	-
609Ah	00h	Set ACC and DEC	Command unit/s²	U32	rw	RxPDO

		speed (homing)					
607Ch	00h	Set home offset	Command unit	I32	rw	RxPDO
60B8h	00h	Probe function	-	U16	rw	RxPDO
60B9h	00h	Probe Status	-	U16	ro	TxPDO
60BAh	00h	Probe Posl Pos Value	Command unit	I32	ro	TxPDO
60BBh	00h	Probe Posl Neg Value	Command unit	I32	ro	TxPDO
60BCh	00h	Probe Pos2 Pos Value	Command unit	I32	ro	TxPDO
60BDh	00h	Probe Pos2 Neg Value	Command unit	I32	ro	TxPDO

7 Parameters

7.1 Parameter list

<mark>INSTRUCTIONS</mark>

● The applicability column shows the applicable control mode. 'P' means position control applicable, 'S' means speed control applicable, 'T' means torque control applicable, and 'ALL' means it is applicable for position, speed and torque control all.

● Parameter number plus ★ indicates that after modification the parameter needs to be saved, to will be effective after the power cycle. Parameter number without ★ indicates that after modification the parameter will be effective at once.

● Parameter value plus ＊ means the factory default may be different, if the drive model is different.

● Parameters usually used are
Test machine parameters: PA4, PA21, PA53
Motor parameters: PA1, PA18, PA45, PA61
Operating parameters: PA4, PA81, PA84
Tuning parameters: PA5, PA6, PA9, PA29, PA33, Fn40

7.1.1 PA parameters

No.	Name	Parameter range	Factory default	Unit	Applicability	Bus address
PA0	Parameter password	0-9999	315	/	ALL	2000h

PA1 ★	Motor model	1-132	1	/		ALL	2001h
PA2 ★	Drive model	0-4	0	/		ALL	2002h
PA3 ★	Initial display state	0-35	0	/		ALL	2003h
PA4 ★	Control method	0-16	0	/		ALL	2004h
PA5	Speed proportional gain	2-2000	150*	/		ALL	2005h
PA6	Speed integral time constant	1.0-1000.0	50.0*	ms		P, S	2006h
PA9	Position proportional gain	1-1000	50*	/		P	2009h
PA10	Speed feed forward gain	0-200	0	%		P	200Ah
PA12 ★	Position command pulse frequency division numerator	1-32767	1	/		P	200Ch
PA13 ★	Position command pulse frequency division denominator	1-32767	1	/		P	200Dh

PA14 ★	Position command pulse input mode	0-4	0	0, Bus command (incremental motor) 3, Bus command (absolute motor) 4, internal location	P	200Eh
PA15 ★	Command reverse direction setting	00000b - 11111b	00000b	Bit0, Position command reverse direction Bit1, Speed command reverse direction Bit2, Torque command reverse direction Bit3/4, rsv	All	200Fh
PA17	Position deviation is out of detection tolerance range	0-3000	30	X0.1 laps	P	2011h
PA18	Absolute encoder usage mode	00000b- 11111b	00101b	Bit0: Whether to use the battery Bit1: ABS source Bit2: Motor parameter automatic	ALL	2012h

				identification Bit3:rsv		
PA20 ★	Servo control auxiliary switch	00000b-11111b	00000b	Bit1, Control mode switch allowed Bit2, IO jog function allowed Bit3, rsv	ALL	2014h
PA21	JOG speed/Torque mode max speed	0-3000	300	rpm	S	2015h
PA22 ★	Speed command source selection	0-2	0	/	S	2016h
PA23 ★	User sets the max speed percentage limit	1-200	100	%	ALL	2017h
PA25	Torque command source selection	0 - 8	0	/	T	2019h
PA27	Internal speed command 1	-9000-9000	0	rpm	S	201Bh
PA29	Load rotation inertia ratio	0-8000	200	%	P, S	201Dh
PA30 ★	Motor torque overload alarm value	10-300	160	%	ALL	201Eh

PA33	Rigidity level	0- 31	0	/	ALL	2021h
PA38	DP menu dynamic display items	0-300	/	/	ALL	2026h
PA40	Acceleration time constant	0-10000	20	ms,0 to max speed time	S	2028h
PA41	Deceleration time constant	0-10000	20	ms, max speed to 0 time	S	2029h
PA44 ★	Pulse command function selection	00000b-11111b	00000b	Bit2: handwheel pulse function	P	202Ch
PA45 ★	Absolute encoder single-turn bits	0- 30	0	0 means the default digits	ALL	202Dh
PA47	Enable disconnect waiting time when the motor is stationary	0-5000	0	ms	ALL	202Fh
PA48	Electromagnetic brake braking waiting time when the motor is running	0-5000	50	ms	ALL	2030h
PA49	Brake action speed when the motor is running	0-3000	100	rpm	ALL	2031h
PA50	Brake off delay	0-300	20	ms	ALL	2032h

	when motor is enabled	0				
PA51 ★	Braking resistor selection switch	0-1	0	/	ALL	2033h
PA52	Position command smoothing time constant	0.0-100.0	0.0	ms	P	2034h
PA53	Lower 5 bits input terminals forced ON	00000b-11111b	00000b	Binary	ALL	2035h
PA54	Higher 5 bits input terminals forced ON	00000b-11111b	00000b	Binary	ALL	2036h
PA55	Lower 5 bits input terminals logical reverse	00000b-11111b	00000b	Binary	ALL	2037h
PA56	Higher 5-bits input terminals logical reverse	00000b-11111b	00000b	Binary	ALL	2038h
PA57	Output terminal logic reverse	00000b-11111b	00000b	Binary	ALL	2039h
PA61 ★	Motor encoder type setting	-1- 7	2	-1: Motor default setting	ALL	203Dh

				0: Incremental		
				1: ABZ incremental		
				2: Tamagawa protocol		
				3: Reserved		
				4: Nikon protocol		
				5: Panasonic protocol		
				6: BissC protocol		
				7: Increment without HALL		
				9: Sankyo protocol		
PA62	Alarm shield setting bits	00000b-11111b	00000b	Bit0:Err18 Bit1:Err35 Bit2:Err41&6 Bit3:Err25 Bit4:Err8	ALL	203Eh
PA64	Current proportional gain	1-500	150*	/	ALL	2040h
PA65	Current integration time constant	1-100.0	20.0*	ms	ALL	2041h
PA69	External braking	0-750	50	Ω	ALL	2045h

★	resistor value						
PA70 ★	External braking resistor power	0-10000	50	W		ALL	2046h
PA74	Internal current command	-300-300	0	%		T	204Ah
PA78 ★	The output pulses per motor revolution	1-32767	2500	x4 pulses		ALL	204Eh
PA79 ★	System feedback pulse output logical reverse	0-1	0	/		ALL	204Fh
PA80	Absolute encoder reset setting	00000b-11111b	00000b	/		ALL	2050h
PA81 ★	The low bits of command pulses per motor revolution	0-32000	0	/		P	2051h
PA84 ★	The high bits of command pulses per motor revolution	0-10000	0	x10000		P	2054h
PA90 ★	UVW encoding Corresponding to Z pulse	0-6	0	/		ALL	205Ah

PA91 ★	Incremental encoder UVW direction	0-1	0	/			ALL	205Bh
PA93 ★	System feedback Z pulse polarity setting	0-1	0	/			ALL	205Dh
PA94 ★	System feedback Z pulse width setting	0-15	4	/			ALL	205Eh
PA97	Alarm shield setting bits	00000b-11111b	00000b	/			ALL	/
PA98	Origin (Home) position confirmation range	0-30	0	/			ALL	2062h
PA99 ★	Absolute multi-turn data upper limit	0-32000	0	/			ALL	2063h

7.1.2 Fn parameters

No.	Name	Parameter range	Factory default	Unit	Applicability
Fn0	Digital input DI1 function	0-31	1	/	ALL
Fn1	Digital input DI2 function	0-31	2	/	ALL
Fn2	Digital input DI3 function	0-31	3	/	ALL
Fn3	Digital input DI4 function	0-31	4	/	ALL

Fn4	Digital input DI5 function	0-31	5	/	ALL
Fn5	Digital input DI6 function	0-31	6	/	ALL
Fn6	Digital input DI7 function	0-31	7	/	ALL
Fn7	Digital input DI8 function	0-31	8	/	ALL
Fn8	Digital input DI9 function	0-31	9	/	ALL

Set the point function corresponding to the digital IO input, the function codes are shown in the table below.

No.	Symbol	DI function	No.	Symbol	DI function
0	NULL	No definition	1	SON	Servo enabled
2	ALM_RST	Alarm clear	3	FSTP	CCWL
4	RSTP	CWL	5	M1_SEL	Mode switch1
6	M2_SEL	Mode switch2	7	RSV	Reserved
8	RSV	Reserved	9	CLE	Position deviation clear
10	ZEROSPD	Zero speed clamp	11	SENS	Yaskawa protocol feedback trigger
12	SPD_SEL1	Internal speed selection 1	13	SPD_SEL2	Internal speed selection 2
14	RSV	Reserved	15	RSV	Reserved
16	RSV	Reserved	17	INH	Position command pulse inhibit
18	JOG_CCW	Jog CCW	19	JOG_CW	Jog CW

20	RSV	Reserved	21	Torq_dir	Torque command direction setting
22	Spd_dir	Speed command direction setting	23	RSV	Reserved
26	Org_sw	Origin switch signal	27	Org_tog	Origin trigger signal
30	Org_set	Absolute motor origin (home) setting			

No.	Name	Parameter range	Factory default	Unit	Applic ability
Fn10	Digital output DO1 function	0-31	11	/	ALL
Fn11	Digital output DO2 function	0-31	12	/	ALL
Fn12	Digital output DO3 function	0-31	13	/	ALL
Fn13	Digital output DO4 function	0-31	14	/	ALL
Fn14	Digital output DO5 function	0-31	15	/	ALL

Set the corresponding point function of digital IO output. The function code is shown in the following table.

No.	Symbol	DO function	No.	Symbol	DO function
0	NULL	No definition	1	SRDY	Servo ready
2	ALM	Servo alarm	3	AT-POS	Position arrival

4	BRK	Brake action	5	AT-SPD	Speed reached
6	HOME	Origin return (homing) complete	7	TQ_LMT	Torque limiting
8	ZSP	Zero speed detection	9	Home	Origin (Home) position arrival

⚠️ **ATTENTION**

The same DI function can't be assigned to 2 or more IO input terminals, otherwise the alarm Err26 occurs. (IO input terminal function configuration error).

7.1.3 Bn parameters

No.	Name	Parameter range	Factory default	Unit	Applic ability
Bn1	Emergency stop acceleration and deceleration time	0-1000	100	ms	ALL
Bn9	Alarm shielding setting bits	00000-11111b	00000b	/	ALL
Bn24	Command smoothing time	0-1024	0	x0.2 ms	ALL

8 Fault Alarm

8.1 Alarm code list

INSTRUCTIONS

● The alarm with ★ after the alarm code indicates that the alarm cannot be reset. To clear the alarm, the servo needs to be restarted.

● The digital tube shows Err x. x is the alarm code and can be viewed through the current interface of the digital tube. When the digital tube displays 'r 0.', it can be viewed by the 19Err value under the Dp menu. If there is a decimal point flashing in the lower right corner of 0(r 0.), there are alarms in the servo.

Table 10-1 Alarm list

Alarm code	Alarm name	Description
0	Normal/No alarm	/
Err 1	Over speed	Servo motor speed exceeds the set value (PA23)
Err 2	Main circuit over voltage	Main circuit power supply voltage is too high
Err 3	Vibration detected	The vibration has been detected, that exceeds the set threshold
Err 4	Position out of tolerance	The positional deviation counter value exceeds the set value (PA17)
Err 5	Motor average load current alarm	The motor average load current is too large
Err 6	Speed amplifier saturation fault	Speed regulator is saturated for a long time
Err 7	CCWL and CWL abnormal	Both of the CCWL and CWL input are OFF
Err 8	IPM over temperature alarm	IPM temperature exceeds the set value

Err 9A/B/C	Encoder A / B / Z phase error	Encoder A / B / Z phase signal error
Err 10★	Motor parameter error	Motor parameter is out of range
Err 11★	IPM module faulty	IPM smart module is faulty
Err 12	Over current	Motor current is too large
Err 13	Over load	Servo drive and motor are overloaded (instantaneous overheating)
Err 14	Braking fault	Brake circuit is faulty
Err 15	Encoder count error	Encoder count is abnormal
Err 16	Braking resistor braking ratio is too high	Braking ratio is out of range
Err 18	Absolute encoder alarm	Encoder communication error
Err 19★	Absolute encoder battery failure	Battery voltage is lower than 2.5V, multi-turn position information has been lost
Err 20★	EEPROM error	EEPROM error
Err 21★	Phase A current sampling error	Phase A current sampling error
Err 22★	Parameter values out of range	Some servo parameter values are out of the specified range
Err 23★	Phase B current sampling error	Phase B current sampling error
Err 24★	Absolute encoder parameter read/write error	Motor encoder EEPROM parameter error
Err 25	Encoder AB feedback is abnormal	Encoder AB feedback frequency is too high
Err 26	IO input terminal function configuration is abnormal	Different IO input terminals are configured to the same function
Err 27	Absolute encoder battery alarm	Battery voltage is lower than 3.1V, the battery voltage is low

Err 28	Absolute encoder communication timeout alarm	Feedback from the absolute encoder timed out
Err 29	Torque overload	Motor load exceeds the value and duration set by user
Err 30★	Encoder Z pulse lost	Encoder Z pulse lost
Err 31★	Encoder UVW signal error	Encoder UVW signal is incorrect or does not match with the encoder
Err 32★	Encoder UVW signal encoding is invalid	The UVW signal is kept at full high or full low level
Err 33★	Dynamic memory allocation error	Dynamic memory allocation error
Err 34★	Flash reads CRC error	Flash reads CRC error
Err 35★	Motor adaptation error	The motor is not adapted.
Err 36	Watchdog error	Internal watchdog error
Err 37★	Motor initial zero lock error	Zero position lock error
Err 38★	External braking resistance value is incorrect	The resistance value of external braking resistance is less than the minimum allowed value
Err 40	Bus communication error	In periodic communication state, the data of 3 consecutive frames is wrong
Err 41	Bus connection is interrupted	The physical network connection is down or the network connection status is changed.
Err 43	The control mode is not written before switching the OP state	The control mode is not written before switching the OP state
Err 44	Bus state machine switching is abnormal	Abnormal switching of the bus state machine
Err 45★	Bus cycle configuration is abnormal	The bus cycle value is not an integer multiple of 0.2ms.
Err 51	Multi-turn value exceeds the set value	Multi-turn value exceeds the set value

Err 52	Main power supply under voltage alarm	In the enabled state, the bus voltage is lower than 245V
Err 53	AC main power supply failure/ is off	It is powered off in the power supply cable L1, L2, and L3
Err 54	AC main power phase loss	There is phase loss in power supply cable L1, L2, and L3
Err 55★	Dynamic braking overcurrent	Dynamic braking overcurrent error
Err 56	Internal D5V undervoltage	The voltage supplied to the control board is less than 5 V
Err 58	Unsupported origin return (homing) mode	The unsupported origin return (homing) mode is used
Err 62	Motor speed out of control	There is large difference between command speed and actual speed.
Err 64	Multi-turn value out of range alarm	The actual multi-turn value of the motor is out of range

The End

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