SD310/311 SERVO DRIVER

USER'S MANUAL

Beijing KND CNC Technique Co., Ltd.

F015B-0000-T00N-0101

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WWW.KND.COM.CN
2015年08月

CONTENT

1 Specification 1

1.1 Specification 2
1.2 Installation Dimensions 6
1.3 Name Plate 8

2 Installation and Wiring 11

2.1 Installation Surroundings 12
2.1.1 Electrical cabinet 12
2.1.2 Vibratory equipment 12
2.1.3 Application condition 12
2.1.4 EMI 12
2.2 Installation Method 12
2.3 Wiring 14
2.3.1 Wiring 14
2.3.2 Cable specification 14
2.4 Cautious 15

3 Interface 17

3.1 Power Supply Terminals 18
3.2 Servo Bus Interface CN3 & CN4 19
3.3 Encoder Signal Input Interface CN2 19
3.4 Digital Input /Output Interface CN5 21
3.5 Grating Ruler Interface CN6（SD311driver） 23
3.6 Battery Box CN3A/CN3B 24
3.7 Interface Terminals Arrangement 24
3.8 Input/Output Interface Types 25

4 Parameters 27

4.1 Parameter Explanations 28
4.2 Method for Adjusting Servo Systems 52
4.2.1 Automatic parameters adjustment 54
4.2.2 Rigidity adjustment 55
4.2.3 Shorten positioning time 56
4.2.4 Vibration adjustment 56

5 Protection Function 59

5.1 Error/Warning List 60
5.2 Error/warning Remedy 65
5.3 Diagnosis List About The Servo Bus 81

6 Display and Operation 83

6.1 First Layer 85
6.2 Second Layer 86
6.2.1 Parameter consulting & setting (PA) 86
6.2.2 Monitoring menu (dP) 88
6.2.3 Parameter management (EE) 92
6.2.4 Adjusting menu (tU) 95

7 Run 99

7.1 Grounding 100
7.2 Working Sequence 100
7.2.1 Power on sequence 100
7.2.2 Time sequence diagram 101
7.3 Adjustment and Setting 103
7.3.1 Select motor model 103
7.3.2 Electronic gear ratio 103
7.3.3 Motors' rotation direction 104
7.3.4 Hardware overtravel protection 104
7.3.5 Software overtravel protection 106

7.3.6 Mechanical brakes of motors 107
7.3.7 Parameters related to the performance of servo systems 108
7.3.8 Start-stop characteristic adjustment 108
7.3.9 Battery installation and replacement 109
7.3.10 Low voltage error/warning monitoring of encoder battery 109
7.4 Pilot Running 110
7.4.1 Check before pilot running 111
7.4.2 Pilot running in velocity control mode 111
7.5 Position Control Mode 112
7.6 Velocity Control Mode 113
7.7 Torque Control Mode 113
7.8 Single-axis Positioning 114
7.9 Closed Loop Control（SD311 driver） 116
7.9.1 Connection 116
7.9.2 Parameter setting 117
7.10 Rotary Table Function 118
7.11 Friciton Compensation 120
7.12 FAQ 123
7.12.1 Er 009/Er 030/Er 032/Er 034 occurs frequently 123
7.12.2 POWER indicator can't be lit up 124
7.12.3 Motors do not rotate 124
7.12.4 How to stop the flickering status 124
7.12.5 How to clear an error or alarm 125
7.12.6 How to drive low-power motors with high-power drivers 125
7.12.7 When to perform -tU3 operation 125
7.12.8 Mask Er.032 when using saving-line encoders 125
7.12.9 How to perform -tU3 operation on relative encoder 126
7.12.10 Error occurs after performing -tU3 operation 127
7.12.11 Operations of changing the zero point 127
7.13 Relative Knowledge 127
7.13.1 Lag pulses in position control mode 127
7.13.2 Relationship between lag pulses and the motors' speed 128

8 Connect with KND systems and Motors 129

8.1 Connect with KND systems 130
8.2 Feedback Cable (2500-line incremental encoders) 130
8.2.1 Non-saving-line encoders 130
8.2.2 Saving-line encoders 131
8.3 Feedback Cables (17-bit absolute encoders) 131
8.3.1 Motors with 17-bit single circle/12-bit mechanical multi-circle encoders (KND M1) 131
8.3.2 Motors with 17-bit absolute encoders (KND E/KND M/HuaDa LEBB/HuaDa LMBB) 132

Appendix 133

1. Parameter List of Motor Model 133
2. Driver Parameter List 143

Update Record 150

1 Specification

1.1 Specification

Table 1.1 Servo Driver Specifications

Model / Name		KND SD310/311 - 30 KND SD310/311 - 50 KND SD310/311 - 75 KND SD310/311 - 100
Power	Main circuit	Three-phase(Single-phase) AC220V －15～＋10％ 50Hz
	Control circuit	Single-phase AC220V －15 ～ ＋10％ 50Hz
Work environment	Temperature	Running: 0 ～ ＋55℃ Storage: －20℃ ～ ＋80℃
	Humidity	90% RH or less (free from dew)
	Vibration	0.5g(4.9 m/s²) or less, 10 ～ 60Hz (not continuously running)
	Prevention grade	IP10
	Altitude	1000 meters or lower
	Other	Keep away from powerful magnetic field Take electrostatic protection measures
Control mode		Position control Velocity control Torque control Pilot running in velocity control mode Single-axis positioning control IGBT-PWM vector control
Dynamic braking		Internal (standard configuration) or External regenerated energy dead resistance
LED display		LED for monitoring or setting operations Servo ready indicator light Power supply indicator light

Servo bus（KSN）		Specify the bus station address in PA70 Synchronizing period is selected by the master station and the following periods are available: 0.5ms, 1ms, 2ms, and 4ms.
Position control	Command input style	Servo bus (KSN)
	Electronic gear ratio	1 ～ 32767 / 1 ～ 32767 0.001< Electronic gear ratio value<1000
	Velocity/position feedback equipment	① 2500 pulses/r incremental encoder ② 17-bit absolute encoder (Mechanical or battery-operated) ③ Incremental or absolute grating ruler (SD310 driver)
Velocity control	Command input style	Servo bus (KSN)
	Frequency characteristic	200Hz
	Velocity Variations	Compared with rated velocity <±0.03 (Load fluctuation: 0～100％); <±0.02 (Power fluctuation: -15％～+10％)
	Velocity range	1 rpm ～ 5000 rpm (The lower limit of the velocity range is the least speed that the motor keeps rotation under condition of rated torque load)
	Support the function of outputting VCMP signal when velocity reaches the specified value.	
Torque control	Command input style	Servo bus (KSN)
	Support the function of outputting VLT signal when torque is limited. Support the velocity clamping function when rotation speed reaches the maximum value.	

Pilot running in velocity control mode		Specify the pilot running speed in PA21.
Single-axis positioning control	Command input style	Specified by parameters
	The following parameters are used to specify positioning information: PA49~PA52: 4 positioning positions PA29~PA32: Corresponding absolute value of positioning speed. Maximum positioning range: ±16000r PA77: The unit of positioning information: 1 ～ 0.001r PA25: Absolute value of positioning acceleration: 1 ～ 500 r / s^2 PA18: Delay time after positioning finished: 0 ～ 1000s POSI_RDY is used to start the positioning operation.	
Sequential control input		① DEC ② EXT ③ CCW ④ CW Input signals' states can be simulated by PA54 and their active level can be specified by PA49
Sequential control output		① Servo ready ② Servo alarm ③ Positioning finished/Speed arrived/Torque limited ④ Start mechanical brake The active levels of output signals can be specified by PA57.
Acceleration/deceleration control		In both velocity control mode and pilot running in velocity control mode, exponential acceleration/deceleration control is available. The time constants used are set in parameters PA40 & PA41(1~1000ms)

Rotary table function	When using a motor with multi-circle absolute encoder, motor axis is connected to rotary table (rotary axis) by gear ratio. No matter how the rotary table rotates (unidirectional rotation or reciprocating rotation), driver can calculate correct angle of rotary table. Besides, if the motor rotates after driver is powered off, driver can get correct rotary table angle when it is powered on.
Monitoring function	Rotation speed, Current position, Command position, Offset between the command and actual position, Torque load ratio, Phase current, Current control mode, Speed command, IO signals, Current torque, Current alarm/warning numbers, Synchronous period of servo bus, Encoder/grating ruler feedback position, Vibration frequency, Positioning coordinates in single-axis positioning control mode, Software version, Some other monitoring functions
Protection function	Feedback velocity exceeds available range Command velocity exceed available range Overvoltage or low-voltage in main circuits Transient overcurrent Long term overload Abnormal braking Encoder malfunction Position offset is out-of-tolerance Limit switches malfunction Battery low-voltage warning

Software/hardware overtravel limit	Hardware overtravel switches of CCWI & CWI terminals. Software overtravel protection function is available for the applications using absolute encoders or grating rulers. When overtravel happens, motors stop after deceleration process and the maximum overtravel distance can be specified.
Available load inertia	Less than 7 times of servo motor inertia
Optional module	① Battery box module (battery type absolute encoder) ② Closed-loop module (SD311 driver with grating ruler)

1.2 Installation Dimensions

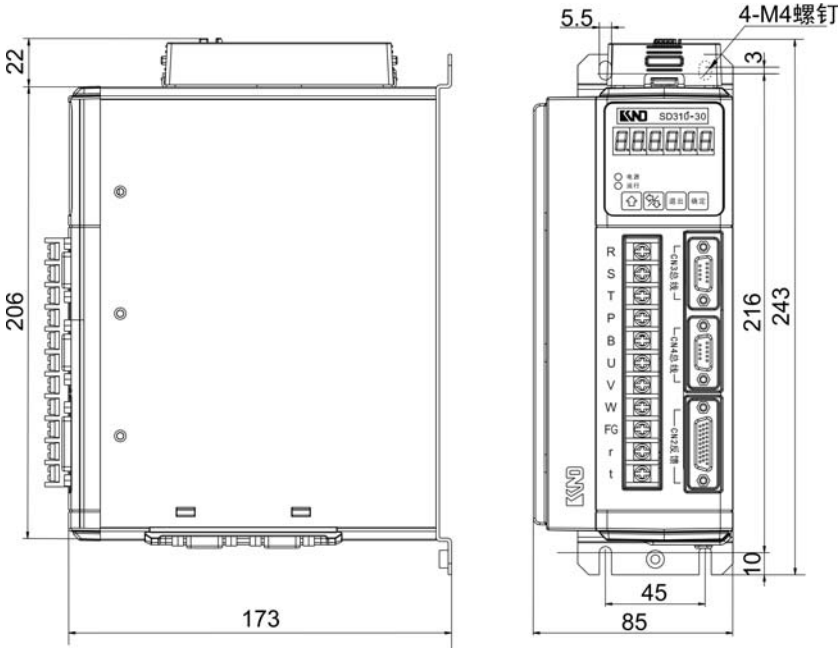


Figure 1.1 KND SD310/311－30 installation dimension (unit: mm)

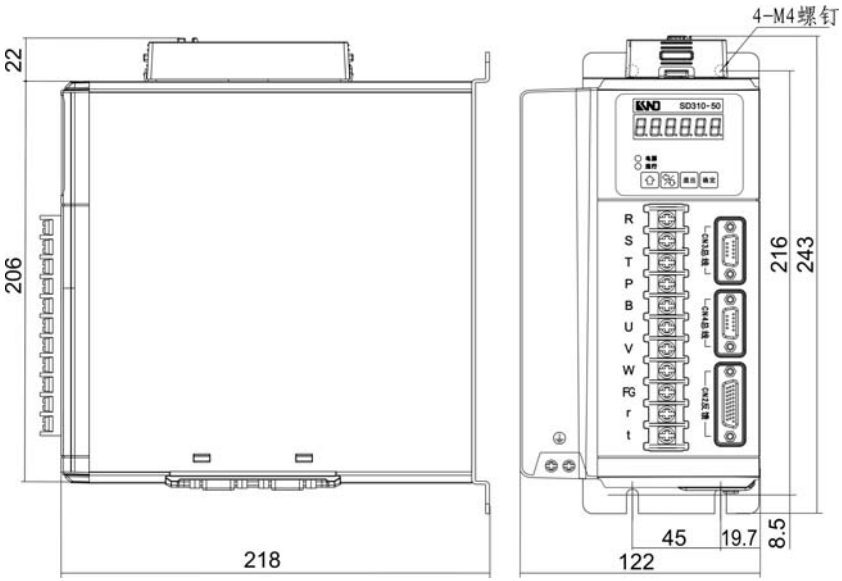


Figure 1.2 KND SD310/ 311－50 installation dimension (unit: mm)

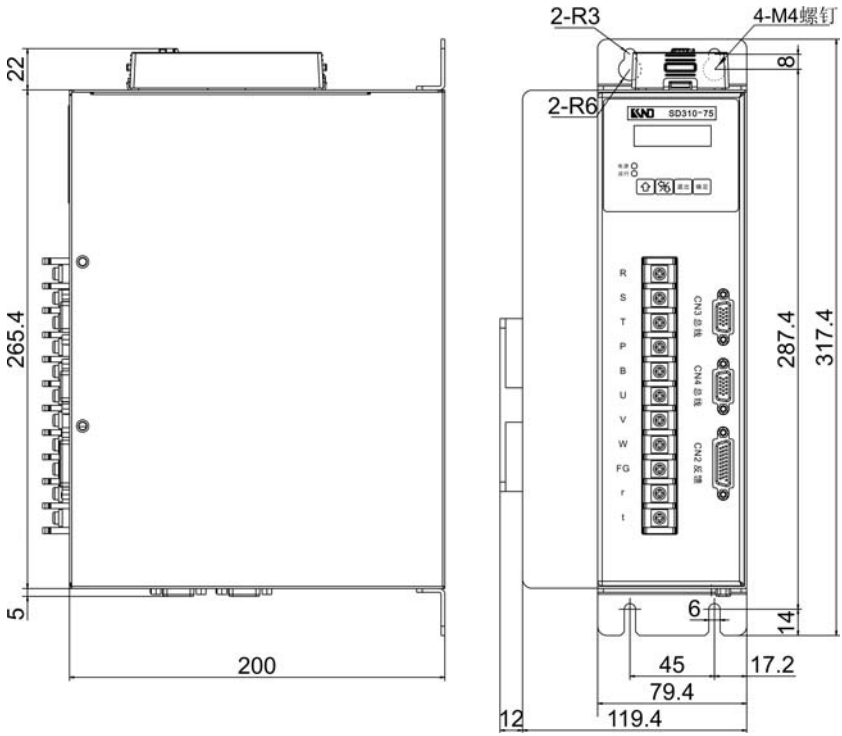


Figure 1.3 KND SD310/311－75/100 installation dimension (unit: mm)

1.3 Name Plate

<table>
<tr><td rowspan="5">凯恩帝数控 KND CNC SYSTEM

AC SERVO DRIVER

Model: SD310

Serial No.:

Voltage: AC220V 50/60Hz</td><td colspan="2">⚠ WARNING
1. Refer to the manual when wiring and installing.
2. Don't touch the driver in 3 minutes after power-off
3. Dangerous for users to open it.
4. Grounding firmly and supply power through transformers</td></tr>
<tr><td colspan="2">Specifications</td></tr>
<tr><td>Version</td><td></td></tr>
<tr><td>Model</td><td>☐General ☐Special</td></tr>
<tr><td>Absolute encoder type</td><td>☐Battery
☐Mechanical</td></tr>
</table>

Figure 1.4 Name plate of SD310/ SD311

Version

Software version

Model

SD310 drivers are available for both general applications and special applications.

Absolute encoder type

The following types of motors are available when using battery encoders:

- Motors with incremental encoders (Battery box is not necessary)
- Motors with 17-bit single-circle or 0-bit multi-circle absolute encoders (Battery box is not necessary)
- Motors with 17-bit single-circle or 16-bit multi-circle absolute encoders (Need Battery box)

The following types of motors are available when using mechanical encoders:

- Motors with incremental encoders (Battery box is not necessary)
- motors with 17-bit single-circle or 12-bit multi-circle absolute encoders (Battery box is not necessary)

2 Installation and Wiring

2.1 Installation Surroundings

2.1.1 Electrical cabinet

Generally, the temperature in electrical cabinet is higher than that of surroundings.

Working in high temperature will obviously reduce the servo drivers' service life and increase the failure rate. Be careful to arrange the components in cabinet and consider the cooling for servo drivers. Ensure that the temperature around these drivers is below 55°C (below 45°C when working for long-term) and the relative humility (RH) is less than 90%.

2.1.2 Vibratory equipment

Make sure that the vibrating acceleration speed is less than 0.5g (4.9m/s2).

2.1.3 Application condition

This driver is designed for ordinary application conditions. It is recommended to install them in electrical cabinet to prevent them from corrosive gases and liquids, water or metallic particles.

To use them in these adverse conditions, please contact KND.

2.1.4 EMI

Some interfere signals emitting from the equipment around may result in the servo driver working unexpectedly. It is recommended to install a noise filter and an insulating transformer at the power supply interface and pay attention to the leak current. Install the control signals cable carefully because they are easily to be interfered.

2.2 Installation Method

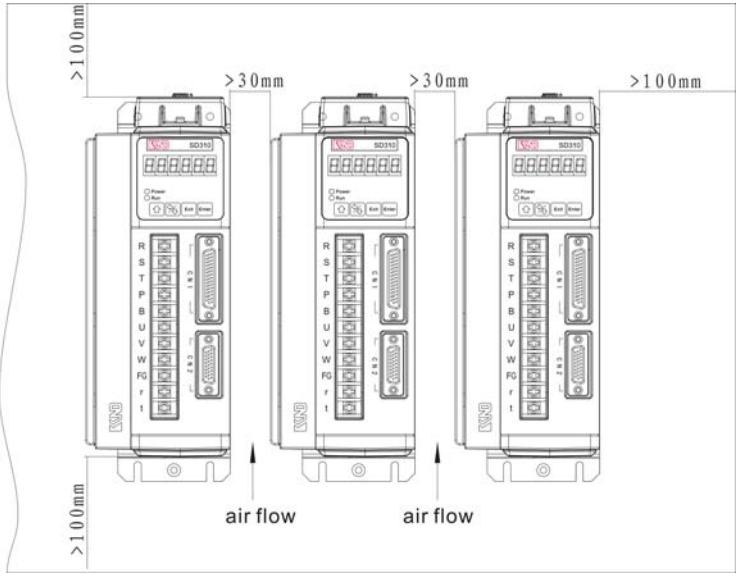


Figure 2.1 SD310/SD311 Installation dimension

1 Direction

Install vertically.

2 Mounting

Four M5 screws are necessary to mount the servo driver.

3 Install distribution

Refer to the Figure 2.1 above to install servo drivers in the cabinet. Bigger space between servo drivers is recommended to ensure well elimination of heat.

4 Heat elimination

Servo driver adopts natural cooling method. Installing a fan in the cabinet is necessary for cooling.

5 Notice

◆ When installing, be careful to prevent iron chips, screws, mill dusts and some other objects entering inside of servo drivers. Servo drivers are designed for given types of AC permasyn motors. Do not attempt to control mismatching servo motors.

2.3 Wiring

2.3.1 Wiring

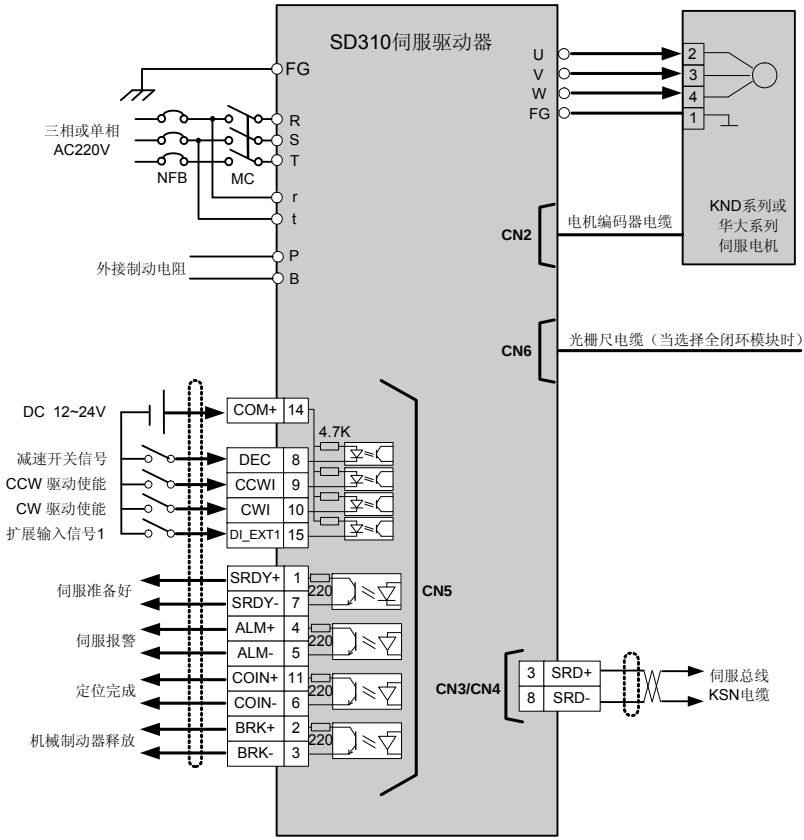


Figure 2.2 Standard wiring for SD310/ SD311

2.3.2 Cable specification

1 Power supply terminals

- Select line width of R, S, T, U, V, W and FG according to table 2.1.
- Use insulated chill-pressing terminals and connect firmly.

- Use strong grounding lines. Connect the grounding terminals of the servo motor and the driver firmly. The ground resistance should be less than 100Ω.
- It is recommended to supply power to servo driver through three phase insulating transformers.
- Install noise filters to reduce interfere.
- Install circuit breaker to protect the servo driver when some accident happens.

2 Digital IO signal interface CN5, motor encoder signal interface CN2 and grating ruler signal interface CN6

- Use shielded cables (twisted pair line is recommended) for transform control signals and the line width should be bigger than 0.12 mm^2.
- Cables should be as short as possible. Command signal cables should be 15 meters or less and encoder feedback cables should be 20 meters or less.
- Control signal cables and power cables should be installed separately.

3 Servo bus cables CN3 and CN4

Use the servo bus cables supplied by KND.

Table 2.1 Specifications of circuit breaker, contactor and main circuit cable

Model SD310/SD311	Circuit breaker （A）	Contactor （A）	Main circuit cable (copper conductor) （mm^2）
30	25	16	1.5/2.5
50	40	32	2.5/4.0
75	63	40	4.0/6.0
100	63	40	6.0

2.4 Cautious

1 Connect the UVW terminals of drivers with those of servo motors correspondingly. Do not attempt to change the rotary direction of a servo

motor in the method of exchanging the order of UVW terminals, which is totally different from the method used by step motors and asynchronous motors.

2 High frequency switching current, which is necessary to control servo motors, will lead to relatively high level leakage current. Connect the grounding terminals (FG) of servo drivers and motors together and ground it to earth. It will prevent electric shocking and malfunctions.

3 Large value capacitors are used inside of SD310. In short time after turning off the power, high voltage still exists in the circuits. To prevent electric shocking, wait at least 10 minutes to touch servo drivers or motors after turning off the power.

4 Ordinary operators should keep distance from servo drivers and motors when the power is turned on.

5 Cut off the power to servo drivers when they are not used in a long time.

3 Interface

3.1 Power Supply Terminals

No.	Mark	Name	Function
1	R	Main circuit power supply	Single phase or three phase AC220V 50Hz Note: Do not connect to U, V, W.
2	S		
3	T		
4	P	External braking resistor	Consume the regenerative energy inside of servo drivers when servo motors are braking.
5	B		
6	U	Power supply for servo motor	Connect to U, V, W terminals of servo motors correspondingly
7	V		
8	W		
9	FG	Grounding terminals	Connect to shell ground and protective ground of servo motors.
10	r	Control circuit power supply	Single phase AC220V 50Hz
11	t		

Method for using external brake resistors

Generally, it is not necessary to connect an external brake resistor at the P and B terminals. If the regenerative energy in deceleration process is too large to be consumed by the internal braking resistor, alarm Er.002, Er.017 or Er.014 may happen. In this case, try to increase the deceleration time. If the alarm still happens, external braking resistor is needed to improve the braking effect.

The resistance range of braking resistors is about from 40Ω to 200Ω and its power is about from 100W to 50W. The smaller resistance, the bigger braking current and the bigger power consumed. Note that too small resistance may result in the damage of servo drivers. It is recommended to select an appropriate resistance in the method of changing braking resistance from big to small until the alarm is not issued any more. External braking resistor can be installed in parallel with internal ones. Wait at least 10 minutes after turning off the power before touching servo drivers.


WARNING

P and B terminals are connected with internal high voltage circuits. To prevent electric shocking, do not touch P and B terminals when servo driver is working or in 10 minutes when its power is turned off. Keep P and B terminals away from other terminals to prevent short-circuit or damage to the drivers.

3.2 Servo Bus Interface CN3 & CN4

No.	Mark	Name	Function
1/2/4 5/6/7/9	—	—	—
3	SRD+	Servo bus (KSN) signal	Servo bus (KSN) communication signals
8	SRD-		

Note: The terminals' arrangement of CN3 and CN4 are the same. Only SRD+ and SRD- are used for communication. Other terminals are not used and should be unconnected.

3.3 Encoder Signal Input Interface CN2

No.	Function	Name	I / O Type	Description
8/17/ 18	5V power supply	+5V	—	Power supply for encoders. To reduce line voltage drop, use multiply wires to connect these signals when the cable is too long.
10～ 16	Power Supply Grounding	0V	—	
1	A+ Input	A+	Type 3	Connect to the A+ terminal of incremental encoder
2	A- Input	A-		Connect to the A- terminal of incremental encoder
3	B+ Input	B+	Type 3	Connect to the B+ terminal of

No.	Function	Name	I / O Type	Description
				incremental encoder
4	B- Input	B-		Connect to the B- terminal of incremental encoder
5	Z+ Input	Z+	Type 3	Connect to the Z+ terminal of incremental encoder
6	Z- Input	Z-		Connect to the Z- terminal of incremental encoder
19	U+ Input	U+	Type 3	Connect to the U+ terminal of incremental encoder
20	U- Input	U-		Connect to the U- terminal of incremental encoder
21	V+ Input	V+	Type 3	Connect to the V+ terminal of incremental encoder
22	V- Input	V-		Connect to the V- terminal of incremental encoder
23	W+ Input	W+	Type 3	Connect to the W+ terminal of incremental encoder
	D+	D+	Type 4	Absolute encoder communication signal D+
	BISS_MAY	BISS_Y		Absolute encoder communication signal MAY
24	W- Input	W-	Type 3	Connect to the W- terminal of incremental encoder
	D-	D-	Type 4	Absolute encoder communication signal D-
	BISS_MAZ	BISS_Z		Absolute encoder communication signal MAZ
7	Power supply for battery	VBAT	—	Power supply for battery of absolute encoder

No.	Function	Name	I / O Type	Description
25	BISS_SLA	BISS_A	Type 4	Absolute encoder communication signal SLA
26	BISS_SLB	BISS_B		Absolute encoder communication signal SLB
Shell	Shielded line	FG	—	Shielded grounding terminal

3.4 Digital Input /Output Interface CN5

No.	Function	Name	I / O Type	Description
14	Positive pole for input signals	COM+	—	DC12~24V, ≥100mA Drive the light electric coupler of input signals
15	Extended DI (Note 1)	DI_EXT1	Type 1	Extended DI signal
8	Deceleration switch	DEC	Type 1	Deceleration switch input signal DEC ON: Active DEC OFF: Inactive
9	CCW Enable (Note1)	CCWI	Type 1	Input signal to enable CCW rotation CCWI ON: Enable CCWI OFF: Disable Note1: Used by over-travel limitation function. When turned off, CCW rotation is disabled. Note2: Setting PA82.1 to 0 can mask this function without connecting this signal.

No.	Function	Name	I / O Type	Description
10	CW Enable (Note1)	CWI	Type 1	Input signal to enable CW rotation CWI ON: Enable CWI OFF: Disable Note1: Used by over-travel limitation function. When turned off, CW rotation is disabled. Note2: Setting PA82.1 to 0 can mask this function without connecting this signal.
1	Servo Ready (Note2)	SRDY+	Type 2	ON: Circuit power is turned on and no alarm happens. OFF: No power supply or some alarm happens
7		SRDY-		
4	Servo Alarm (Note2)	ALM+	Type 2	Servo alarms output signal ON: No alarms OFF: Some alarm occurs
5		ALM-		
11	Positioning finished /Speed arrived/ Torque limit output (Note2)	COIN+ VCMP+ VLT+	Type 2	Positioning finished output signal COIN in position control mode ON: Position offset exceeds the specified range. OFF: Position offset is less than specified value. Speed arrived output signal VCMP in speed control mode ON: Rotation speed is in specified range OFF: Rotation speed is not in specified range Torque limit output signal VLT in torque control mode. ON: Torque limited state OFF: Normal state
6		COIN- VCMP- VLT-		
2	Mechanical brake	BRK+	Type 2	This signal is used to control brake of motors with mechanical

No.	Function	Name	I / O Type	Description
3	release (Note2)	BRK-		brake. ON: Disable braking, motor is free OFF: Enable braking, motor is clamped

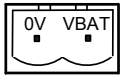
Note 1: Polarity of these input signals can be selected conveniently by setting PA59. The description above uses the default setting of PA59 (00000). PA54 can be used to simulate these input signals when no cable is connected to these terminals.

Note 2: Polarity of these output signals can be set by PA57. The description above use the default setting of PA57 (0000)

3.5 Grating Ruler Interface CN6（SD311driver）

No.	Function	Name	I / O Type	Description
1	GSCLK+	CLK+	Type 4	Absolute grating ruler signal CLK+
	GSB+	B+	Type 3	Incremental grating rule signal B+
2	GSCLK-	CLK-	Type 4	Absolute grating ruler signal CLK-
	GSB-	B-	Type 3	Incremental grating rule signal B-
4	GSDATA+	DATA+	Type 4	Absolute grating ruler signal DATA+
	GSA+	A+	Type 3	Incremental grating rule signal A+
5	GSDATA-	DATA-	Type 4	Absolute grating ruler signal DATA-
	GSA-	A-	Type 3	Incremental grating rule signal A-
6	GSZ+	Z+	Type 3	Incremental grating rule signal Z+
11	GSZ-	Z-	Type 3	Incremental grating rule signal Z-
3/7/9 10/14	0V	GND	—	Power supply for grating rules. To reduce line voltage drop, use multiple wires to connect these signals when the cable is too long.
8/12 13/15	+5V	+5V	—	

3.6 Battery Box CN3A/CN3B

No.	Function	Name	I / O Type	Description
1	Positive pole of battery	VBAT	—	 When the plug is placed as above, the left terminal is 0V, and the right terminal is VBAT.
2	Negative pole of battery	0V	—	

3.7 Interface Terminals Arrangement

The types of sockets on SD310 are as follows: CN2 adopts DB26-3 (female) sockets, CN3 and CN4 adopt DB9 (female) sockets, CN5 adopts DB15-3 (female) sockets, and CN6 adopts DB15-3 (male) sockets. The socket arrangements on cables are as follows:

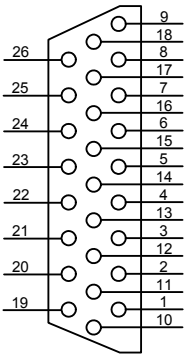


Figure 3.1 Socket connecting to CN2 (DB26-3) (male)

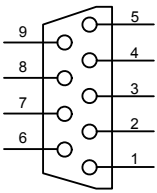


Figure 3.2 Socket connecting to CN3 & CN4 (DB9) (male)

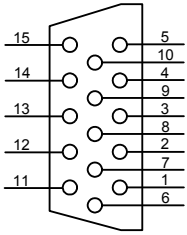


Figure 3.3 Socket connecting to CN5 (DB15-3) (male)

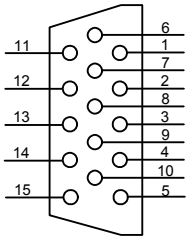
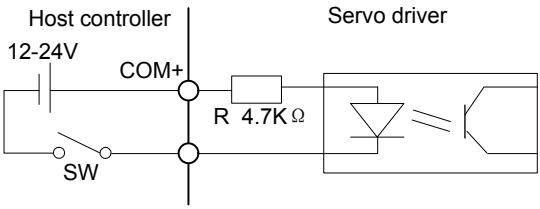
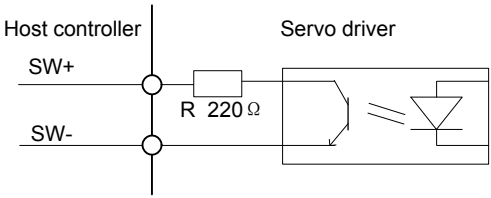
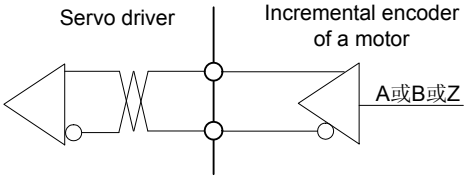
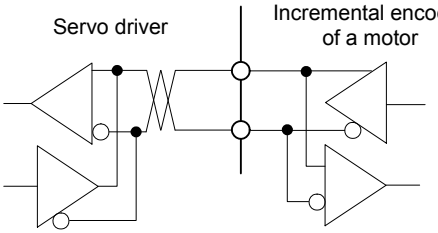


Figure 3.4 Socket connecting to CN6 (DB15-3) (female)

3.8 Input/Output Interface Types

Type	Name	Remarks
1	Switching value input signals	 1. Power supply: DC12~24V, ≥100mA 2. Reversed power polarity or improper voltage may result in the servo driver working unexpectedly.
2	Switching value output signals	

		 1. External power is provided by users, and reversed power polarity may damage servo drivers. 2. Use open-collector output signals, the maximum current is 50mA, and the maximum voltage is 25V. Overload may damage servo drivers. 3. For inductive loads such as relays, install a fly-wheel diode in parallel reversely. Improper installation may damage servo drivers.
3	Input signals from incremental encoders or grating rulers	 Received by 26LS32, level as same as RS422
4	Absolute encoders or grating rulers communication interface	 Sent or received by using SN65HVD05

4 Parameters

4.1 Parameter Explanations

PA00	Default	Min.	Max.	Unit
	315	0	65535	---
	Operation password			

- Set PA00 to 315 to get the authority to change modifiable parameters except for PA01 (Motor model selection), PA33 (Enable driver by force), PA26 (Zero drift of motor encoders) and reversed parameters.
- Set PA00 to 385 to get the authority to change modifiable parameters except for reversed parameters.
- When setting PA00 to other values, all parameters except for PA00 are read only.
- Modification of parameter PA00 itself is unlimited by operation password.

Note

- PA00 is volatile which means that its value will always be default ones when power-on.
- EE-DEF operation does not affect PA00.

PA01	Default	Min.	Max.	Unit
	---	---	---	---
	Motor model selection			

Please refer to <Parameter List of Motor Model> of appendix for details of setting operation.

Note

- Set PA00 to 385 or higher authority password before setting this parameter.
- Do not set this parameter in running state. If Er.15 occurs after setting, restart servo drivers to valid the setting. If no error occurs, the setting will be effective immediately.
- Motor models supported are different from the servo drivers' models.

- When using motors with saving-line encoders, set PA36 to 1 to mask Er.032.
- EE-DEF operation does not affect PA00.

PA02	Default	Min.	Max.	Unit
	---	---	---	---
	Main software version			

- PA02 displays the main software version and is read only.
- Extended software version can be read from the monitoring menu UER.
- Software version consists of main software version and extended ones which are printed on the name plate of drivers.

PA03	Default	Min.	Max.	Unit
	SPEED	---	---	---
	The default monitoring item when power-on			

- PA03 are used to select the default monitoring item (DP) when the power is turned on.
- If no keys are pressed after power-on, this monitoring item will be displayed all the time.

SPEED	Rotation speed	PLS_L	Reserved
POS_L	Lower 6-bit of motor position	PLS_H	Reserved
POS_H	Higher 4-bit of motor position	TRQ	Percentage of outputting torque
CPO_L	Lower 6-bit of command position	IA	Current of U-phase
CPO_H	Higher 4-bit of command position	IB	Current of W-phase
EPO_L	Lower 6-bit of command position	CNT	Control mode
EPO_H	Higher 4-bit of command position	CS	Speed command

PA04	Default	Min.	Max.	Unit
	POS	---	---	---
	Control mode selection			

Control modes:

POS	Position control mode
SPD	Velocity control mode
TOR	Torque control mode
D-SPD	Pilot running in velocity control mode
A-POS	Single-axis positioning control mode

Note

- Change PA04 when motors are not running.

PA05	Default	Min.	Max.	Unit
	40	1	200	Hz
	Gain of velocity circulation			

- It affects the response speed and reliability of velocity circulation.
- After setting PA55, the value of PA05 is also changed automatically.

Note

- Generally, it is not necessary to change the value of PA05.

PA06	Default	Min.	Max.	Unit
	25	1	1000	ms
	Integral time constant of velocity circulation			

- It affects the response speed and reliability of velocity circulation.
- After setting PA55, the value of PA06 is also changed automatically.

Note

- Generally, it is not necessary to change the value of PA06.

PA07	Default	Min.	Max.	Unit
	160	1	4000	Hz
	Band width of the torque filter			

After setting PA55, the value of PA07 is also changed automatically.

Note

◆ Generally, it is not necessary to change the value of PA07.

PA08	Default	Min.	Max.	Unit
	0001	—	—	—
	Functional selection parameter 5			

Rightmost bit: Monitoring function for abnormality of closed loop
0: Closed
1: Open
2nd bit: —
3rd bit: —
Leftmost bit: —

PA09	Default	Min.	Max.	Unit
	40	1	200	1/s
	Gain of position circulation			

◆ It affects the response speed and reliability of position circulation.

◆ After setting PA55, the value of PA09 is also changed automatically.

Note

◆ Generally, it is not necessary to change the value of PA09.

PA10	Default	Min.	Max.	Unit
	0	0	100	%
	Feedforward factor of position circulation			
Increasing its value will reduce the position following deviation, but too big value will result in machine tools vibrating.				

PA11	Default	Min.	Max.	Unit
	1000	50	2000	Hz
	Band width of the feedforward filter of velocity circulation			
Generally, it is not necessary to change the value of PA11.				

PA12/PA13	Default	Min.	Max.	Unit
	1	1	32767	---
	Numerator of electric gear ratio/Denominator of electronic gear ratio			

Electronic gear ratio determines the unit relationship between command and feedback pulses from encoders.

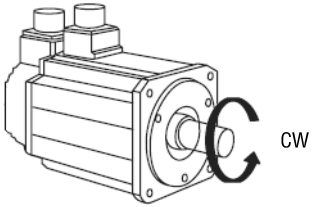
Note

- This function is valid only when drivers are in position control mode (PA04=POS).
- Electronic gear ratio associates with motor encoders, but not grating rulers. The unit relationship between command and feedback pulses from grating rulers are specified by parameters about grating rulers including PA87, PA89 and so on.
- Electronic gear ratio should range from 1/1000 to 1000.

PA15	Default	Min.	Max.	Unit
	0	0	1	---
	Reverse the rotation direction of motors			

0: Normal 1: Reverse

Watching motors from the axis heads, the counterclockwise direction is defined as the positive direction (CW). Reversely, the clockwise direction is defined as the negative direction (CCW).



When PA15 is set to 0, if positioning commands are positive or VCMD/TCMD is a positive value, motors rotate in the positive direction (CW).

When PA15 is set to 1, if positioning commands are positive or VCMD/TCMD is a positive value, motors rotate in the negative direction (CCW).

The rotation direction of motors depends on two elements:

- The value of PA15
- Commands directions

PA16	Default	Min.	Max.	Unit
	1	0	20000	0.001 r
	The range used to judge the positioning completion			

In position control mode (PA04=POS), if the position following deviation is less than the value of PA16, the COIN signal is effective.

PA17	Default	Min.	Max.	Unit
	2000	0	20000	0.001 r
	Threshold value to judge position deviation alarm			

In position control mode (PA04=POS), if the position following deviation is bigger than the value of PA17, Er.004 occurs.

PA18	Default	Min.	Max.	Unit
	1.0	0.0	1000.00	s
	Delay time when performing the single-axis positioning			
In single-axis positioning control mode, PA19 is used to specify the delay time between the pre-performed single-axis positioning operation and the next one.				

PA19	Default	Min.	Max.	Unit
	0	0	1000	ms
	Position command exponential filtering time			
Position command exponential filtering time 0: No filtering Others: Filtering time				

PA20	Default	Min.	Max.	Unit
	120	50	300	%
	Percentage of maximum motor speed (corresponding to rated motor speed)			
Percentage of maximum motor speed				

PA21	Default	Min.	Max.	Unit
	0	0	Rated rotation speed×120%	r/min
	Speed in D-SPD mode			
PA21 is used to specify the speed of pilot running in velocity control mode.				

Note

- PA21 is volatile which means its value won't be kept after turning off the power.

PA22	Default	Min.	Max.	Unit
	1000	0	1000	ms
	Time constant of the double position feedback filter			
When using the closed loop control function, setting PA22 is necessary to use the feedback data from grating rules.				

PA25	Default	Min.	Max.	Unit
	10	1	500	r/s^2
	Absolute value of acceleration speed in A-POS mode			
In A-POS mode, the absolute value of acceleration speed is specified by PA25.				

PA26	Default	Min.	Max.	Unit
	Relate to motors	0	65535	---
	Zero drift of motor encoders			
Set zero drift value of motor encoders (incremental). Generally it is not necessary to set this parameter.				

Note

- Set PA00 to 385 or higher authority password before setting PA26.
- After setting PA26, Er.015 will occur. Restart the driver to make the setting active.
- EE-DEF operation does not affect PA26.

PA29-PA32	Default	Min.	Max.	Unit
	0	-5000	5000	r/min
	Speed of single-axis positioning			
In A-POS mode, motors travel to the positions specified by PA49~PA52 at the corresponding speeds specified by PA29~PA32.				

PA33	Default	Min.	Max.	Unit
	OFF	OFF	ON	---
	Enable the driver by force			

The parameter is used in pilot running or single-axis positioning control mode when no host controller is equipped.

Note

- Set PA00 to 385 or higher authority password before setting this parameter.
- The value is volatile.
- When an error happens, PA33 is set to OFF status automatically.

PA34/PA35	Default	Min.	Max.	Unit
	300	0	300	%
	Torque limitation ratio			

Setting a proper torque limitation ratio will prevent some damage to machine tools. This function is available for any control mode specified by PA04.

PA36	Default	Min.	Max.	Unit
	0	0	1	---
	Incremental encoder error detection			

0: Detect 1: Do not detect the error from encoders

When using saving-line encoders, set PA36 to 1 to mask the Er.032.

PA37	Default	Min.	Max.	Unit
	0	0	5000	r/min
	The absolute value of speed when VCMP signal is active			

In SPD and D-SPD mode, if the rotation speed of motors is in the range specified by PA37 and PA38, VCMP is effective.

PA38	Default	Min.	Max.	Unit
	10	0	5000	r/min
	The fluctuation of speed when VCMP signal is active			

In SPD and D-SPD mode, if the rotation speed of motors is in the range specified by PA37 and PA38, VCMP is effective.

PA40/PA41	Default	Min.	Max.	Unit
	0	0	1000	ms
	Time constant of acceleration and deceleration in SPD & D-SPD mode			

0: No filting Other value: Time constant of filting

Note

◆ If the acceleration and deceleration process are controlled by host controllers, set PA40 and PA41 to 0.

PA43	Default	Min.	Max.	Unit
	500	0	5000	r/min
	Upper speed limitation in TOR mode			

If the rotation speed of motors reaches this upper limitation in TOR mode, drivers will automatically reduce the torque outputting to keep the actual rotation speed lower than the value of PA43.

PA44	Default	Min.	Max.	Unit
	30000	－30000	30000	Determined by PA82.2
	Maximum traversing distance in the positive direction			

The unit is 1000 or 10000 times of the command division from host controllers. For example, if 1 pulse from host controllers corresponds to 0.1 μm a machine tool moves actually, the unit of this parameter is 1 mm (10000×0.1μm).

PA45	Default	Min.	Max.	Unit
	−30000	−30000	30000	Determined by PA82.2
	Maximum traversing distance in the negative direction			

The unit is 1000 or 10000 times of the command division from host controllers. For example, if 1 pulse from host controllers corresponds to 0.1 μm a machine tool moves actually, the unit of this parameter is 1 mm (10000×0.1μm).

PA46/47	Default	Min.	Max.	Unit
	900	1	1000	---
	Depth of the 1st and 2nd trap filters			

- When using trap filters, decreasing the values of PA46 and PA47 will reduce the damping of servo systems.
- Generally there is no need to change these parameters.

PA48	Default	Min.	Max.	Unit
	150	100	600	%
	Velocity monitoring coefficient			

Generally there is no need to change this parameter.

PA49-PA52	Default	Min.	Max.	Unit
	0	−30000	30000	Determined by PA77.2
	Position commands in A-POS control mode			

These parameters are used to specify positions in single-axis positioning control mode.

PA54	Default	Min.	Max.	Unit
	0000	---	---	---
	Simulated states of input signals			

0: No effect 1: The corresponding input signal is effective by force

3	2	1	0
POSI_RDY	DEC	CCWI	CWI

PA54 is available to simulate the states of one or more input signals which are wanted to be used with no lines connected to the corresponding terminals. For example, setting PA54 to 1000 will enable the input signal POSI_RDY.

PA55	Default	Min.	Max.	Unit
	4	0	12	---
	Rigidity of servo systems			

Higher rigidity of servo systems and quicker response will be obtained by increasing the value of PA55.

Note

- The values of PA05, PA06, PA07 and PA09 will be changed at the same time when changing the value of PA55, But the operation of changing PA05, PA06, PA07 and PA09 do not affect PA55.

PA56	Default	Min.	Max.	Unit
	100	50	800	%
	Load inertia ratio			

- The value of PA56 represents the ratio of loads' inertia to motors' inertia.
- The ratio affects the performance of servo systems.
- It is not recommended to set this parameter manually. Performing the –tU1 operation will automatically change its value.

PA57	Default	Min.	Max.	Unit
	0000	---	---	---
	Reverse the polarity of output signals			

0: Normal

1: Reverse the polarity

3	2	1	0
BRK	CO N / VCMP / VLT	ALM	SRDY

If the active polarities of one or more output signals do not meet your application, use PA57 to reverse their polarity.

PA58	Default	Min.	Max.	Unit
	0	0	500	10ms
	Delay time from the beginning of external brake working to cutting off the controlling of motors			

- PA58 is useful when driving servo motors with mechanical brakes.
- If movement of motors happens when cutting off the power, increasing the value of PA58 may be helpful.

PA59	Default	Min.	Max.	Unit
	0000	---	---	---
	Reverse the polarity of input signals			

0: Normal

1: Reverse the polarity

3	2	1	0
POSI_RDY	DEC	CCWI	CWI

If the active polarities of one or more input signals do not meet your application, use PA57 to reverse their polarity.

Note

- PA59 only affects input signals. For example, if the normal state of one

input signal is 0, while after reversing the polarity by setting PA59, its normal state is regarded as 1.

- Internal states of input signals after the effect of PA59 are displayed in the IN item in DP menu. For servo drivers, the active polarity of input signals is always 1. For example, when the state of CCWI is 1, motors are allowed to rotate in the negative direction while when its state is 0, motors are prohibited to rotate in the negative direction.

PA60	Default	Min.	Max.	Unit
	100	10	600	%
	Gain of friction compensation (%)			
Friction compensation parameter				

PA61	Default	Min.	Max.	Unit
	0	0	100	%
	Factor of friction compensation (%)			
Friction compensation parameter				

PA62	Default	Min.	Max.	Unit
	0	0	100	%
	Amendment for gain of friction compensation (%)			
Friction compensation parameter				

PA65	Default	Min.	Max.	Unit
	1	1	32767	---
	Numerator of gear ratio between motor and rotary table (Turned circles of motor)			
When rotary table function is activated, PA65 must be set.				

PA66	Default	Min.	Max.	Unit
	1	1	32767	---
	Denominator of gear ratio between motor and rotary table (Turned circles of rotary table)			
When rotary table function is activated, PA66 must be set.				

PA70	Default	Min.	Max.	Unit
	1	1	16	---
	Servo bus (KSN)node address			

It specifies the node address of a servo driver in the servo bus (KSN) system. The node addresses of different servo drivers in one servo bus (KSN) system should not be the same, otherwise some communication malfunction will happen.

Note

- Don't set PA70 when motors are running.
- Er.015 will be issued after setting PA70, restart the driver.
- EE-DEF operation does not affect the value of PA70.
- Servo bus (KSN) is not available for setting this parameter and it can be set only by keys on panel manually.

PA71/PA72	Default	Min.	Max.	Unit
	0	0	999	---
	Monitoring items of servo bus (KSN)			

Set monitoring items of servo bus (KSN)

No.	Monitoring value	Description	Unit
0	Rotation speed scale of mot rs	(Rotation speed/Maximum speed) × 0x0100_0000	Scale
1	Specified speed scale of motors	(Specified speed/Maximum speed) × 0x0100_0000	Scale

2	Torque scale outputting	(Torque outputting /Maximum torque) × 0x0100_0000	Scale
3	Lower 32-bit of position deviation	Position deviation	Command unit
4	Higher 32-bit of position deviation		Command unit
10	Lower 32-bit of feedback position	Feedback position from encoders	Command unit
11	Higher 32-bit of feedback position		Command unit
12	Lower 32-bit of feedback position	Feedback position from grating rules	Command unit
13	Higher 32-bit of feedback position		Command unit
16	Rotation speed of motors	Current rotation speed of motors	r/min
17	Specified speed of motors	Current specified speed of motors	r/min
18	Torque ratio specified	(Torque specified/Rated torque) ×100	%
19	Electrical angle of rotors	Based on encoders' unit	Encoder unit
20	Electrical angle of rotors	Current rotation speed of motors	Degree
21	DI	DI signals come from IO interface of drivers. Lower 16 bits are effective. These monitoring items are input values after they are specified by PA54 and PA59. When both PA54 and PA59 are set to 1, this function is effective.	---

		BIT 1: CWLI BIT 2: CCWLI BIT 6: DEC BIT10: POSI_RDY	
22	DO	DO signals come from IO interface of drivers. Lower 16 bits are effective. These monitoring items are output values before they are specified by PA57. When SRDY signal is set to 1 or BRK, COIN and ALM signals are set to 0, this function is effective. BIT 0: SRDY BIT 1: ALM BIT 2: COIN BIT 3: BRK	---
24	Position deviation	Position deviation	Command unit
28	Specified position	Specified position	Command unit
29	Feedback position	Feedback position from encoders	Encoder unit
30	Feedback position	Feedback position from grating rulers	Grating ruler unit
500	Current of U-phase	Current of U-phase	mA
501	Current of W-phase	Current of W-phase	mA
502	Current control modes	0: Position control mode 1: Velocity control mode 2: Torque control mode 15: Open loop control mode	---
505	Load ratio of CPU	Load ratio of CPU	%
509	Error code of servo bus (KSN)	Corresponding detailed error code of driver alarm AL148 (Illegal servo bus (KSN)	---

		command or data)	
513	Angle of rotary table	Angle of rotary table 0 ～ Command number for rotary table turns one circle-1	Command unit

Note:

- The maximum speed of motors = Rated speed × 1.2
- Then maximum torque of motors = Rated torque × (PA34 or PA35) / 100

PA73	Default	Min.	Max.	Unit
	0000	—	—	—
	3rd parameter for selecting functions			

Rightmost bit: When low voltage of external battery of absolute encoders happens, the drivers will output

0: Alarms (Default)

1: Warnings

2nd bit: —

3rd bit: TU3 mode for incremental encoders

0: Search Z signal manually

1: Search Z signal automatically

Leftmost bit: Rotary table function

0: Invalid

1: Valid

PA77	Default	Min.	Max.	Unit
	0000	—	—	—
	2nd parameter for selecting functions			

Rightmost bit: Open phase (Er010) check

0: Permitted

1: Forbidden

2nd bit: Velocity monitor

0: Closed

1: Open

3rd bit: Unit of single-axis positioning

0: 1r

1: 0.1r

2: 0.01r

3: 0.001r

Leftmost bit: Position deviation (Er004) check

0: Permitted

1: Forbidden

PA78	Default	Min.	Max.	Unit
	5.00	0.00	100.00	转
	Maximum distance before stop when overtravel happens			

If the function of stop after deceleration is enabled (PA79), the value of PA78 represents the maximum distance motors move from the overtravel signal is effective to motors' stop.

If the function of stop after deceleration is enabled (PA79), this parameter is meaningless.

Note

- The value of PA78 represents the maximum distance motors move. If the rotation speed of a motor is low when the overtravel signal comes, the motor stops quickly, and the movement distance shall be smaller than the value of PA78.

PA79	Default	Min.	Max.	Unit
	0000	—	—	—
	1st parameter for selecting functions			

Rightmost bit: Method for stopping when overtravel happens

0: Cut off the power to motors after deceleration (Er.038)

1: Do not cut off the power to motors after deceleration

2: Cut off the power to motors immediately (Er.038)

3: Controlled by host controllers 2nd bit: Source of feed forward torque 0: From internal of servo drivers 1: From the command of servo bus (KSN) 3rd bit: Friction compensation function switch 0: OFF 1: ON Leftmost bit: Exchange the position of input signals of CCWI and CWI 0: Normal 1: Exchange

PA80/PA83	Default	Min.	Max.	Unit
	4000	100	4000	Hz
	1st and 2nd frequency of trap filters			
Specify 1st and 2nd frequency of trap filters. PA80 and PA83 are helpful to improve the performance of some servo systems in which one or more resonant points exist.				

PA81/PA84	Default	Min.	Max.	Unit
	47	1	100	---
	Quality factors of 1st and 2nd trap filters			
Specify the quality factors of 1st and 2nd trap filters.				

PA82	Default	Min.	Max.	Unit
	0000	—	—	—
	4th parameter for selecting functions			
Rightmost bit: Software overtravel limit function 0: OFF 1: ON 2nd bit: Hardware overtravel limit function				

0: OFF

1: ON

3rd bit: Setting unit of software overtravel limit

0: Setting unit from host controller ×1000

1: Setting unit from host controller ×10000

Leafmost bit: —

PA85	Default	Min.	Max.	Unit
	0	0	2	---
	Grating ruler types			

0: No grating rulers

1: Incremental rulers

2: Absolute rulers

Note

- Do not set this parameter when motors are running.
- After setting PA85, Er.015 will occur. Restart the driver to enable the setting operation.

PA86	Default	Min.	Max.	Unit
	0	0	1	---
	Installation direction of grating rules			

0: In the positive direction

1: In the negative direction

Note

- Do not set this parameter when motors are running.
- After setting PA86, Er.015 will occur. Restart the driver to enable the setting operation.

PA87	Default	Min.	Max.	Unit
	6	1	100	毫米
	Pitch of leadscrew			

Set pitch of leadscrew.

1 Set this parameter correctly when using the closed loop function.

Note

◆ Do not set this parameter when motors are running.

PA88	Default	Min.	Max.	Unit
	100	1	60000	微米
	Maximum position deviation of grating rules and encoders			

Maximum position deviation of grating rules and encoders

When the position deviation of grating rules and encoders is bigger than the value of PA88, Er.035 occurs.

PA89	Default	Min.	Max.	Unit
	250	1	60000	纳米
	Resolution of grating rulers			

Set minimum checking unit of grating rulers.

Note

◆ Do not set this parameter when motors are running.

PA90	Default	Min.	Max.	Unit
	1500	500	4000	转/分钟
	Upper limitation of motors' speed when performing –tU1			

Set upper limitation of motors' speed when performing –tU1

Note

◆ Ensure that no colliding will happen in the cycle range specified.

PA91	Default	Min.	Max.	Unit
	4	1	9	转
	Maximum rotation cycles when performing –tU1			
Set maximum rotation cycles when performing –tU1				

Note

◆ Ensure that no colliding will happen in the cycle range specified.

PA92	Default	Min.	Max.	Unit
	0	0	1000	百分比
	Feedback gain of acceleration			
Increasing the value of PA92 will reduce the vibration of servo systems, but it is not recommended to set it to a too big value.				

PA93	Default	Min.	Max.	Unit
	0	0	600	百分比
	Feed forward gain of toque			
Increasing the value of PA93 will reduce the position following deviation, but a too big value may result in servo systems vibrating.				

PA94	Default	Min.	Max.	Unit
	1000	50	2000	赫兹
	Band width of feed forward filter of torque			
This parameter should not be changed for general applications.				

Explanations

1. Relevance parameters

If you change the value of a relevance parameter, some other parameters' values may change automatically. SD310 supports two relevance parameters: PA55 and PA01.

（1）PA55 (Rigidity of servo systems)

After setting the value of PA55, the values of PA05, PA06, PA07 and PA09 are also changed automatically.

（2）PA01 (Motor model selection)

The value of PA26 will change after setting PA01.

Note: The relevance is non-reversing, which means that setting PA55 will affect the value of PA05~PA07 and PA09, while setting PA05~PA07 and PA09 will not affect the value of PA55.

2．Power-off retaining function

Based on consideration for safety operations, PA00 (operation password), PA21 (Speed in D-SPD mode) and PA33 (Enable the driver by force) are turned to default value when rebooting systems. The others are all power-off retaining parameters.

3．Parameters need rebooting when setting

Parameters	Description
PA01	Motor model selection
PA22	Time constant of the double position feedback filter
PA26	Zero drift of motor encoders
PA70	Servo bus (KSN) node address
PA73	3rd parameter for selecting functions
PA77	2nd parameter for selecting functions
PA79	1st parameter for selecting functions
PA82	4th parameter for selecting functions
PA85	Grating ruler types
PA86	Installation direction of grating rules
PA87	Pitch of leadscrew
PA89	Resolution of grating rulers

4．Parameters related to closed loop function are effective only on SD311 drivers (with grating ruler interface).

4.2 Method for Adjusting Servo Systems

The parameters related to the performance of servo systems are set to a suit of values. The table below lists some modifiable parameters.

No.	Function	Default value	Min.	Max.	Unit
05	Gain of velocity circulation	40	1	200	Hz
06	Integral time constant of velocity circulation	25	1	1000	ms
07	Band width of the torque filter	160	1	4000	Hz
09	Gain of position circulation	40	1	200	1/s
10	Feed forward factor of position circulation	0	0	100	%
11	Band width of the feed forward filter of velocity circulation	1000	50	2000	Hz
55	Rigidity of servo systems	4	0	12	—
56	Load inertia ratio	100	50	800	%

Generally, it is not necessary to set these parameters above except for PA56. On the other hand, if the performance of servo systems does not satisfy your request, set these parameters according to your actual mechanical characteristics.

After the operation of –dEF in EE menu or the load inertial has changed obviously, set PA56 again.

SD310 supports two methods for setting PA56:

（1）Estimate the load inertia and set it in PA56 manually. (Not recommended)

（2）Perform the automatically setting operation. (Recommended)

Please follow the following procedure to adjust these parameters:

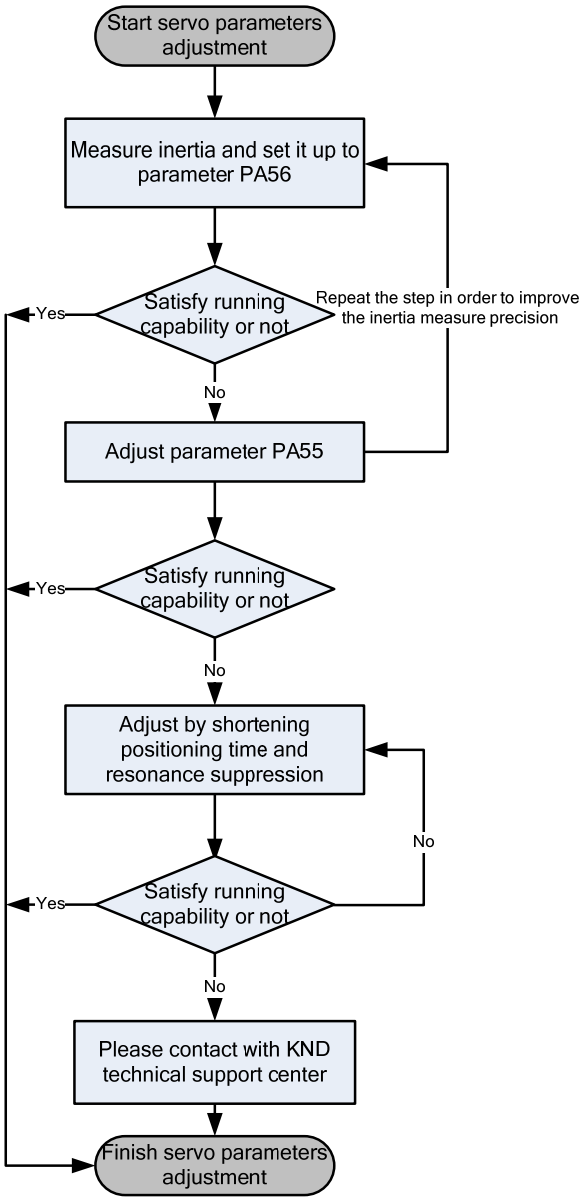


Figure 4.1 Parameters adjustment procedure

4.2.1 Automatic parameters adjustment

Among the parameters relating to the performance of servo systems, PA56 is the most important one. It obviously affects the capability of the velocity loop. In addition, slide friction, static friction, asymmetry load and some other elements also affect the capability of the whole servo systems. SD310 provides the function of measuring these elements automatically. Follow the procedures below:

- Make sure that servo axes have enough distance of travel (Bigger than the value of PA91).
- Set PA04 to POS mode.
- Enable the servo driver. (Use host controllers or set PA33)
- Set PA90 and PA91 correctly. Generally, use the default values.
- Enter the tU menu and select –tU. Press ENTER and keep pressing until "------" is displayed. Then motors will rotates some circles specified in PA91 in the positive and negative directions. For motors equipped with absolute encoders, they will find zero positions first and begin rotates specified circles.
- Display the inertial ratio or some warnings.

Related parameters associated with automatic adjustment are listed below:

No.	Description	Default value	Unit	Meaning
90	Upper limitation of motors' speed when performing –tU1	1500	rpm	The maximum speed of tU1 is the speed of inertia measurement. The speed with small value could effect to the measurement precision. Please set it up in the range of motor rated speed.
91	Maximum rotation cycles when performing –tU1	4	r	The maximum circle of tU1 is the trip of inertia measurement. The trip with small value will make a great acceleration which could cause errors (AL129); the trip with big value not only may effect to the measurement precision, but also may cause a crash.

After adjusting, all the related parameters including PA56 are set.

Ensure that enough movement distances are provided for each axis to prevent colliding when performing the –tU1 operation.

4.2.2 Rigidity adjustment

Set PA55 to adjust rigidity.

The maximum rigidity is restricted by the rigidity of transmission agents.

No.	Function	Default value	Minimum	Maximum
55	Rigidity of machine tools	4	0	12

Generally, servo system rigidity could be classified as the following types:

Low rigidity system: 0～3 grade

Middle rigidity system: 4～6 grade

High rigidity system: above 6 grade

The smaller rigidity, more slowly system responses, and the lower ability system has. The bigger rigidity, more quickly system responses, the higher ability system has. Too big rigidity may result in vibration.

The values of PA05, PA06, PA07 and PA09 will be changed according to the value of PA55. The relationship is as follows:

Rigidity	Position gain	Speed gain	Integral time	Band width of torque filters
PA55	PA09 (1/s)	PA05 (Hz)	PA06 (ms)	PA07 (Hz)
0	10	10	100	70
1	15	15	70	80
2	20	20	50	90
3	30	30	40	120
4	40	40	25	160
5	50	50	22	200
6	60	60	20	230
7	80	80	18	300
8	100	100	15	400

9	120	120	10	520
10	140	140	9	670
11	160	160	8	800
12	200	200	6	1060

After setting PA55, the values of PA05, PA06, PA07 and PA09 are set to the default values listed above. Changing these values slightly may obtain better performance.

Do not change them in a wide range in case of instability of systems.

When the following conditions appear, manual adjustment can be performed:

If when PA55 is set to be a certain value, responsibility and anti-interference of servo systems cannot meet the requirements; but when PA55 is set to be a larger grade value, resonance of servo systems occur, then PA05～PA07and PA09 can be adjusted manually to make system rigidity be a intermediate value between two rigidity grades.

Setting the value of one or more of PA05, PA06, PA07 and PA09 will not affect the value of PA55.

Automatic parameter adjustment and selecting rigidity are two basic procedures. Users can repeat these two procedures to make system characteristic meet requirements. If special requirements are needed, please keep on adjusting the following parameters.

4.2.3 Shorten positioning time

- PA10 are used to change the feed forward factor of the position circulation. Increase its value will shorten the positioning time.
- Set PA77.1 and PA48 to enable the velocity monitoring function. It will increase the gain of velocity loop, which will shorten the positioning time indirectly. Make sure PA56 is set properly before enable the velocity monitoring function.
- Set PA93 (Feed forward gain of toque) to increase responsibility and shorten positioning time.

4.2.4 Vibration adjustment

- If the load rigidity is low or the inertia is too big, servo systems may vibrate.

Increase the value of PA07 to reduce vibration.

- If there exist resonant points, adjust the value of PA80/PA81/PA46 and PA83/PA84/PA47 to suppress resonance. Vibration frequency can be read from DP-FrE.
- If load inertia is too big, and exceeds maximum value set in PA56, TU1 operation will fail to perform. Manually set PA56, read DP-FrE displaying option and use trap filter to suppress resonance. Repeat these procedures and increase PA56 to maximum value gradually without vibration.
- Set PA92 (Feedback gain of acceleration) to suppress vibration.

5 Protection Function

5.1 Error/Warning List

No.		Type	Description	Emergency
Dec.	Hex.			
000	00H	Normal	No error or alarm	
001 ~ 127				
001	01H	Error	Rotation speed exceeds the maximum value	◆
002	02H	Error	Main circuit overvoltage (Hardware)	◆
003	03H	Error	Main circuit low-voltage (Hardware)	
004	04H	Error	Positioning deviation is out of tolerance	
006	06H	Error	Velocity saturates for long time	
007	07H	Error	Positive and negative limitation switches error	◆
009	09H	Error	Encoder error (UVW or ABZ signals of incremental encoder)	◆
010	0AH	Error	Open-phase for main input circuit	
011	0BH	Error	IPM error	◆
012	0CH	Error	Motor's instant current exceeds the max. value	◆
013	0DH	Error	Driver and motor are overload for a long time	
014	0EH	Error	Braking resistor are working for a long time	◆
015	0FH	Error	Restart driver	
016	10H	Error	Software and hardware are not matched	
017	11H	Error	Main circuit overvoltage (Software)	◆
018	12H	Error	Torque commanded exceeds the max. value	◆
019	13H	Error	Speed commanded exceeds the max.	◆

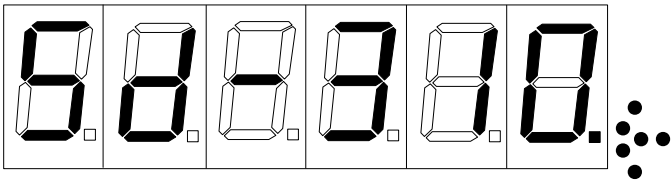
No.		Type	Description	Emergency
Dec.	Hex.			
			value	
020	14H	Error	EEPROM error when reading or writing	
021	15H	Error	No data is in the EEPROM parameter backup area or data has been damaged.	
022	16H	Error	Data in the EEPROM parameter storage area has been damaged.	
023	17H	Error	Value of parameters in the EEPROM exceeds the specified range.	
024	18H	Error	Position command after gear ratio exceeds the maximum speed of motors.	◆
025	19H	Error	Core error	◆
026	1AH	Error	Main circuit low-voltage (Software)	
030	1EH	Error	Incremental encoder Z-phase error	◆
031	1FH	Error	IPM overheat	◆
032	20H	Error	Illegal code of UVW signals from incremental encoders.	◆
033	21H	Error	Encoder type error	◆
034	22H	Error	Absolute encoder communication error	◆
035	23H	Error	Position deviation feedback exceeds the specified limitation	
036	24H	Error	Incremental grating rules malfunction	◆
038	26H	Error	Position commanded exceeds the maximum range specified in software.	◆
039	27H	Error	Parameters are not suitable in A-POS mode	
041	29H	Error	Multi-circle data lose due to low battery voltage error of absolute encoders (With battery).	
042	2AH	Error	Absolut encoders' multi-circle data error	◆

No.		Type	Description	Emergency
Dec.	Hex.			
			(With battery)	
045	2DH	Error	U/V/W phase sequence error of motors or zero point error of encoders	◆
050	32H	Error	Gear ratio between motors and mechanisms exceeds application range.	
054	36H	Error	Absolute encoder counting error	◆
060	3CH	Error	Absolute encoder extending multi-circle error	◆
062	3EH	Error	Feedback speed excess	◆
072	48H	Error	Low voltage of external battery for absolute encoders with battery	
128 ~ 191				
128	80H	Alarm	The operations are not allowed when the motor is running	
129	81H	Alarm	Servo motors' acceleration is excessive when performing automatic parameters adjusting.	
130	82H	Alarm	EEPROM parameters region is not initialized.	
131	83H	Alarm	Load inertia ratio varies too much when performing parameters adjusting. (±20%)	
132	84H	Alarm	Load inertia ratio got from automatic adjusting operation exceeds the drivers' range	
133	85H	Alarm	Some parameters are changed through servo bus (KSN)	
134	86H	Alarm	It is prohibitive to change this parameter through servo bus (KSN)	
135	87H	Alarm	It is not allowed to change parameters through servo bus (KSN) at the current authority.	
136	88H	Alarm	Zero position returning operation is needed	
144	90H	Alarm	Encoder temperature alarm	
147	93H	Alarm	Servo bus commands are performed overtime	

No.		Type	Description	Emergency
Dec.	Hex.			
148	94H	Alarm	Illegal servo bus (KSN) command or data	
150	96H	Alarm	Voltage of the external battery used on absolute encoders is low	
151	97H	Alarm	Unsupported motor model is specified through servo bus	
152	98H	Alarm	-tU3 operation is needed	
153	99H	Alarm	Parameters are set invalid; please execute this operation once again.	
154	9AH	Alarm	Parameter value exceeds permitted range.	
155	9BH	Alarm	TU1 operation needs be performed in running status (when running indicator lamp goes on).	
156	9CH	Alarm	Inner error when performing TU1	
157	9DH	Alarm	TU3 should be performed in ready status (when ready indicator lamp goes on and no Err fault occurs).	
158	9EH	Alarm	TU3 can not be operated in running status (when running indicator lamp goes on).	
159	9FH	Alarm	Inner error when performing TU3	
160	A0H	Alarm	Servo driver is not ready	
161	A1H	Alarm	Setting speed (PA90) exceeds maximum motor speed.	
192 ~ 255				
228	E4H	Error	Servo bus (KSN) overrun	
229	E5H	Error	Servo bus (KSN) position interpolation error	
230	E6H	Error	Servo bus (KSN) communication error	
231	E7H	Error	Unsupported synchronizing period	
232	E8H	Error	Servo bus (KSN) WDT error	
233	E9H	Error	Servo bus (KSN) synchronizing error	
234	EAH	Error	Servo bus (KSN) initialization error	

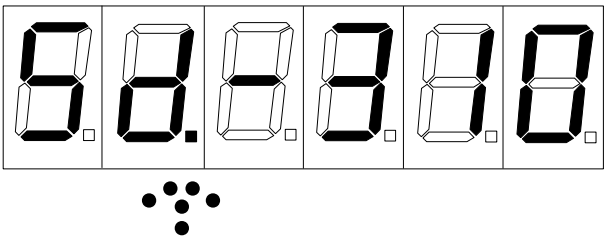
Explanations

1. "Er" and error code will flicker when one or more errors occur. Pressing Exit key can stop the flickering status, but the decimal point at the right bottom corner will flicker simultaneity, which indicates that the driver is in error status.



The current error number can be read in the monitor menu "Err". When some error happen, the RUN indicator will be turned off immediately, motors are put in free status or braking status (with mechanical brake and wiring correctly).

2. "AL" and warning code will flicker when one or more alarms occur. Pressing Exit key can stop the flickering status, but the decimal point at second LED right bottom corner will flicker simultaneity, which indicates that the driver is in alarm status.



The current alarm number can be read in the monitor menu "AL". After reasons which cause the alarm are removed, pressing "Exit" key uninterruptedly can clear alarm prompt and decimal point won't flicker any longer. Alarm prompts only remind users of secondary messages

that don't affect safe running. When alarm prompts appear, running status of motors doesn't change.

3. When errors or alarms occurs on drivers, if drivers exit from flicker status, and only decimal point flickers, after reasons which cause the alarms are removed, pressing Exit key uninterruptedly until drivers display "------" will clear alarms and errors that don't need rebooting and makes drivers be in ready status.

4. Servo drivers' malfunction can be classified as two types: emergent malfunctions and non-emergent ones. When a non-emergent malfunction happens and the motor' rotation speed is lower than 100r/min, servo driver opens the external brake firstly and cut off the power to the motor after a time specified by PA58. When an emergent malfunction happens or the motor' rotation speed is bigger than 100 r/min, servo driver cut off the power to the motor immediately and enable the external brake at the same time.

5.2 Error/warning Remedy

No.	Name	Status	Reason	Remedy
Er 001	Over speed	Occurs at the power-on of control circuits	1 Control circuits' fault 2 Encoders' fault	1 Replace servo driver 2 Replace motor
		Occurs when the motor is running	Command frequency is too high	Set command frequency correctly
			Acceleration and deceleration time is too short	Increase the time constant
			Electronic gear ratio is too large	Set it correctly
			Encoders malfunction	Replace a motor

No.	Name	Status	Reason	Remedy
			Encoders' cable malfunction	Replace a cable
			Servo systems' overshoot is too big	Decrease the rigidity of servo system(PA55)
		Occurs at the start up moment	Load inertia is too big	1 Reduce the load inertia 2 Replace more powerful drivers and motors
			Zero fault of encoders	Perform the -tU3 operation
			Line sequence of U/V/W is wrong	Connect cables correctly
			Encoders' cable malfunction	
Er 002	Over voltage	Occurs at the power-on of control circuits	PCB malfunction	Replace a servo driver
		Occurs at the power-on of main circuits	1 Over voltage of power source 2 Abnormal waveform of power source	Check the power source
		Occurs when motors are running	Brake resistor malfunction	Install brake resistors firmly
			Damage of brake transistors Damage of inner brake resistors	Replace a servo driver

No.	Name	Status	Reason	Remedy
			Capacity of braking circuits is low	1 Reduce start-stop frequency 2 Increase acceleration time constant 3. Reduce torque limitation 4 Reduce load inertia 5 Replace more powerful drivers and motors
Er 003	Low voltage	Occurs at the power-on of control circuits	1 PCB malfunction 2 Fuse malfunction 3 Soft start circuit malfunction 4 Rectifier damage	Replace a servo driver
			1 Voltage of power is low 2 Instant power-off	Check power source
		Occurs when motors are running	1 Capacity of power is not enough 2 Instant power-off	Check power source
			Radiator over-heat	Check load
Er 004	Position deviation exceeds the specified value	Occurs at the power-on of control circuits	PCB malfunction	Replace servo driver
		1 Occurs at the power-on of main circuits 2 Motors don't move	1 Line sequence of U/V/W is wrong 2 Encoders' cable malfunction	Connect cables correctly
			Encoders' malfunction	Replace a servo motor
		Occurs when motors are running	The range judging position deviation is too small	Extend the range

No.	Name	Status	Reason	Remedy
			Gain of position circulation is too small	Increase the gain
			Shortage of torque	1 Check the torque limitation 2 Reduce load capacity 3 Replace more powerful drivers and motors
			Frequency of command is too high	Decrease the frequency
			Zero position of motors is wrong	Perform –tU3 operation
			Exceed the hardware overtravel limitation	Check the states of CCWI and CWI
Er 006	Saturation of the velocity circulation	Occurs when motors start rotating	Motors are trapped abnormally	Check the load of motors
		Occurs when motors are running	Load is too big	1 Reduce load 2 Replace more powerful drivers and motors
			1 Malfunction of some connectors inside of drivers 2 Switch-power source malfunction 3 Chip malfunction	1 Check connectors inside of drivers 2 Check power source 3 Replace servo drivers
Er 007	Limitation switches malfunction	Occurs at the power-on of control circuits	CCWI and CWI signals are ineffective When motors are rotating in positive direction, overtravel limit signal of negative direction is triggered.	1 Check wiring and input signals 2 Set PA82.1=0（close hardware overtravel limit function）or set PA79.0=3（overtravel limit is handled by

No.	Name	Status	Reason	Remedy
		Occurs when motors are running	(that is, driver enable signal CCW is invalid) When motors are rotating in negative direction, overtravel limit signal of positive direction is triggered. (that is, driver enable signal CW is invalid)	host controller）
Er 009	Encoders' hardware signals malfunction	1 Occurs at the power-on of control circuits 2 Occurs when motors are running	Incorrect motors' model	Set PA01 correctly
			Wiring malfunction of encoders	Wiring correctly
			Cable malfunction of encoders	Replace a cable
			Feedback cables from encoders are too long	Shorten the cable Use multiple lines to supply power to encoders
			Encoder is damaged	Replace a motor
			1 Malfunction of some connectors inside of drivers 2 Switch-power source malfunction 3 Chip malfunction	1 Check connectors inside of drivers 2 Check power source 3 Replace servo drivers
Er 010	Open phase for power input	Occurs when motors get energized	Open phase for three-phase power input	Check input power of RST terminals
Er 011	IPM malfunction	Occurs at the power-on of control circuits	PCB malfunction	Replace a servo driver

No.	Name	Status	Reason	Remedy
		Occurs when motors are running	1 Voltage of power source is low 2 Over heat	1 Check the servo driver 2 Reboot the driver 3 Replace a servo driver
			Short circuit happens among U, V and W phases	Check the wiring
			Grounding malfunction	Grounding correctly
			Damage of motors' insulation	Replace a motor
			Be interfered	1 USE FIlters 2 Keep away from interference sourCE
			Wrong zero points of motors with absolute encoders	Perform the -tU3 operation
Er 012	Instantaneous excess current	1 Occurs at the power-on of control circuits 2 Occurs when motors are running	Short circuit happens among U, V and W phases	Check the wiring
			Grounding malfunction	Grounding correctly
			Damage of motors' insulation	Replace a motor
			Servo driver is damaged	Replace a servo driver
			Wrong zero points of motors with absolute encoders	Perform the -tU3 operation

No.	Name	Status	Reason	Remedy
Er 013	Overload	Occurs at the power-on of control circuits	PCB malfunction	Replace a servo driver
		Occurs when motors are running	Exceed the rated torque when running	1 Check load 2 Reduce the start-stop frequency 3 Reduce the torque limitation value 4 Replace more powerful drivers and motors
			Hold-brake does not open	Check the hold-brake
			Motors' vibration	1 Adjusting the gain 2 Increase the acceleration and deceleration time 3 Reduce the load inertia
			1 ONE LIne of U, V and W phases' is break 2 Feedback lines from encoders is wrong	Check the wiring
Er 014	Brake malfunction	Occurs at the power-on of control circuits	PCB malfunction	Replace a servo driver

No.	Name	Status	Reason	Remedy
		Occurs at the power-on of main circuits	1 The voltage of the main circuits' power source is too high 2 The waveform of the main circuits' power source is abnormal	Check the power source
		Occurs when motors are running	The wire of brake resistors is broken	Wiring again correctly
			Damage of the brake transistors or brake resistors	Replace a servo driver
			The capacity of the brake circuits is too small	1 Reduce the start-stop frequency 2 Increase the acceleration and deceleration time 3 Reduce the torque limitation value 4 Reduce the load inertia 5 Replace more powerful drivers and motors
			The voltage of the main circuits' power source is too high	Check the power source
Er 015	Reboot	Occurs when setting some parameters	Occurs when setting some special parameters	Reboot the driver
Er 016	Hardware malfunction	Occurs at the power-on of control circuits	Software version does not match the hardware	Contact sellers

No.	Name	Status	Reason	Remedy
Er 017	Over voltage of the main circuits	Refer to the remedies of Er.002		
Er 018	Torque command is too high	Occurs when running in TOR mode.	Torque command exceeds the torque limitation of motors	Decrease the torque command
Er 019	Velocity command is too high	Occurs when running in SPD mode.	Velocity command exceeds the velocity limitation of motors	Decrease the velocity command
Er 020	Saving malfunction	Occurs when turning on the power or running	Damage of chips or PCBs	Replace a servo driver
Er 021	Saving malfunction	Occurs when performing the -rS operation	No data or data is damaged in EEPROM backup spaces	Perform the –BA operation
Er 022	Saving malfunction	Occurs when turning on the power or running	The data is damaged in EEPROM parameters space	Initialize parameters to the factory setting and check the performance
Er 023	Saving malfunction	Occurs when turning on the power or running	One or more parameters' values exceed their maximum values.	Initialize parameters to the factory setting and check the performance
Er 024	Command frequency is too high	Occurs when running	1 PA12 and PA13 are setting incorrectly 2 Command frequency is too high	1 Check the values of PA12 and PA13 2 Reduce the command frequency

No.	Name	Status	Reason	Remedy
Er 025	Core malfunction	Occurs when running	Inner malfunction	Reboot the driver. If it occurs frequently, replace a servo driver
Er 026	Refer to the remedies of Er.003			
Er 030	Z-phase signals' malfunction	Occurs when turning on the power or running	1 Z-phase signal is lost 2 Encoders' malfunction 3 Z-phase signals' circuit is damaged 4 Cable malfunction 5 Cable shield layer malfunction 6 Encoders' interface circuit malfunction	1 Check the interface circuit of encoders 2 Replace a servo driver 3 Replace a motor
Er 031	IPM over-heat	Occurs when turning on the power or running	1 Ambient temperature is high 2 Too big load inertia 3 IPM is damaged	1 Improve the radiating performance of cabinet 2 Decrease the load inertia 3 Replace a servo driver
Er 032	Wrong code from encoders	Occurs when turning on the power or running	1 Cable malfunction 2 Cable shield layer malfunction 3 U/V/W signals of encoders are damaged 4 Encoders' interface circuit malfunction 5 When using saving-line encoders	1 Check the wiring 2 Grounding correctly 3 Replace a cable 4 Replace a servo driver 5 Replace a motor 6 Set PA36 to 1
Er 033	Wrong encoders' type	Occurs when turning on the power	The motors' model is specified in correctly	Set PA01 correctly

No.	Name	Status	Reason	Remedy
Er 034	Absolute encoder malfunction	Occurs when turning on the power or running	1 Wrong motor's model 2 Cable malfunction 3 Cable shield layer malfunction 4 Encoders' interface circuit malfunction	1 Set PA01 correctly 2 Replace a cable 3 Check the interface circuit of encoders 4 Replace a motor
Er 035	Closed loop malfunction	Occurs when running	The deviation between the positions feedback from grating rules and encoders is out-of-tolerance	If it occurs when turning on the power, check the setting of PA82 and PA86. If it occurs when running, adjusting the value of PA22 or increasing the value of PA88.
Er 036	Grating rules malfunction	Occurs when turning on the power or running	The wire of incremental grating rules is broken	Check the grating rule's interface (CN6).
Er 038	Overtravel alarm	Occurs when turning on the power or running	Servo drivers' positions exceed the software or hardware limitation.	Make the motor rotate in the reverse direction to get off the malfunction
Er 039	A-POS malfunction	Occurs when running	When running in A-POS mode, motors' position exceed the maximum rang specified by parameters or the time used exceed the available value.	Check the following parameters: PA29~PA32, PA49~PA52, PA25 and PA77.
Er 041	Absolute encoders'	Occurs when turning on the	1 DRIVE a motor with an absolute	Perform the –tU4 operation

No.	Name	Status	Reason	Remedy
	malfunction	power or running	encoder at the first time 2 Battery voltage is low 3 The encoder is damaged	
Er 042	Absolute encoders' malfunction	Occurs when turning on the power or running	The encoder is damaged	Perform the –tU4 operation If it occurs frequently, replace a motor
Er 045	Abnormal malfunction of closed loop	Occurs at first running	1 Phase sequence of UVW is wrong or zero point of of motor encoders is wrong. 2 Checking mistake	1 Make sure phase sequence of UVW is correct;Make sure TU3 operation is performed normally. 2 Set PA08.0=0
Er 050	Gear ratio is set wrong	Occurs at power-on or when setting parameters	Gear ratio setting on system is abnormal and beyond supported range of drivers	Make sure gear ratio is set correct
Er 054	Absolute encoders counting error	Occurs at power-on or during running	Encoders error	Replace encoders
Er 060	Absolute encoders error	Occurs at power-on	When using rotary table function, multiple logic of absolute encoder gets error.	Reboot the drivers. If this error appears continuously, please replace servo drivers.
Er 062	Excessive feedback speed of encoders	Occurs at power-on or during running	1 Rotary speed of motors is Excessive 2 Encoders are broken	1 make sure rotary speed of motors is in permitted range. 2 Replace motors
Er 072	Low voltage of battery of absolute	1 Battery voltage is low or battery is	Install battery or replace new battery. Make sure feedback cable of encoder	Low voltage of battery of absolute encoders

No.	Name	Status	Reason	Remedy
	encoders	not installed. 2 Feedback cable of encoder connects wrong or feedback cable is open circuit. 3 Encoders are broken	connects correctly and firmly.	
Er 228	Servo bus malfunction	Occurs when running	1 OverRun malfunction 2 Hardware malfunction	1 Reboot 2 If it occurs frequently, replace a servo driver
Er 229	Servo bus malfunction	Occurs when running	1 Position interpolation malfunction 2 Hardware malfunction	1 Reboot 2 If it occurs frequently, replace a servo driver
Er 230	Servo bus malfunction	Occurs when running	Communication malfunction	1 Check the cable of servo bus 2 Reboot 3 If it occurs frequently, replace a servo driver
Er 231	Servo bus malfunction	Occurs when turning on the power or running	Unsupported synchronizing period	Check that the host controller is working well
Er 232	Servo bus malfunction	Occurs when running	WDT malfunction.	1 Check the connection of CN3 and CN4 2 Ensure that the host controller is working well and perform the initializing operation 3 If it occurs frequently,

No.	Name	Status	Reason	Remedy
				replace a servo driver
Er 233	Servo bus malfunction	Occurs when running	The synchronizing signal is lost. The servo bus connection is broken or the host controller is shut down.	Ensure that the host controller is working well.
Er 234	Servo bus malfunction	Occurs when turning on the power	1 Initialization of servo bus is wrong 2 Hardware malfunction	1 Reboot 2 If it occurs frequently, replace a servo driver

No.	Name	Reason	Remedy
AL128	The operation is forbidden when running	Some forbidden operations are performed when motors are running.	Perform the operation when the RUN indicator goes out
AL129	Alarm about parameter automatic adjusting	The acceleration speed is too big when perform the operation	1 Decrease the value of PA90 2 Increase the value of PA91
AL130	No data in the EERPOM parameters' space	The EEPROM parameters' space is not initialized.	No operation is needed. System will initialize the space when the alarm occurs.
AL131	Alarm about parameter automatic adjusting	The variation of the load inertia ratio is too big when adjusting parameters (≥20 %)	1 Check the disturbance on motors shaft 2 Increase the value of PA90
AL132	Alarm about parameter	1 The load inertial ratio exceeds the available range of this driver	1 Reduce the load inertia 2 Replace more

No.	Name	Reason	Remedy
	automatic adjusting	2 PA01 is set incorrectly	powerful drivers and motors 3 Check the setting of PA01
AL133	A relevant parameter is set	A relevant parameter is set through the servo bus	System note. No operation is needed.
AL134	The parameter is forbidden to set	A forbidden parameters is set through the servo bus	The parameter's value is not changed. Try another way too set the parameter.
AL135	The parameter is forbidden to set	The current authority is not high enough to set the parameter through the servo bus	Set PA00 to obtain higher authority and change the parameter again.
AL136	The origin point of the position coordinate is changed.	The reason may be one of the following cases: 1 Electronic gear ration is changed 2 Rotation direction is changed 3 Grating rules' attributes is changed	No operation is needed.
AL144	Work temperature alarm for absolute encoders	Temperature of work environment is excessive and absolute encoders can not work normally	Improve work environment
AL147	Servo bus commands are performed overtime	Executing time of servo bus commands exceeds 20 seconds.	Check and remove reasons of overtime.
AL148	Unsupported commands or data	Unsupported commands or data from host	No operation is needed.

No.	Name	Reason	Remedy
	are received	controllers are received	
AL150	The voltage of the battery used by absolute encoders is low	1 The voltage is low or no battery is installed 2 Cable malfunction 3 The encoder is damaged	1 Replace a new battery 2 Check the cable and wiring it firmly
AL151	Unsupported motor's model	Unsupported motor's model is specified	No operation is needed.
AL152	The electric angle zero point of the absolute encoder is wrong	The electric angle zero point is not specified	Perform the –tU3 operation
AL153	Invalid parameter setting	Parameters are set too fast	Re-perform this operation
AL154	Excessive parameter value	Parameter value exceeds permitted range	Confirm parameter value range
AL155	Fail to perform TU1	TU1 operation needs be performed in running status (when running indicator lamp goes on)	Re-perform this operation in running status
AL156	Fail to perform TU1	Inner error for TU1 operation	Re-perform this operation
AL157	Fail to perform TU3	TU3 should be performed in ready status (when ready indicator lamp goes on and no Err fault occurs).	Re-perform this operation
AL158	Fail to perform TU3	TU3 can not be operated in running status (when running indicator lamp goes on).	Re-perform this operation in non-running status
AL159	Fail to perform TU3	Inner error for TU3 operation	Re-perform this operation
AL160	Servo driver is	The driving command is	Find the reason for

No.	Name	Reason	Remedy
	unready	received from the servo bus when the driver is unready	the unready problem and solve it.
AL161	Parameters are set wrong	Setting speed (PA90) exceeds maximum motor speed.	Confirm parameters value range

5.3 Diagnosis List about the Servo Bus

When the AL148 occurs, the corresponding detail information about the alarm can be read in the BUS-ER displaying item (in dP menu). The information can also be transmitted to host controllers through the servo bus by setting the parameters PA71 and PA72.

Code	Description
101	The command of servo bus can't be executed in the current status
102	Unsupported command through servo bus are received
103	The serial number of the servo bus command exceeds the maximum value
104	The data of the servo bus command is wrong
121	The sub-command of servo bus can't be executed in the current status
122	The sub-command can't be executed when executing the current command
123	Unsupported sub-command of servo bus are received
124	The serial number of the servo bus sub-command exceeds the maximum value
125	The data of the servo bus sub-command is wrong

6 Display and Operation

The display and operation panel of SD310 consists of the following there parts: six nixie tubes, two indicators and four keys. Working together, the three parts support all operation and displaying applications.

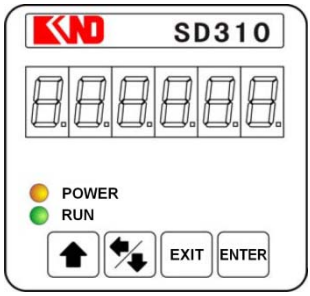


Figure 6.1 Display and operation panel

1. Keys

: Increase the sequence numbers or values

: Decrease the sequence numbers or values/Shift to the left

Exit: Return to the previous menu or cancel one operation

Enter: Enter the next layer menu or confirm one operation

Keep pressing or continuously, sequence numbers or values will continuously increase or decrease, the longer holding time, the bigger value vary range.

2 LED indicator

POWER indicator

The POWER indicator will be lit up after 800 ms when turning on the main circuits' power and go out when the main circuits' power is turned off.

High capacities in servo driver bring the risk of electric shocking even when the POWER indictor goes out. Do not touch any part of a driver in 10 minutes after turning off its power in case of accident.

RUN indicator

The RUN indicator will be lit up when the servo motor is in drive status.

Reversely, if it goes out, the servo motor is in free status or in braking status (equipped with mechanical brakes).

After turning on the control circuits' power, drivers display the default monitoring menu set by PA03. Press any key to enter the main interface in which the characters "Sd-310" is displayed.

The operation guide map is as follows:

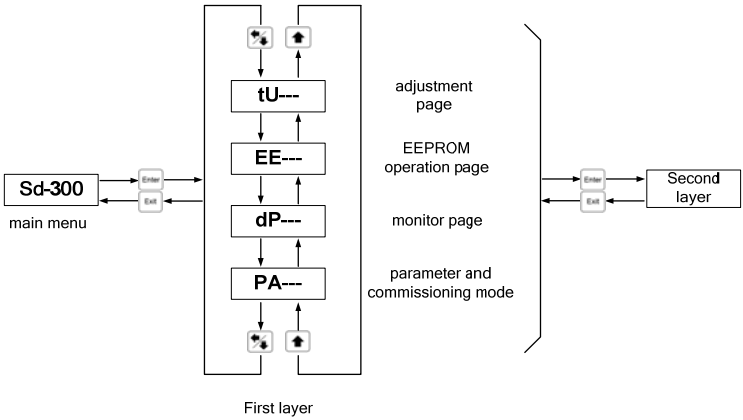


Figure 6.2 Operation guide map

6.1 First Layer

Press Enter in the main interface to enter the first layer menu which includes four sub-menus: tU, EE, dP and PA. Press ↑ or ↓ to switch among the four sub-menus described in Figure 6.2. Select one sub-menu and press Enter to enter the second layer menu. Press Exit to exit and enter the main interface.

1 PA---Parameter menu

Parameters' displaying and setting operations are performed under this menu.

2 DP---Monitoring menu

Running status of motors and drivers are displayed under this menu.

3 EE---EEPROM menu

The operations of EEPROM are performed under this menu to achieve the function of managing parameters.

4 tU---Adjustment menu

In this menu perform the operation of adjusting the servo systems' performance such as automatic parameters' setting, absolute encoders zero point setting, absolute encoders zero adjusting, absolute encoders multi-circle data clearing etc.

6.2 Second Layer

6.2.1 Parameter consulting & setting (PA)

Select "PA---" in the first layer menu and press Enter to enter the second layer. Follow the below procedure to read or set parameters.

1 Select a parameter sequence number

When the parameter sequence number is flickering, pressing ↑ will increase the number and select a desired parameter. For one bit, the value changes from 0 to 9, and then it changes to 0 circularly. Press ←/↓ to shift to the left number. Pressing ←/↓ repeatedly will select any number circularly from right to left.

2 Press Enter to display the selected parameter's value.

3 Modify parameters' values

Like the operation in step 1, press [▲] or [◄/▼] to change parameters values. Parameters' values meet some specified ranges. SD310 automatically restricts the setting value in these ranges. The parameter value set newly is not effective in control process immediately.

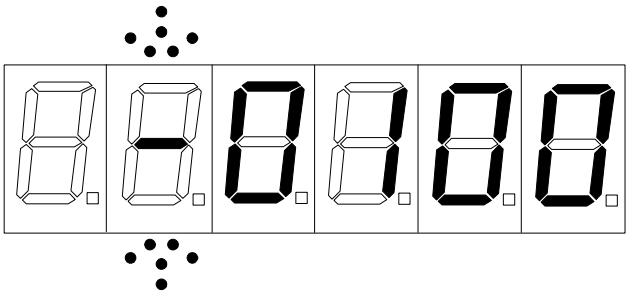
4 Confirm or cancel setting operation

If parameters' values set newly satisfy your application, press [Enter] to confirm the setting. When "------" stops flickering, the values set newly will be effective in control process. If the value set does not satisfy your application, press [Exit] to cancel the setting and go back to step 1.

Press [Exit] to return to the first layer sub-menu "PA - - - ".

Note

1. Set PA00 to a specified value before setting parameters.
2. The signs of parameter values are set at the highest order digit. For example, if a parameter's value range is from -5000 to 5000, the sign should be specified in the 5th digit from right to left. If the current value is 100 but -100 is needed, users should press [◄/▼] until the "0100" is displayed and press [▲] to select the negative sign.



6.2.2 Monitoring menu (dP)

Select “dP---” in the first layer menu and press Enter to enter the second layer. Press or to select a specified monitoring menu. Press Enter to read the desired value.

Name	Symbol	Description	Unit
SPEED	r	Motor’s rotation speed	rpm
POS_L	P	Low-6-bit of current position	Command pulses
POS_H	P	High-4-bit of current position	Command pulses
CPO_L	C	Low-6-bit of the command position	Command pulses
CPO_H	C	High-4-bit of the command position	Command pulses
EPO_L	E	Low-6-bit of position offset	Command pulses
EPO_H	E	High-4-bit of position offset	Command pulses
PLS_L	P	Undefined	—
PLS_H	P	Undefined	—
TRQ	t	Motor torque load ratio	%
IA	I	U-phase current value	mA
IB	I	W-phase current value	mA
CNT	—	Current control mode POS: Position control mode SPD: Velocity control mode TOR: Torque control mode Note: CNT value indicates the current control mode, which may be different from the setting of PA04.	—

Name	Symbol	Description	Unit
CS	r	Speed command	rpm
APO	A	Electrical angle of motors	$2\pi \times 2^{-15}$ rad
COD	COd	UVW code from encoders	—
IAD	IAd	Zero-offset value of U-phase current	—
IBD	Ibd	Zero-offset value of W-phase current	—
LOAD	L	CPU load ratio	%
TRQN	t	Current torque	Nm
BUS-PD	T	Synchronizing period of servo bus	us
BUS-ER	nO	Alarm codes about servo bus	—
ENC_L	P	Low-6-bit of feedback positions from encoders	Feedback unit
ENC_H	P	High-4-bit of feedback positions from encoders	
RAS_L	P	Low-6-bit of feedback positions from grating rules	Feedback unit
RAS_H	P	High-4-bit of feedback positions from grating rules	
REE	P	The position deviation between grating rules and encoders	um
ENC-TP	—	Encoders type D-C-17: 17-bit single-circle/16-bit multi-circle absolute encoders INC-25: 2500 p/r incremental encoders HSL-17: 17-bit single-circle/12-bit multi-circle absolute encoders D-C017: 17-bit single-circle/0-bit multi-circle absolute encoders	—
PCOR	C	Coordinate of single-axis positioning operation	Up to PA77.2
NQ	q	Quality factor of the trap filter	—

<table>
<tr><th>Name</th><th>Symbol</th><th>Description</th><th>Unit</th></tr>
<tr><td>SPRI</td><td>C</td><td>Elastic coefficient of servo system</td><td>Nm/rad</td></tr>
<tr><td>DAP</td><td>b</td><td>Damp coefficient of servo system</td><td>Nm/rad/s</td></tr>
<tr><td>UBUS</td><td>U</td><td>Voltage of the main circuits</td><td>V</td></tr>
<tr><td>TAB_L</td><td>D</td><td>Low-6-bit of rotation table angle</td><td>Command pulses</td></tr>
<tr><td>TAB_H</td><td>D</td><td>High-4-bit of rotary table angle</td><td>Command pulses</td></tr>
<tr><td>ENR_L</td><td>E</td><td>Low-6-bit of extended multi-circle of absolute encoders</td><td>Circles</td></tr>
<tr><td>ENR_H</td><td>E</td><td>High-4-bit of extended multi-circle of absolute encoders</td><td>Circles</td></tr>
<tr><td>ERR</td><td>Er</td><td>Error code</td><td>—</td></tr>
<tr><td>ER1</td><td>Er</td><td>The 1st latest error code</td><td>—</td></tr>
<tr><td>ER2</td><td>Er</td><td>The 2nd latest error code</td><td>—</td></tr>
<tr><td>ER3</td><td>Er</td><td>The 3rd latest error code</td><td>—</td></tr>
<tr><td>ER4</td><td>Er</td><td>The 4th latest error code</td><td>—</td></tr>
<tr><td>ER5</td><td>Er</td><td>The 5th latest error code</td><td>—</td></tr>
<tr><td>ER6</td><td>Er</td><td>The 6th latest error code</td><td>—</td></tr>
<tr><td>ER7</td><td>Er</td><td>The 7th latest error code</td><td>—</td></tr>
<tr><td>ER8</td><td>Er</td><td>The 8th latest error code</td><td>—</td></tr>
<tr><td>ER9</td><td>Er</td><td>The 9th latest error code</td><td>—</td></tr>
<tr><td>AL</td><td>AL</td><td>Alarm code</td><td>—</td></tr>
<tr><td>AI</td><td>U</td><td>—</td><td>—</td></tr>
<tr><td>IN</td><td>I</td><td>Input signals to servo drivers
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Signal</td><td>—</td><td>—</td><td>—</td><td>POSI_RDY</td></tr>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Signal</td><td>DEC</td><td>CCW</td><td>CWI</td><td>SVON</td></tr>
</table></td><td>—</td></tr>
</table>

<table>
<tr><th>Name</th><th>Symbol</th><th>Description</th><th>Unit</th></tr>
<tr><td>OUT</td><td>O</td><td>Output signals from servo drivers
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Signal</td><td>—</td><td>—</td><td>—</td><td>—</td></tr>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Signal</td><td>BRK</td><td>COIN/
VCMP/
VLT</td><td>ALM</td><td>SRDY</td></tr>
</table></td><td>—</td></tr>
<tr><td>FRE</td><td>F</td><td>Vibration frequency</td><td>Hz</td></tr>
<tr><td>D-NO</td><td>—</td><td>Development version number</td><td>—</td></tr>
<tr><td>UER</td><td>—</td><td>Extended software version number (Refer to PA02 for software main version number)</td><td>—</td></tr>
<tr><td>ASIC</td><td>n</td><td>Firmware version number</td><td>—</td></tr>
<tr><td>ASIC-S</td><td>n</td><td>Firmware minor version number</td><td>—</td></tr>
</table>

Explanations

1 Checking monitoring menu is free of any authority (PA00).

2 Motor position:

(1) Motors position is countered by command pulses. The zero position can be specified by the operation of TU2.

(2) If the electronic gear ratio (PA12 & PA13) or the value of PA15 or grating ruler application parameters are changed when drivers are running, the zero position of motors will shift, but the motors position displayed will not change. In this case, zero position returning operation should be performed immediately, otherwise colliding or overtravel may happen.

3 When a motors is in free status (the RUN indicator goes out), the command position changes with the motor's (or grating ruler's) actual position. That is, command position is motor's (or grating ruler's) position.

4 When the digit number reaches 6, sings is not displayed. (E.g. -12345)

5 Output signal status without considering the control of PA57 are read in OUT. The effective level of BRK, COIN and ALM is 0, while the effective level of SRDY, VCMP and VLT is 1.

6 Input signals considering the control of PA54 and PA59 are read in IN item. The effective level of INH/SC2, CLE/SC1/ZSPD, CCWI, CWI and SVON is 1. The rising edge of ACLR is effective.

7 The monitoring status of IN and OUT show as follows:

Figure 6.3 Monitoring status in IN item

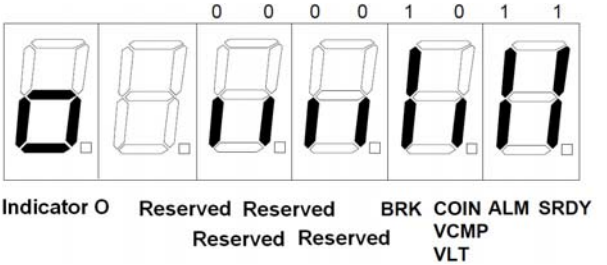


Figure 6.4 Monitoring status in OUT item

6.2.3 Parameter management (EE)

Parameters in SD310 are saved in EEPROM. Two independent regions are used to manage parameters:

1 Parameter region

2 Backup region

Parameter region

It is used to save all parameters used (not including volatile parameters). When the power is turned on, SD310 reads these parameters into memory. After modifying one or more parameters, the corresponding parameters in this region will be written with new values. Performing the dEF operation will initialize parameter region to the factory-set values.

Backup region

It is used to save the current using parameters. Perform bA or rS operation to read or write this region.

Parameter management operations are shown as follows:

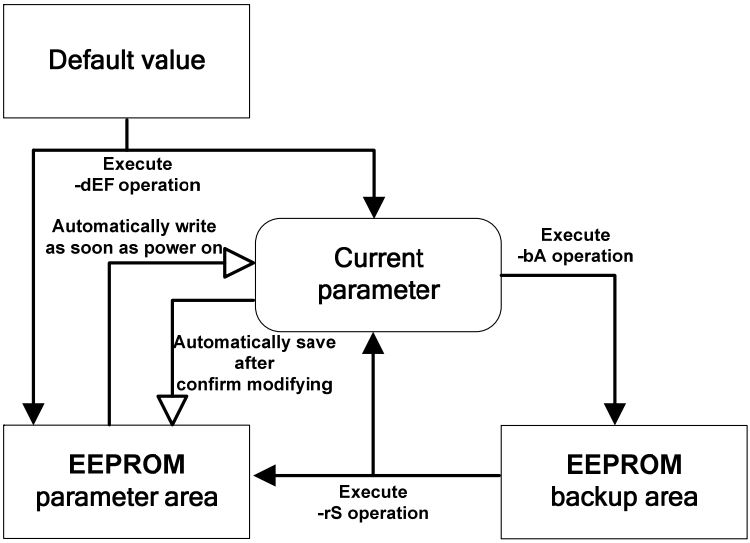


Figure 6.5 Parameter management operation diagram

Select “EE---” and press Enter to enter the parameter management menu.

SD310 supports three parameter management functions:

- dEF

  Perform the dEF operation to initialize all parameters except for PA00, PA01, PA26 and PA70 to factor-set values. When parameters are disordered, dEF operation should be performed. Some parameters’ default values are different from the motor models specified by PA01. Ensure that the value of PA01 is the desired model before performing the dEF operation. Performing dEF operation does not affect backup region.

- bA

  Save all parameters expert for volatile ones in backup region. Perform the bA operation when the following cases happen:

  (1) When debugging drivers, save the current set of parameters which are properly match you application before trying to change some parameters to

achieve better performance.

(2) When a set of parameters has been obtained after debugging drivers, perform the bA operation to save them. Once some parameters are changed, perform the rS operation will load these parameters into memory again.

- rS

Load parameters in backup region into memory. The current using parameters' values will be lost.

Press [↑/↓] or [↑] to select the three operations above and press [Enter] to confirm your operation. The example of saving parameters is as follows: Select the bA menu and keep pressing [Enter] until "------" is displayed, then SD310 saves the current using parameters into backup region in EEPROM, if the saving operation succeeds after several seconds later, "Er015" is displayed. Reboot drivers to activate modified parameters. If the saving operation fails, "Er" code is displayed. Press [Exit] to return to the upper layer menu. Operation map is as follows:

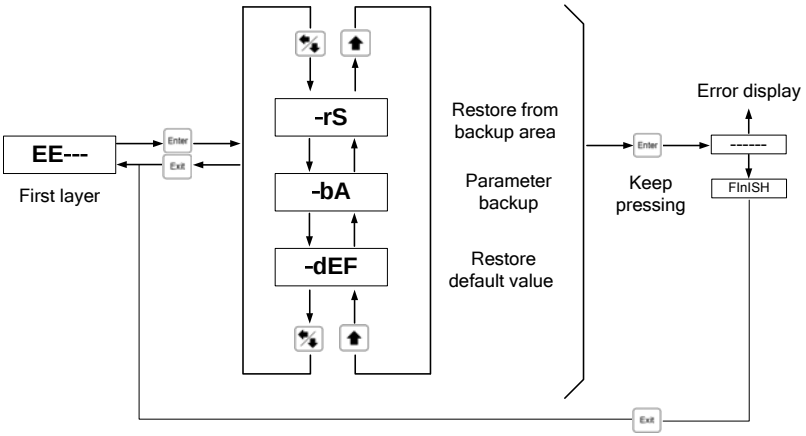


Figure 6.6 EEPROM management operation map

Explanations

1 Set PA00 to 315 or higher authority password before performing parameter

management operations.

2 Do not perform dEF and rS operations when the motor is running. If –dEF and -rS operations succeeds, “Er015” is displayed and drivers need reboot.

3 Setting operation in PA menu will save parameters into EEPROM and the bA operation is not needed.

4 After changing the value of PA01, the parameters associated with servo system controlling such as PA05, PA06, PA07, PA09, PA55, PA56 and so on keep unchanged, but SD310 controls motors following the newly style which is determined by PA01. Perform the dEF operation according to your application after changing the value of PA01.

6.2.4 Adjusting menu (tU)

Select “tU---” and press Enter to enter tU menu.

1 **tU1**

Automatically adjust parameters associated with servo systems’ performance such as rotary inertia, sliding friction etc.

2 **tU2:** Set origin position of machine coordinated system

Use tU2 to set the origin position of motors equipped with absolute encoders. After the tU2 operation, the current position is defined as the origin position. The position data (POS monitoring item under DP menu) based on the specified origin are transmitted to host controllers. The origin position is nonvolatile. This function is not available when driving motors equipped with incremental encoders.

3 **tU3**: Set the zero point of electrical angle of absolute encoders or incremental encoders.

Perform the operation when motors with absolute encoders are firstly driven. Ensure that the following conditions are satisfied before performing the tU3 operation:

1 The power of control circuits and main circuits are turned on

2 Servo driver is not enabled (the RUN indicate is not lit up)

3 Stop motor is fixed and connects no loads

4 Release the brake if motors are equipped with mechanical brake.

After the tU3 operation, the zero point of electrical angle of absolute encoders is saved.

The zero points of electrical angle of absolute encoders are saved in motor encoders. So the tU3 operation is performed only once generally in spite of replacing drivers.

When installing a incremental encoder incorrectly that causes abnormal running of a motor, or replacing a incremental encoder, TU3 operation should be performed.

WARNING

The above conditions should be satisfied before performing the tU3 operation, otherwise it may result in personnel injury, damage of servo drivers or some other troubles.

TU3 operation should be performed when drivers are not in error status. Ensure that the decimal point at the rightmost of the LED nixie tube does not flicker. If TU3 operation is performed when rightmost decimal point is flickering, Error is displayed. At this moment, check monitoring item DP-Err and remove related errors, then re-perform TU3 operation.

Set PA00 to 385 or higher authority password before performing TU3 operation.

4 **tU4**: Clear the multi-circle data of absolute encoders.

If servo drivers issue Er041 or Er042 alarm when driving motors with absolute encoders, perform the tU4 operation. Ensure that the following conditions are satisfied before performing the tU4 operation:

1 The power of control circuits (from r and t terminals) is turned on.

2 Servo driver is not enabled (the RUN indicate is not lit up).

After the tU4 operation, the position of absolute encoders is changed. The

position data upper transmitted to host controllers are not correct. Reference position returning operation is needed in this case.

5 **tU9**

No matter motors are energized or not, performing TU9 will reboot software of drivers. It is usually used when Er015 occurs instead of manual power-off and power-on.

The operation method is similar to that in EE menu.

Explanations

Set PA00 to 315 or higher authority password before performing TU2 and TU4 operations. Set PA00 to 385 or higher authority password before performing TU3 operation.

7 Run

7.1 Grounding

Both servo drivers and motors should be put to earth reliably. It is recommended to keep the protection grounding terminals of servo drivers and those of control cabinets together to prevent electrical shocking. The PWM technology used in driving may result in interfere to the whole servo system including servo drivers and cables. To meet the criterion of EMC, grounding wires should be as strong as possible and the grounding resistors should be as small as possible.

7.2 Working Sequence

7.2.1 Power on sequence

1 Supply power to the main circuits through electromagnetic connectors. Connect R, S and T for three phase applications and connect R, S for single phase applications.

2 Turn on the power of control circuits at the same time of turning on that of main circuits or after it. If only the power of control circuits is turned on, servo ready signal (SRDY) is OFF.

3 800 ms after the main circuits power is turned on, servo ready signal (SRDY) is ON, which means that the servo driver is ready to receive servo enable signals (SVON) from host controllers. After receiving SVON signals successfully, servo drivers are put in RUN status. Servo drivers will in free status if SVON signals are not received, some alarms are issued or the power of main circuits is turned off.When SVON signals and circuits' power are turn on together, the base circuits will be put through after 800 ms.

4 Frequently turning on and off circuits' power may damage the soft start circuits and braking circuits. The turning on and off frequency should be less than 5 times per hour and 30 times per day. After clearing of a fault about overheat of servo drivers or motors, turn on the power at least 30 minutes later to let them cool down.

7.2.2 Time sequence diagram

The SVON signal in the following diagrams is an internal signal of the driver. Its status can be specified by servo bus command or PA33. When some malfunctions happen or the power to the main circuits is turned off, SVON becomes ineffective.

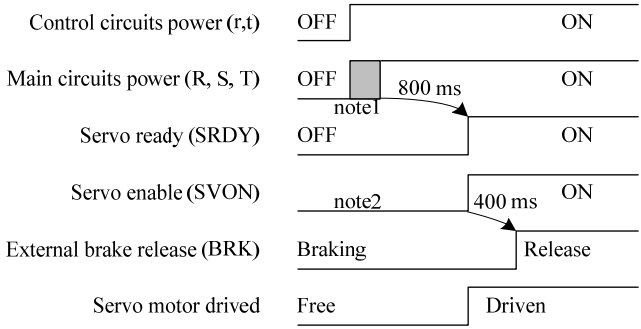


Figure 7.1 Power-on sequence

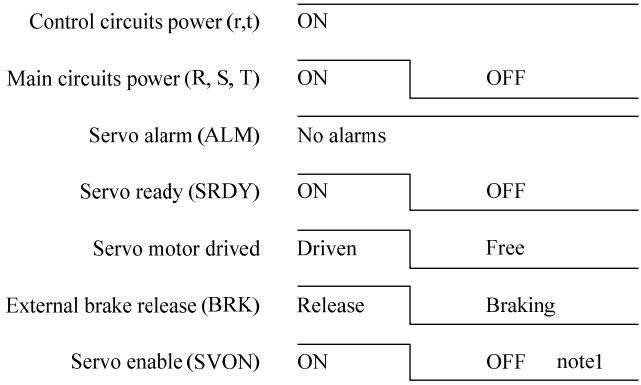


Figure 7.2 Sequence after turning off the main circuits' power

Malfunctions are classified to the following two types according to whether driving the motor continuously or not when a malfunction happens: emergency malfunctions and non-emergency ones.

When a non-emergency malfunction happens and the rotation speed is lower than 100 r/min, SD310 enables the external mechanical brake of the motor firstly.

After the delay time specified by PA58, it cuts off the power to the motor.

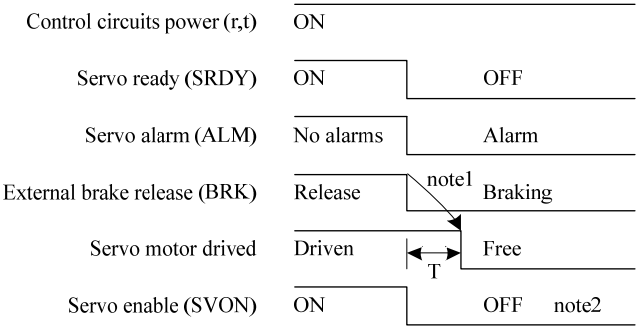


Figure 7.3 Sequence when a non-emergency malfunction happens

If an emergency malfunction happens or a non-emergency one happens when the rotation speed is higher than 100 r/min, SD310 enables the external brake and cuts off the power of the motor.

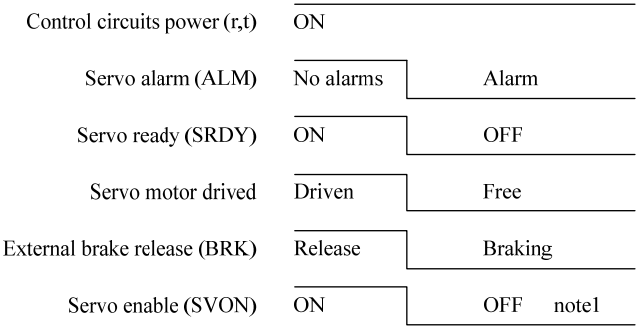


Figure 7.4 Sequence when an emergency malfunction happens

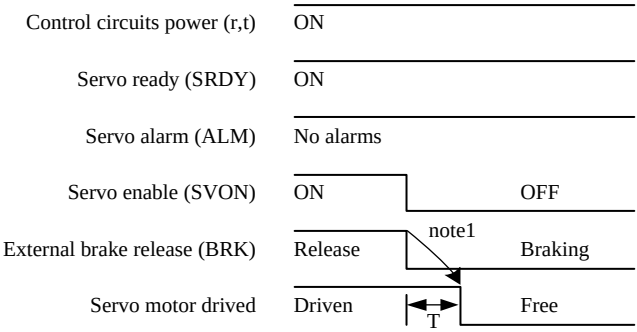


Figure 7.5 Sequence when SVON becomes ineffective

7.3 Adjustment and Setting

7.3.1 Select motor model

SD310 can be used to drive dozens of models of motors. Select the correct motor model (Refer to《List of motor model》) and set it in PA01.

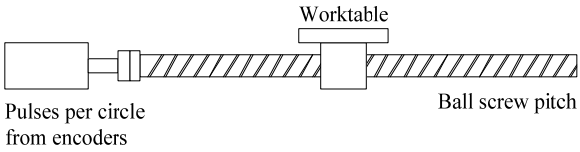
By keys on panel: use the model in the list.

By servo bus: use the sequence number in the list.

7.3.2 Electronic gear ratio

Electronic gear ratio is used to set the proportional relationship of command pulses and actual movements.

If worktables are equipped with the following structure, electronic gear ratio is calculated as follows:



$$\frac{PA12}{PA13} = \frac{\text{Pulse number from motor encoders per revolution}}{\text{Pitch of ball screw (mm)} \times 1000} \times \text{Moving distance per command pulse}(\mu m)$$

For example:

When using 2500 p/r encoders, 10000 pulses will be received per revolution. If 1 command pulse corresponds to 1um or 0.1um, the typical electronic gear ratio is as follows:

$\frac{PA12}{PA13}$	Pitch of ball screw				
	4mm	5mm	6mm	8mm	10mm
1um	$\frac{5}{2}$	$\frac{2}{1}$	$\frac{5}{3}$	$\frac{5}{4}$	$\frac{1}{1}$
0.1um	$\frac{1}{4}$	$\frac{1}{5}$	$\frac{1}{6}$	$\frac{1}{8}$	$\frac{1}{10}$

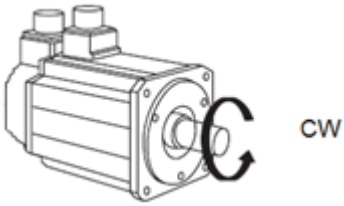
For example:

When using 17-bit absolute encoders, 131072 pulses will be received per revolution. If 1 command pulse corresponds to 1um or 0.1um, the typical electronic gear ratio is as follows:

PA12 / PA13	Pitch of ball screw				
	4mm	5mm	6mm	8mm	10mm
1um	4096/125	16384/625	8192/375	2048/125	8192/625
0.1um	2048/625	8192/3125	4096/1875	1024/625	4096/3125

7.3.3 Motors' rotation direction

Watching a motor from the axis head, the counterclockwise direction is defined as the positive direction (CW). Reversely, the clockwise direction is defined as the negative direction (CCW).



When PA15 is set to 0, if positioning commands are positive, motors rotate in the positive direction (CW).

When PA15 is set to 1, if positioning commands are positive, motors rotate in the negative direction (CCW).

Note

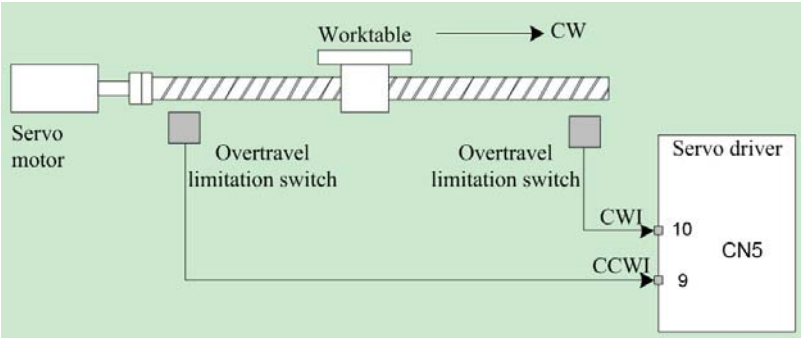
1 Setting PA15 changes the rotation direction of motors, but has no relationship with the definition of CW and the sign of feedback position values.

2 The rotation direction setting in SPD mode and TOR mode are the same.

7.3.4 Hardware overtravel protection

Drivers provide the hardware over travel protection function when using over

travel limitation switches on machine tools.



Set PA82.1 to 1 to enable the function. When the limitation switch signal in CW direction is received, the torque outputted in CW direction is zero. When the limitation switch signal in CCW direction is received, the torque outputted in CCW direction is zero.

The default state of CWI and CCWI are normal open. If the active states of limitation switches are normal closed, using PA59 to change the active polarity of CWI and CCWI.

When overtravel happens, the stopping style described below can be specified by setting PA79.0.

1 Motor is stopped after a deceleration process. The maximum distance in deceleration process is specified by PA78.

2 Motor is stopped freely.

3 Weather Er.038 is issued or not after the motor is stopped.

When the over travel protection is active, drive motors in the opposite direction to exit from the over travel position.

Overtravel protection function is available for every control mode specified by PA04 as follows:

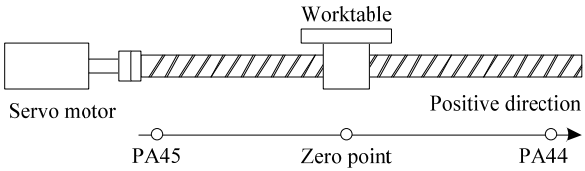
PA04	Phenomenon	Processing method
POS	Movement is forbidden in the direction of overtravel. If host controller keeps on driving motors move in the	After host controller or drivers clear errors, Drive motors in the opposite direction to exit from the overtravel position.
A-POS		

	direction of overtravel, Er004 is issued.	
SPD	Movement is forbidden in the direction of overtravel.	Drive motors in the opposite direction to exit from the overtravel position.
D-SPD		
TOR	Outputting torque is forbidden in the direction of overtravel.	Drive motors in the opposite direction to exit from the overtravel position.

7.3.5 Software overtravel protection

When using grating rulers or driving a motor with an absolute encoder in POS mode, software overtravel protection function is available by setting PA08 to 1. The function is useful to save some limitation switches to achieve the same application effect.

Set PA44 and PA45 (unit of which is specified by PA82.2) correctly when using this function.



Explanations

1 This function is available only for the POS mode.

2 If the zero point position is changed, ensure that the values of PA44 and PA45 are changed correspondingly. The following operations may change the zero point position.

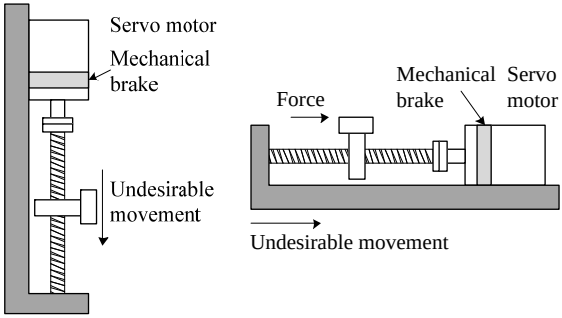
No.	Operation	Warning
1	1 The electronic gear ration is changed (PA12/PA13) 2 The rotation direction a motor is changed (PA15) 3 Mechanic gear ratio between motor and rotary table (PA65/PA66)	AL 136
2	Some parameters associated to gating rulers	—

	(PA85~PA87, PA89)	
3	The host controller performs some setting operations by servo bus command.	—
4	Perform the tU2 operation	AL 136
5	Perform the tU4 operation	—
6	Mechanical devices are changed	—

- The process methods for the software overtravel protection function is the same as those for hardware overtravel protection function except for the two notes above.

7.3.6 Mechanical brakes of motors

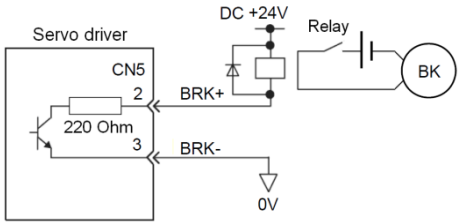
When driving a vertical axis or an axis subjected to some external forces, a mechanical brake is needed to clamp the motor to prevent some unexpected movement when the power to the motor is cut off.



The BRK+ and BRK- signals in CN5 socket are used to control a mechanical brake.

Example

For a mechanical brake using DC power source, its typical application diagram is as follows:



7.3.7 Parameters related to the performance of servo systems

The load inertia ratio (PA57) should be set correctly when adjusting servo systems. To achieve better performance, the related parameters should be adjusted properly according to the mechanical attributes.

7.3.8 Start-stop characteristic adjustment

1 Load inertia and start-stop frequency

When the start-stop frequency is relative high, the available start-stop frequency range should be confirmed which depends on motor types, load inertias, rotation speeds and some other elements. When the load inertia is *m* times of that of motor inertia, the available start-stop frequency range and recommended acceleration/deceleration time are as follows:

Load inertia	Available start-stop frequency
m ≤ 3	>100 time/minute; 60ms or less
m ≤ 5	60~100 time/minute; 150ms or less
m > 5	<60 time/minute; 150ms or more

When using KND series CNC systems to control SD310, the acceleration/deceleration times of CNC can be set following the table above. If the cases described above can't satisfy your applications, try reducing the internal torque limitation specified by PA34 and PA35 or decreasing the rotation speed of motors.

2 Motor models and start-stop frequency

The available start-stop frequency range is different from motor models which may be used in variant applications. Please refer to motors' manual for more information.

3 Adjusting method

Generally, load inertia should be 1~3 times of that of motors. When driving motors with too large load inertia, SD310 may issue some errors because of the regenerative energy during deceleration process. In this cases, follow the below

procedures:

- Reduce the internal torque limitation specified by PA34 and PA35.
- Reduce the rotation speed of motors.
- Increase the acc./dec. time of CNC.
- Install external braking resistors.
- Change a motor with bigger inertia.

7.3.9 Battery installation and replacement

When driving motors with multi-circle absolute encoders using batteries, the absolute position is remembered with the help of batteries when drivers' power is turned off. SD310 provides a battery box on the top of its body in which three #5 batteries are installed. These batteries can be replaced conveniently by users. Battery replacement operation can be performed when drivers are supplied power or not.

When drivers' power is turned on, replacing batteries will not lose the absolute position information, but AL150 will be issued. When drivers' power is turned off, replacing batteries operation will lose the absolute position information, which will result in issuing Er.041 at the moment of restarting the driver.

Note

It is not necessary to reboot the driver after replacing batteries when the power is on. Press Exit continuously will clear the AL.150 alarm.

7.3.10 Low voltage error/warning monitoring of encoder battery

Function instructions

For motors with multi-circle absolute encoders using batteries, voltage of batteries decreases along with consuming. When battery voltage is less than 3.2V, encoders issue low voltage of battery alarm; when battery voltage is less than 2.8V, after drivers are turned off, encoders can not keep working, and multi-circle data gets lost. So, after drivers appear low voltage of battery alarm, replace batteries as soon as possible.

There are two alarm ways of low voltage of battery alarm:

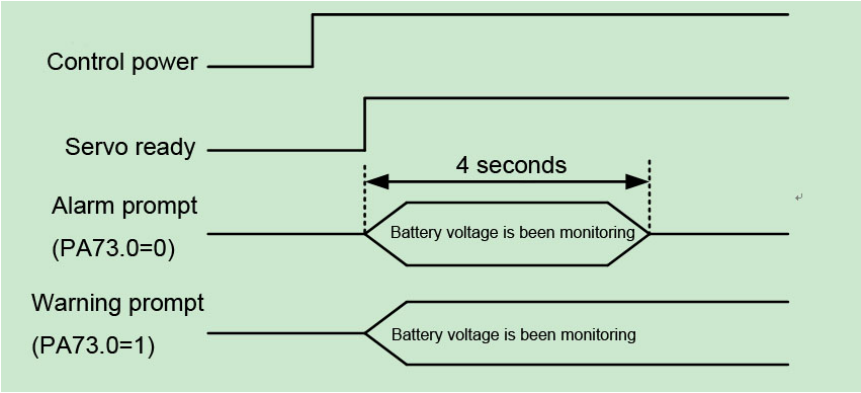
(1) When setting PA73.0=0 (default): Low voltage of external battery for

absolute encoders with battery (Er072)

After drivers are turned on, starting from driver ready signal is active, battery voltage is monitored for 4 seconds. Er072 occurs when battery voltage is low. 4 seconds later, error is not detected in spite that battery voltage is lower than standard value.

(2) When setting PA73.0=1: Low battery voltage alarm (AL150)

After drivers are turned on, battery voltage is monitored all the time. AL150 occurs when battery voltage is low.



Parameter

Parameter	Description	Default	Mini.	Max.	Unit
73	PA73.0: When low voltage of external battery of absolute encoders happens, drivers will output 0: Alarms (default) 1: Warnings	xxx0	—	—	—

7.4 Pilot Running

CAUTION

When debugging a servo driver, pilot running should be performed firstly. When no abnormality happens, the following running mode can be performed next. Ensure that do not drive any load in POS, SPD or TOR mode when pilot running is not performed.

7.4.1 Check before pilot running

Check the following conditions before turning on the power of servo drivers and motors:

- Wiring is correct and firm
- Power voltage is correct
- Power cables to drivers and motors have no short circuits and are put to earth correctly
- Control signals are connected correctly
- The polarity and level of input and output signals are correct
- The encoders' signals are connected correctly
- Do not drive any load in pilot running mode

7.4.2 Pilot running in velocity control mode

1 Connecting servo bus interfaces CN3 and CN4 is unnecessary.
2 Turn on the power of control circuits, while the main circuits' power is not turned on. If some error is issued, please check the wiring.
3 Perform necessary setting according to the last chapter.
4 Turn on the power of main circuits and indicator lamp of power goes on.
5 Set PA04 to D-SPD mode and PA21 to a reasonable value. Set PA40 and PA41 to 300ms.
6 Set PA33 to ON (before setting PA33 to ON, set PA00 to 385) after confirming that no malfunctions and abnormalities happen, then the motor gets excited, run indicator lamp goes on and motor will rotates at the speed specified in PA21.
7 The rotation direction of motors can be changed by setting PA15.
8 The rotation speed of motors can be specified by setting PA21. Motor speed can be monitored under dP menu whether it is same as setting value of PA21.
9 Change value of PA21 to rated speed of motor and watch whether it is

abnormal.

10 Set PA33 to OFF, then motor is turned off and run indicator lamp goes off.

11 Pilot running in velocity control mode is finished.

7.5 Position Control Mode

1 Turn on the power to control circuits and main circuits, confirm that the POWER indicator is lit up and the LED displays normally.

2 Set P04 to POS to enter the position control mode.

3 If no abnormality or malfunction happens, perform the servo bus connection initialization by the host controller. The RUN indicator is lit up. The motor is driven and is in zero-speed status.

4 Host controllers send position command through servo bus to control motors' running.

The associated parameters and displaying items about the position control mode are described in the below diagram:

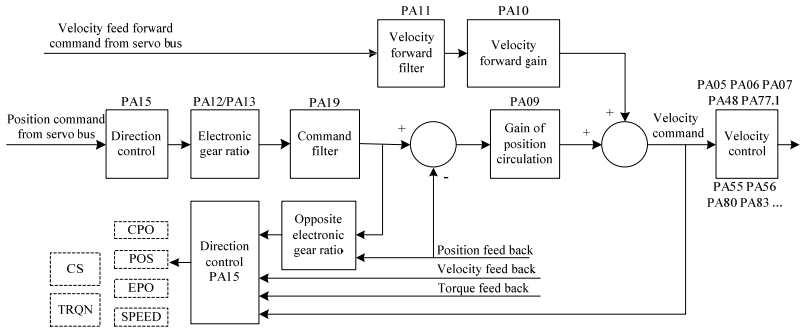


Figure 7.4 Schematic diagram of the position control mode

Note

In position control mode, if the absolute value of deviation is less than the value of PA16, COIN signal is effective, while if the value is bigger than the value of PA17, Er.004 is issued.

7.6 Velocity Control Mode

1 Turn on the power to control circuits and main circuits, confirm that the POWER indicator is lit up and the LED displays normally.

2 Set P04 to SPD to enter the velocity control mode.

3 If no abnormality or malfunction happens, perform the servo bus connection initialization by the host controller. The RUN indicator is lit up and the motor is driven.

4 Host controllers send velocity command through servo bus to control motors' rotation speed.

The associated parameters and displaying items about the velocity control mode are described in the below diagram:

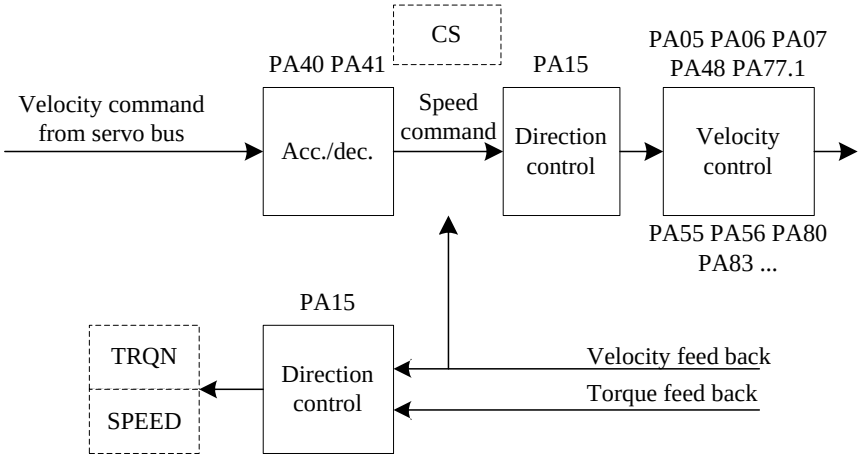


Figure 7.5 Schematic diagram of the velocity control mode

Note

In SPD or D-SPD mode, if the rotation speed is in the range specified by PA37 and PA38, the output signal VCMP is effective.

7.7 Torque Control Mode

1 Turn on the power to control circuits and main circuits, confirm that the POWER indicator is lit up and the LED displays normally.

2 Set P04 to TOR to enter the torque control mode.

3 If no abnormality or malfunction happens, perform the servo bus connection initialization by the host controller. The RUN indicator is lit up and the motor is driven.

4 Host controllers send torque command through servo bus to control motors' torque outputted.

The associated parameters and displaying items about the torque control mode are described in the below diagram:

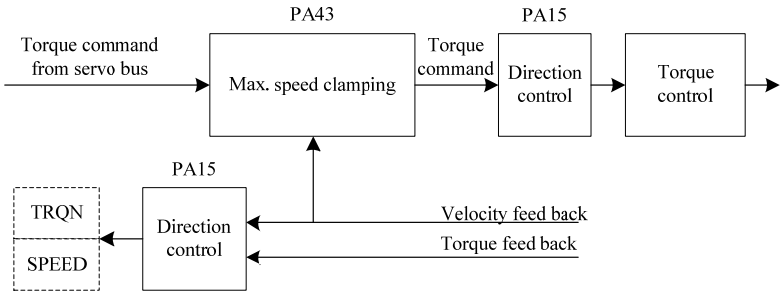


Figure 7.6 Schematic diagram of the torque control mode

Note

Motors will accelerate when the torque outputted is bigger than that the actual load needs. SD310 provides the over-speed clamping function to protect the load equipment. The maximum speed is set in PA43. When the over-speed clamping function is effective, output signal VLT is effective. If the value of PA43 is bigger than the maximum speed of motors, before the actual rotation speed reaches the value set by PA43, Er.01 will be issued. If the external analog torque command reduces to a normal range when the rotation speed is clamped, servo drivers will ineffective the clamping function and work in torque control mode.

7.8 Single-axis Positioning

The single-axis positioning operation is suitable for the following situations:

- When simple positioning operation is needed without host controllers

- Demonstration running without host controllers

Set PA04 to A-POS to enter the single-axis positioning mode. Four positions are specified in PA49~PA52 and their corresponding speed (absolute value) when positioning are specified in PA29~PA32. The general view of single-axis positioning is as follows:

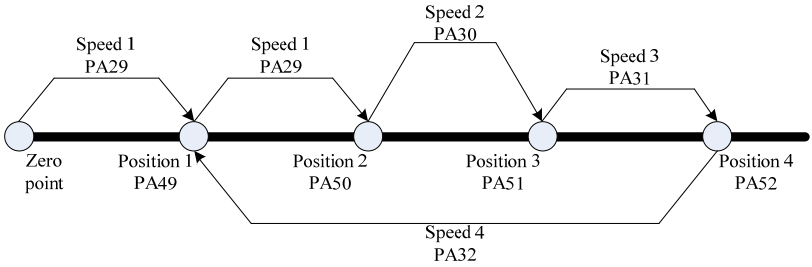


Figure 7.7 Schematic diagram of the A-POS control mode

Procedure of performing the single-axis positioning operation:

Set PA33 to ON and supply power to the motor. The current position is regarded as the zero point and servo driver performs the positioning operation to the next point specified. When positioning, the linear acceleration process is used. When reaching the target point, servo driver delays a time specified by PA19 and waits until the POSI_RDY signal is effective and perform the positioning operation to the next point. When reaching the position 4 specified by PA52, servo driver moves to the position 1 as the next point periodically.

The values' unit of PA49~PA52 is specified by PA77.2 and the range is from 1r to 0.001r. The delay time after a single positioning operation is specified by PA19, its range is from 0s~1000s. The absolute value of the acceleration speed is specified by PA25.

The upper distance limitation between two positioning points is 16000r. The longest time of positioning process should shorter than 500 seconds. When the above limitations are reached, Er.039 will be issued.

Note

- If the distance between two positioning points is short while the positioning speed is high, the positioning speed may not be reached because of the acceleration process.
- When positioning, the motor's coordinate can be read in the PCOR

displaying item.

- The CW direction of the motor is regarded as the positive direction of positioning operation.
- POSI_RDY signal uses the DI_EXT1 terminal. If the DI_EXT1 terminal is not connected with any line, it is available to set POSI_RDY effective forcibly using PA54.
- For safety consideration, setting PA04 to A-POS is only valid for the current restarting operation. PA04 is set to POS automatically after rebooting the driver.

7.9 Closed Loop Control（SD311 driver）

SD311 provides the interface connecting grating rules and supports the closed loop control. Closed loop control function and related parameters are effective only on SD311 drivers.

7.9.1 Connection

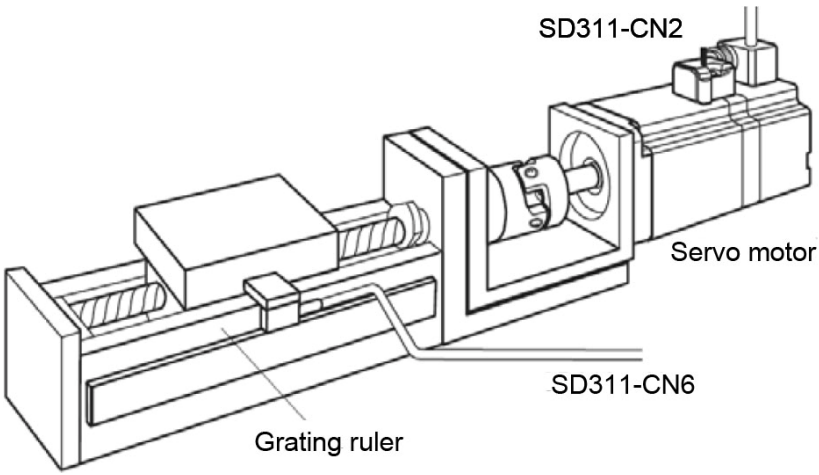


Figure 7.8 Connection diagram when grating rules

Absolute grating rulers and incremental ones are available for SD311.

7.9.2 Parameter setting

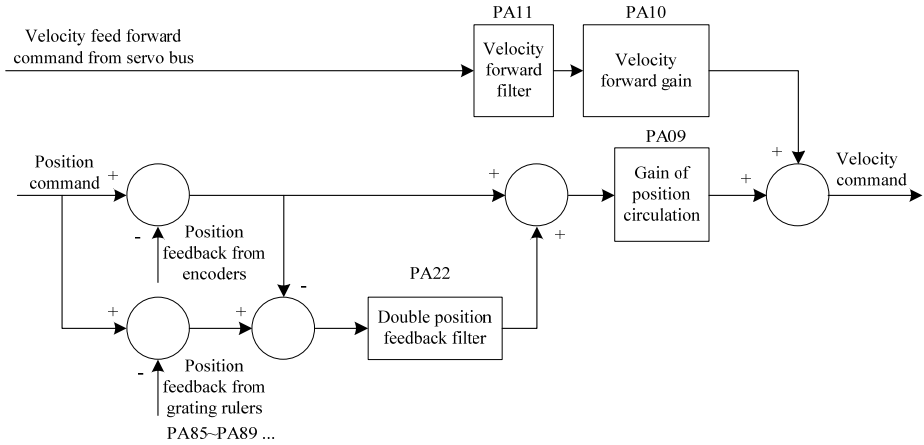


Figure 7.9 Schematic diagram of the closed loop control

Step	Operations and explanations
1	Set PA04 to POS to enter the position control mode.
2	➢ Set PA85 to select absolute grating rulers and incremental ones ➢ Specify the pitch of ball screw by setting PA87. Pitch length represents the distance worktable moves when the motor rotates one circle. ➢ Select the resolution of the grating rule by setting PA89. ➢ Reboot the driver.
3	Examine the RAS_L and RAS_H displaying items: ➢ When using incremental grating rules, their values are close to 0. ➢ When using absolute grating rules, their values represent the absolute position. The values changes while the screw is rotated.
4	Examine the ENC_L and ENC_H displaying items to confirm that the values changes at the same direction with those of RAS. If the directions that the values of RAS and ENC changes are not same, set PA86 to 1.
5	Confirm that the value of PA22 is 1000, which means not using the feedback data from grating rules. Reboot the driver.

6	Supply power to the motor and make the motor rotate at a low speed in CW and CCW repeatedly. Check the REE displaying item and ensure that the value of PA88 is bigger than the maximum absolute value displayed in REE item.
7	Cut off the power to the motor and set PA22. When PA22 is set to 0, servo driver only uses the grating rule as the position feedback source. Increasing the value of PA22 will increase the position feedback ratio the encoder takes. When PA22 is set to 1000, servo driver only uses the encoder as the position feedback source.
8	Supply power to the motor and make the motor rotate at a low speed in CW and CCW repeatedly. Ensure that the motor running smoothly.
9	Debugging is complete.

7.10 Rotary Table Function

The motor matched with a multi-circle absolute encoder, connects the rotary table (rotary axis) through gears. No matter how rotary table rotates (in single direction or alternate direction), driver can calculate correct rotation angle of rotary table. Besides, even if the motor rotates after driver is turned off, driver can also get correct rotary table angle after rebooting.

When using rotary table function, be sure to set parameters according to the following steps in turns. Assuming that gear ratio between motor and rotary table is m:n (m-turned circles of a motor, n-turned circles of the rotary table).

1. Set electronic gear ratio parameters PA12/PA13

Formula for calculating electronic gear ratio:

$$\frac{PA12}{PA13} = \frac{\text{Pulse number from encoder per revolution}}{\text{Command pulse number that motor rotating one turn needs}}$$

Feedback pulse number from encoder per revolution = 131072 (motor encoder is 17-bit encoder)

Command pulse number that motor rotating one turn needs = Command pulse number that rotary table rotating one turn needs* n / m.

NOTE:

Command pulse number that rotary table rotating one turn needs must be 2^x, otherwise, rotary table function will be abnormal when using with CNC systems.

Select proper value of x to make PA12/PA13 less than 1.

Example:

m = 90，n = 1，x = 24，that is, when a motor rotates 90 turns, rotary table rotates 1 turn, 2^{24} pulses are needed to rotate rotary table 1 turn, so:

$$\frac{PA12}{PA13} = \frac{131072}{2^{24} \times \frac{1}{90}} = \frac{45}{64}$$

Set parameters PA12 = 45，PA13 = 64。

NO.	Description	Default	Mini.	Maxi.	Unit
12	Numerator of electric gear ratio	1	1	32767	—
13	Denominator of electronic gear ratio	1	1	32767	—

2. Set gear ratio parameters between motor and rotary table PA65/PA66

Formula for calculating gear ratio between motor and rotary table:

$$\frac{PA65}{PA66} = \frac{\text{Turned circles of motor (m)}}{\text{Turned circles of rotary table (n)}}$$

Example

m = 90，n = 1，means that when a motor rotates 90 turns, rotary table rotates 1 turn, so:

$$\frac{PA65}{PA66} = \frac{90}{1}$$

Set parameters PA65 = 90，PA66 = 1。

NO.	Description	Default	Mini.	Maxi.	Unit
65	Turned circles of motor	1	1	32767	—
66	Turned circles of rotary table	1	1	32767	—

3. Set rotary table functional switch parameter PA73.3

After setting the parameters above correctly, set PA73=1xxx to enable rotary table function.

When setting PA73 = 0xxx, rotary table function is unavailable.

When do not using rotary table function, be sure to set PA73 = 0xxx.

NO.	Description	Default	Mini.	Maxi.	Unit.
73	PA73.3 (leftmost bit): Rotary table function 0: Open 1: Closed	**0**xxx	—	—	—

7.11 Friciton Compensation

When load friction is relatively large, relatively large position follow error is generated at load start-stop or reversing speed. By compensating load friction, friction compensation function is used to decrease position follow error caused by friction.

◆ Cautious

(1) Before performing friction compensation, load inertia ratio (PA56) must be set correctly (load inertia ratio can be learned by performing tU1 operation). If load inertia ratio is set wrong, vibration may be generated during adjusting friction force compensation parameters.

(2) to get better compensation effect, please measure resonance frequency first, and set frequency of trap filters (PA80), then adjust rigidity of servo system (PA55) to a proper value.

◆ Procedures of adjusting parameters

（1）Set parameters of friction compensation to default value to enable friction compensation function.

Gain of friction compensation（PA60）: 100%

Factor of friction compensation（PA61）: 0%

Amendment for gain of friction compensation（PA62）: 0%

Friction compensation function switch（PA79.2）: 1

（2）Adjust factor of friction compensation PA61

Increase factor of friction compensation PA61 until follow error curve of path on system or quadrantal points of work part gets relatively good performance.

（3）Adjust gain of friction compensation PA60

If friction compensation is still not enough after adjusting PA61, increase setting value of PA61 by 10% each time until vibration disappears.

（4）usually, it's no need to adjust amendment for gain of friction compensation PA62

◆ Friction compensation effect

（1）Effect of adjusting parameters

PA60: Gain of friction compensation. This parameter determines response speed of anti-interference of external load force. The larger of setting value, the faster of respose speed. If a resonance point exists in load system, excessive setting value of PA60 may cause vibration.

PA61: Factor of friction compensation. This parameter determines effect of friction compensation. The larger of setting value, the better effect of friction compensation. Excessive factor of friction compensation may cause vibration. So it is usually set less than 95%.

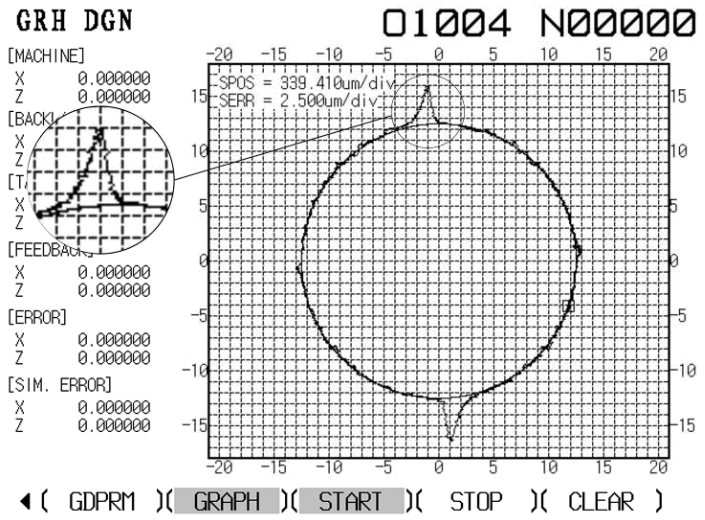
（2）Effect of friction compensation

When machining a circle with interpolation of 2 axes, relative large friction force may cause protuberance at quadrantal points. Adjusting friction compensation parameters can obviously decrease protuberance.

◆ Cautious when adjusting parameters

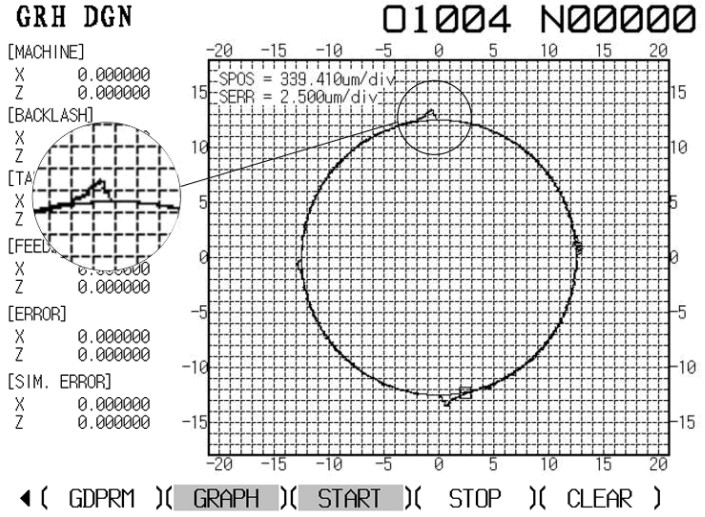
（1）When adjusting factor of friction compensation (PA61), please increase parameter value gradually by less than 10% in case of vibration and damage of mechanism.

（2）When adjusting gain of friction compensation (PA60), if vibration appears, please try to decrease this parameter gradually.



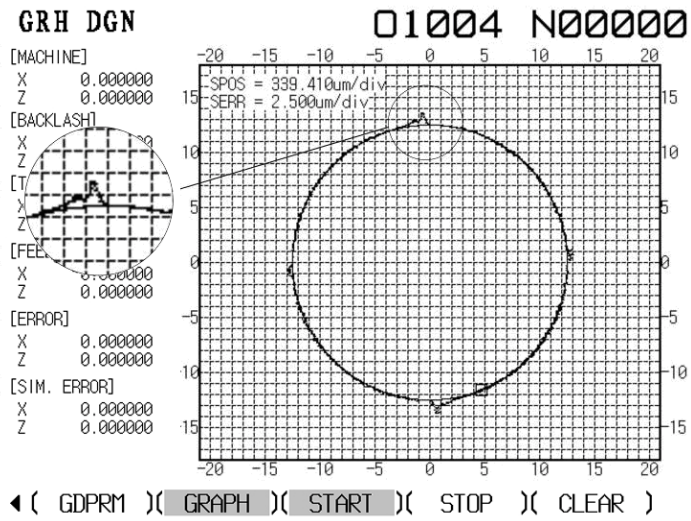
Figure（a） PA60=100，PA61=0

No friction compensation, height of protuberance at quadrantal points is about 10um



Figure（b） PA60=100，PA61=80

Protuberance at quadrantal points gets retrained; height of protuberance is about 2.5um. Performance of compensation is obvious.



Figure（c） PA60= 50，PA61=80

Protuberance at quadrantal points gets retrained; height of protuberance is about 2.5um. But path follow error gets overshot.

7.12 FAQ

7.12.1 Er 009/Er 030/Er 032/Er 034 occurs frequently

These alarms possibly represents that encoders are broke down or the feedback cables are not connected firmly or correctly. Solve the problem following the tips below:

- Check the connection between cables and sockets.
- Check the connection of shield wires.
- Ensure that the FG terminals of servo drivers and motors are grounded well.
- Too long feedback cables may result in relatively higher pressure loss. In this case, use multiple wires to connect the 5V and 0V signals between drivers and motors.
- Install feedback cables away from heavy-current cables.
- Replace a same model motor.

NOTE

When setting parameter PA36 to 1, servo drivers do not detect the alarms about incremental encoders. When driving motors with saving-line encoders, PA36 should be set to 1.

7.12.2 POWER indicator can't be lit up

When the power to main circuits and control circuits are turned on and work well, the nixie tubes on panel display no alarm or error, but the POWER indicator can't be lit up and servo driver does not work. The problem may possibly be caused by the malfunction of braking circuits, which put servo drivers into the protection status. Please connect the technical support centers of KND.

7.12.3 Motors do not rotate

When the RUN indicator is lit up after the servo enable signal from host controllers is received, servo drivers do not response command and motors stay still. The command position monitored in dP menu does not change. The reason for this problem may be wrong setting of PA04. Ensure that PA04 is set to POS.

7.12.4 How to stop the flickering status

Error

Drivers will issue a corresponding error code flickeringly when a malfunction happens. Press Exit to exit from flickering status, but the decimal point on the right bottom corner of nixie tubes will still flicker which indicates that the driver is in trouble. The error code can be read in the Err item in monitoring interface. After solving the problem, inputting ACLR signal or restarting the driver will clear the error state.

Alarm

Drivers will issue a corresponding alarm code flickeringly when some malfunction happens. Press Exit to exit from flickering menu, but the left second decimal point of nixie tubes will still flicker which indicates that the driver is in trouble. The alarm code can be read in the AL item in monitoring interface. After solving the problem, Pressing Exit will clear the alarm and the decimal point will stop flickering.

7.12.5 How to clear an error or alarm

When an error or alarm happens, following the above operations described in the section 7.12.4 to stop the flickering status and only the corresponding decimal point flickers. After solving the problem leading to the error or alarm, keep pressing Exit for several seconds until "------"is displayed and then the servo driver will clear the alarm or error (rebooting is not necessary) and enter the ready status.

Note

- Find the reason for the alarm or error and solve it before perform the above operation, or the alarm or error will happen again.
- Er.015 and Er.016 can't be cleared.

7.12.6 How to drive low-power motors with high-power drivers

Generally, Use different models of driver to drive motors with different rated powers. 错误！未找到引用源。-30 is used to drive motors whose rated power is lower than 2KW. 错误！未找到引用源。-50 and 错误！未找到引用源。-75 are used to drive motors whose rated power is higher than 1.5KW and lower than 5.5KW. SD310-100 is used to drive motors whose rated power is higher than 2KW. In some special applications, 错误!未找到引用源。are available to driver motors out of the general power range. Please connect the technical support centers of KND. Ensure that never attempt to drive high-power motors with relatively low-power drivers, or the damages caused are not maintained freely.

7.12.7 When to perform -tU3 operation

When motors with absolute encoders are used at the first time, AL.152 will be issued and the -tU3 operation is needed to clear the alarm. The operation result is remembered in the memory of encoders, so –tU3 operation is only performed once correctly for a certain motor. Even the driver is changed, -tU3 operation is not needed.

7.12.8 Mask Er.032 when using saving-line encoders

Set PA36 to 1 to make the driver not to detect the alarms from incremental

encoders.

7.12.9 How to perform -tU3 operation on relative encoder

When installation position of relative encoder deviates so that motor rotates abnormally, or replacing a relative encoder, TU3 operation needs be performed. PA73.2 (the right third bit) is used to set searching mode for Z signals. When performing TU3 operation, driver searches for Z signals automatically or manually after motor is locked by driver.

When PA73.2 = 1, driver searches for Z signals automatically and set installation offset value to PA26 automatically after TU3 operation.

When PA73.2 = 0 (default), operations are same as that of SD200. After adjusting, installation position of encoder is same as factory-set position. The specific operation procedures are as follows:

(1) Cables between motors and drivers are connected correctly and motors cannot connect any load during installation.

(2) Turn on the drivers, and confirm whether motor model set in PA01 is same as the motor label;

(3) Set PA73.2 to 0（x0xx）for searching Z signals manually.

(4) Set PA00 to 385, perform TU3, motors enter manual mode for searching Z signals and motors get enabled;

(5) Rotate sleeve of taper hole inside encoders manually to make encoder rotate. Angle displayed on drivers (APO option in DP interface) varies from 0 to 32767 and confirm encoders work normally. Then find a angle position from 32667 to 32767 or 0 to 100 (0 is the optimum position), install inner taper hole of encoders to outer taper shaft of servo motors and fasten screws.

(6) Take use of bearing frame of encoders to adjust installation position finely, making angle value in range of 32667～32767 or 0～100 (0 is the optimum position) and fasten two screws. Make sure that angle value is in range of 32667～32767 or 0～100 (0 is the optimum position) after adjustment, or reinstalling encoders is needed.

(7) Perform TU9 operation, and driver reboots without power-off;

(8) Set PA04 to D-SPDmode, and PA33=ON. Specify PA21 by 10-1000-rated

speed. If the motor rotates smoothly and speed is correct, it means encoder is installed successfully, or encoder needs readjustment.

7.12.10 Error occurs after performing -tU3 operation

TU3 operation must be performed when no error occurs on driver. Before operating, please confirm the rightmost decimal point is not flickering, or “Error” will appear when performing TU3 operation. At this time, check DP-Err display option and clear related errors, then perform TU3 again.

TU3 operation can be performed in warning status of driver.

7.12.11 Operations of changing the zero point

Consider the consequence caused by changing the zero point after the following operations, or colliding or overtravel may happen.

NO.	Operation	Warning
1	➢ The electronic gear ratio is changed (PA12/PA13) ➢ The rotation direction a motor is changed (PA15) ➢ The gear ratio between motor and rotary table is changed (PA65/PA66)	AL 136
2	Some parameters associated to gating rules (PA85~PA87, PA89)	—
3	The host controller performs some setting operations by servo bus command.	—
4	Perform the tU2 operation to set current position as reference point.	AL 136
5	Perform the tU4 operation to clear multi-circle data of absolute encoders.	—
6	Mechanical devices are changed	—

7.13 Relative Knowledge

7.13.1 Lag pulses in position control mode

In position control mode, the difference between feedback pulses and command pulses number after electronic gear ratio is called lag pulses. The lag

pulses number can be read in the motoring menu EPo in dP interface. Lag pulses, the frequency of command pulses, the gain of position circulation and the feed forward quotient of position circulation meet the following equation:

$$\text{Lag pulses} = \frac{\text{The frequency of command pulses(Hz)}}{\text{PA09}} \times (100 - \text{PA10})\%$$

Unit of lag pulses is same as command unit from host controller.

7.13.2 Relationship between lag pulses and the motors' speed

In position control mode, the lag pulses and the rotation speed of motors meet the following equation:

$$\text{Rotation speed} = \frac{\text{Lag pulses}}{\text{Command pulses corresponding to one circle of a motor}} \times \frac{\text{PA09} \times 60}{(100 - \text{PA10})\%}$$

Unit of lag pulses is same as command unit from host controller.

8 Connect with KND systems and Motors

8.1 Connect with KND systems

Servo bus interface: Socket DB9M	
Signal	Pin
SRD+	3
SRD-	8
	Others
FG	Shell

CN3 CN4: Socket DB9M	
Pin	Signal
3	SRD+
8	SRD-
Others	
Shell	FG

8.2 Feedback Cable (2500-line incremental encoders)

8.2.1 Non-saving-line encoders

Driver side: CN2: DB26-3 (male)

Pin	Signal
1	A+
2	A-
3	B+
4	B-
5	Z+
6	Z-
19	U+
20	U-
21	V+
22	V-
23	W+
24	W-
17	+5V
12	0V
Shell	FG

Motor side: AYD28K15TS

Aviation socket	
4	A+
7	A-
5	B+
8	B-
6	Z+
9	Z-
10	U+
13	U-
11	V+
14	V-
12	W+
15	W-
2	+5V
3	0V
1	FG

8.2.2 Saving-line encoders

Driver side CN2: DB26-3 (male)

Pin	Signal
1/22	A+/V-
2/21	A-/V+
3/20	B+/U-
4/19	B-/U+
5/24	Z+/W-
6/23	Z-/W+
17	+5V
12	0V
Shell	FG

Motor side: F1 socket (9-pin)

Aviation socket	
5	B+
8	B-
4	A+
7	A-
6	Z+
9	Z-
2	+5V
3	0V
1	FG

8.3 Feedback Cables (17-bit absolute encoders)

8.3.1 Motors with 17-bit single circle/12-bit mechanical multi-circle encoders (KND M1)

Driver side CN2: DB26-3 (male)

Pin	Signal
1	A+
2	A-
3	B+
4	B-
23	MAY
24	MAZ
25	SLA
26	SLB
18	Sensor+
13	Sensor-
17	+5V
12	0V

Motor side: AYD28K15TS

Aviation socket	
4	A+
7	A-
5	B+
8	B-
12	MAY
15	MAZ
11	SLA
14	SLB
10	5V S
13	0V S
2	Ub
3	Un

Shell	FG

1	FG

8.3.2 Motors with 17-bit absolute encoders (KND E/KND M/HUADA LEBB/HUADA LMBB)

Driver side CN2: DB26-3 (male)

Pin	Signal
23	SD+
24	SD-
7	BAT+
16	BAT-
17	+5V
12	0V
Shell	FG

Motor side: E socket (7-pin)

Aviation socket	
6	SD+
4	SD-
3	E+
2	E-
7	+5V
5	0V
1	FG

- Cable: It is recommended to use paired shield cables (RVVP 12 × 0.2 mm2) as command cables and feedback cables.
- When driving motors with saving-line encoders, please set PA36 to 1 to mask the Er.032 alarm.

Appendix

1. Parameter List of Motor Model

Rated current of matched motor

Servo driver model (SD310-□)	Rated current of matched motor (A)
30	I≤6
50	6<I≤10
75	10<I≤15
100	15<I≤25

List of Matched Motors for SD Series Servo Drivers

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
1	C01030	KND 80STM01030	0.3	1	3000	2.6	30
2	C01330	KND 80STM01330	0.4	1.3	3000	3.6	30
3	C02430	KND 80STM02430	0.75	2.4	3000	4.5	30
4	C03330	KND 80STM03330	1	3.3	3000	5.0	30
5	D01530	KND 90STM01530	0.45	1.5	3000	2.8	30
6	D02430	KND 90STM02430	0.75	2.4	3000	3.0	30
7	D03530	KND 90STM03530	1.1	3.5	3000	4.0	30
8	E02020	KND110STM02020	0.4	2	2000	2.3	30
9	E02030	KND110STM02030	0.6	2	3000	2.7	30
10	E04020	KND110STM04020	0.8	4	2000	3.6	30
11	E04030	KND110STM04030	1.2	4	3000	4.3	30
12	E05030	KND110STM05030	1.5	5	3000	5.0	30
13	E06020	KND110STM06020	1.2	6	2000	4.3	30
14	E06030	KND110STM06030	1.8	6	3000	5.8	30
15	F04015	KND130STM04015	0.6	4	1500	2.6	30

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
16	F04025	KND130STM04025	1	4	2500	3.4	30
17	F05015	KND130STM05015	0.75	5	1500	3.4	30
18	F05025	KND130STM05025	1.3	5	2500	5.9	30
19	F06015	KND130STM06015	1	6	1500	4.2	30
20	F06025	KND130STM06025	1.5	6	2500	5.8	30
21	F07715	KND130STM07715	1.2	7.7	1500	4.6	30
22	F07725	KND130STM07725	2	7.7	2500	7.5	50
23	F10015	KND130STM10015	1.6	10	1500	4.9	30
24	F10025	KND130STM10025	2.6	10	2500	7.5	50
25	F15015	KND130STM15015	2.4	15	1500	8.7	50
26	F15025	KND130STM15025	3.9	15	2500	12.6	75
27	H18015	KND150STM18015	2.8	18	1500	8.8	50
28	H23015	KND150STM23015	3.6	23	1500	11.8	75
29	H27015	KND150STM27015	4.2	27	1500	15	75
30	H32015	KND150STM32015	5.0	32	1500	18.5	100
31	C0103D	KND 80STM01030M	0.3	1	3000	2.6	30
32	C0133D	KND 80STM01330M	0.4	1.3	3000	3.6	30
33	C0243D	KND 80STM02430M	0.75	2.4	3000	4.5	30
34	C0333D	KND 80STM03330M	1	3.3	3000	5.0	30
35	D0153D	KND 90STM01530M	0.45	1.5	3000	2.8	30
36	D0243D	KND 90STM02430M	0.75	2.4	3000	3.0	30
37	D0353D	KND 90STM03530M	1.1	3.5	3000	4.0	30
38	E0202D	KND110STM02020M	0.4	2	2000	2.3	30
39	E0203D	KND110STM02030M	0.6	2	3000	2.7	30
40	E0402D	KND110STM04020M	0.8	4	2000	3.6	30
41	E0403D	KND110STM04030M	1.2	4	3000	4.3	30
42	E0503D	KND110STM05030M	1.5	5	3000	5.0	30
43	E0602D	KND110STM06020M	1.2	6	2000	4.3	30
44	E0603D	KND110STM06030M	1.8	6	3000	5.8	30

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
45	F0401D	KND130STM04015M	0.6	4	1500	2.6	30
46	F0402D	KND130STM04025M	1	4	2500	3.4	30
47	F0501D	KND130STM05015M	0.75	5	1500	3.4	30
48	F0502D	KND130STM05025M	1.3	5	2500	5.9	30
49	F0601D	KND130STM06015M	1	6	1500	4.2	30
50	F0602D	KND130STM06025M	1.5	6	2500	5.8	30
51	F0771D	KND130STM07715M	1.2	7.7	1500	4.6	30
52	F0772D	KND130STM07725M	2	7.7	2500	7.5	50
53	F1001D	KND130STM10015M	1.6	10	1500	4.9	30
54	F1002D	KND130STM10025M	2.6	10	2500	7.5	50
55	F1501D	KND130STM15015M	2.4	15	1500	8.7	50
56	F1502D	KND130STM15025M	3.9	15	2500	12.6	75
57	H1801D	KND150STM18015M	2.8	18	1500	8.8	50
58	H2301D	KND150STM23015M	3.6	23	1500	11.8	75
59	H2701D	KND150STM27015M	4.2	27	1500	15	75
60	H3201D	KND150STM32015M	5.0	32	1500	18.5	100
61	C0103B	KND 80STM01030E	0.3	1	3000	2.6	30
62	C0133B	KND 80STM01330E	0.4	1.3	3000	3.6	30
63	C0243B	KND 80STM02430E	0.75	2.4	3000	4.5	30
64	C0333B	KND 80STM03330E	1	3.3	3000	5.0	30
65	D0153B	KND 90STM01530E	0.45	1.5	3000	2.8	30
66	D0243B	KND 90STM02430E	0.75	2.4	3000	3.0	30
67	D0353B	KND 90STM03530E	1.1	3.5	3000	4.0	30
68	E0202B	KND110STM02020E	0.4	2	2000	2.3	30
69	E0203B	KND110STM02030E	0.6	2	3000	2.7	30
70	E0402B	KND110STM04020E	0.8	4	2000	3.6	30
71	E0403B	KND110STM04030E	1.2	4	3000	4.3	30
72	E0503B	KND110STM05030E	1.5	5	3000	5.0	30
73	E0602B	KND110STM06020E	1.2	6	2000	4.3	30

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
74	E0603B	KND110STM06030E	1.8	6	3000	5.8	30
75	F0401B	KND130STM04015E	0.6	4	1500	2.6	30
76	F0402B	KND130STM04025E	1	4	2500	3.4	30
77	F0501B	KND130STM05015E	0.75	5	1500	3.4	30
78	F0502B	KND130STM05025E	1.3	5	2500	5.9	30
79	F0601B	KND130STM06015E	1	6	1500	4.2	30
80	F0602B	KND130STM06025E	1.5	6	2500	5.8	30
81	F0771B	KND130STM07715E	1.2	7.7	1500	4.6	30
82	F0772B	KND130STM07725E	2	7.7	2500	7.5	50
83	F1001B	KND130STM10015E	1.6	10	1500	4.9	30
84	F1002B	KND130STM10025E	2.6	10	2500	7.5	50
85	F1501B	KND130STM15015E	2.4	15	1500	8.7	50
86	F1502B	KND130STM15025E	3.9	15	2500	12.6	75
87	H1801B	KND150STM18015E	2.8	18	1500	8.8	50
88	H2301B	KND150STM23015E	3.6	23	1500	11.8	75
89	H2701B	KND150STM27015E	4.2	27	1500	15	75
90	H3201B	KND150STM32015E	5.0	32	1500	18.5	100
91	C0103T	KND 80STM01030M1	0.3	1	3000	2.6	30
92	C0133T	KND 80STM01330M1	0.4	1.3	3000	3.6	30
93	C0243T	KND 80STM02430M1	0.75	2.4	3000	4.5	30
94	C0333T	KND 80STM03330M1	1	3.3	3000	5.0	30
95	D0153T	KND 90STM01530M1	0.45	1.5	3000	2.8	30
96	D0243T	KND 90STM02430M1	0.75	2.4	3000	3.0	30
97	D0353T	KND 90STM03530M1	1.1	3.5	3000	4.0	30
98	E0202T	KND110STM02020M1	0.4	2	2000	2.3	30
99	E0203T	KND110STM02030M1	0.6	2	3000	2.7	30
100	E0402T	KND110STM04020M1	0.8	4	2000	3.6	30
101	E0403T	KND110STM04030M1	1.2	4	3000	4.3	30
102	E0503T	KND110STM05030M1	1.5	5	3000	5.0	30

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
103	E0602T	KND110STM06020M1	1.2	6	2000	4.3	30
104	E0603T	KND110STM06030M1	1.8	6	3000	5.8	30
105	F0401T	KND130STM04015M1	0.6	4	1500	2.6	30
106	F0402T	KND130STM04025M1	1	4	2500	3.4	30
107	F0501T	KND130STM05015M1	0.75	5	1500	3.4	30
108	F0502T	KND130STM05025M1	1.3	5	2500	5.9	30
109	F0601T	KND130STM06015M1	1	6	1500	4.2	30
110	F0602T	KND130STM06025M1	1.5	6	2500	5.8	30
111	F0771T	KND130STM07715M1	1.2	7.7	1500	4.6	30
112	F0772T	KND130STM07725M1	2	7.7	2500	7.5	50
113	F1001T	KND130STM10015M1	1.6	10	1500	4.9	30
114	F1002T	KND130STM10025M1	2.6	10	2500	7.5	50
115	F1501T	KND130STM15015M1	2.4	15	1500	8.7	50
116	F1502T	KND130STM15025M1	3.9	15	2500	12.6	75
117	H1801T	KND150STM18015M1	2.8	18	1500	8.8	50
118	H2301T	KND150STM23015M1	3.6	23	1500	11.8	75
119	H2701T	KND150STM27015M1	4.2	27	1500	15	75
120	H3201T	KND150STM32015M1	5.0	32	1500	18.5	100
121	L01330	HUADA 80STM01330	0.4	1.3	3000	2.6	30
122	L02430	HUADA 80STM02430	0.75	2.4	3000	4.2	30
123	L03330	HUADA 80STM03330	1	3.3	3000	4.2	30
124	P02030	HUADA 110STM02030	0.6	2	3000	4.0	30
125	P04030	HUADA 110STM04030	1.2	4	3000	5.0	30
126	P05030	HUADA 110STM05030	1.5	5	3000	6.0	30
127	P06020	HUADA 110STM06020	1.2	6	2000	6.0	30
128	P06030	HUADA 110STM06030	1.8	6	3000	8.0	50

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
129	Q04025	HUADA 130STM04025	1	4	2500	4.0	30
130	Q05025	HUADA 130STM05025	1.3	5	2500	5.0	30
131	Q06025	HUADA 130STM06025	1.5	6	2500	6.0	30
132	Q07720	HUADA 130STM07720	1.6	7.7	2000	6.0	30
133	Q07730	HUADA 130STM07730	2.4	7.7	3000	9.0	50
134	Q10015	HUADA 130STM10015	1.5	10	1500	6.0	30
135	Q10025	HUADA 130STM10025	2.6	10	2500	10.0	50
136	Q15015	HUADA 130STM15015	2.3	15	1500	9.5	50
137	Q15025	HUADA 130STM15025	3.9	15	2500	17.0	100
138	U15025	HUADA 150STM15025	3.8	15	2500	16.5	100
139	U18020	HUADA 150STM18020	3.6	18	2000	16.5	100
140	U23020	HUADA 150STM23020	4.7	23	2000	20.5	100
141	U27020	HUADA 150STM27020	5.5	27	2000	20.5	100
142	L0243B	HUADA 80STM02430LE	0.75	2.4	3000	4.2	30
143	L0333B	HUADA 80STM03330LE	1.0	3.3	3000	4.2	30
144	P0242B	HUADA 110STM02420LE	0.5	2.4	2000	2.9	30
145	P0482B	HUADA 110STM04820LE	1.0	4.8	2000	6.0	30

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
146	P0541B	HUADA 110STM05415LE	0.85	5.4	1500	4.5	30
147	P0641B	HUADA 110STM06415LE	1.0	6.4	1500	8.0	50
148	Q0482B	HUADA 130STM04820LE	1.0	4.8	2000	6.2	30
149	Q0541B	HUADA 130STM05415LE	0.85	5.4	1500	7.0	50
150	Q0722B	HUADA 130STM07220LE	1.5	7.2	2000	9.5	50
151	Q0962B	HUADA 130STM09620LE	2.0	9.6	2000	13.5	75
152	Q1432B	HUADA 130STM14320LE	3.0	14.3	2000	17.0	100
153	L0243D	HUADA 80STM02430LM	0.75	2.4	3000	4.2	30
154	L0333D	HUADA 80STM03330LM	1.0	3.3	3000	4.2	30
155	P0242D	HUADA 110STM02420LM	0.5	2.4	2000	2.9	30
156	P0482D	HUADA 110STM04820LM	1.0	4.8	2000	6.0	30
157	P0541D	HUADA 110STM05415LM	0.85	5.4	1500	4.5	30
158	P0641D	HUADA 110STM06415LM	1.0	6.4	1500	8.0	50
159	Q0482D	HUADA 130STM04820LM	1.0	4.8	2000	6.2	30
160	Q0541D	HUADA 130STM05415LM	0.85	5.4	1500	7.0	50
161	Q0722D	HUADA 130STM07220LM	1.5	7.2	2000	9.5	50
162	Q0962D	HUADA 130STM09620LM	2.0	9.6	2000	13.5	75

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
163	Q1432D	HUADA 130STM14320LM	3.0	14.3	2000	17.0	100
164	R03530	MEGE 80STM03530	1.0	3.5	3000	4.5	30
165	T04025	MEGE 90STM04025	1.0	4.0	2500	4.0	30
166	F07730	KND130STM07730	2.4	7.7	3000	8.8	50
167	F0773D	KND130STM07730M	2.4	7.7	3000	8.8	50
168	F0773B	KND130STM07730E	2.4	7.7	3000	8.8	50
169	F0773T	KND130STM07730M1	2.4	7.7	3000	8.8	50
170	I18015	KND180STM18015	3.0	18	1500	16.5	75
171	I1801D	KND180STM18015M	3.0	18	1500	16.5	75
172	I1801B	KND180STM18015E	3.0	18	1500	16.5	75
173	I1801T	KND180STM18015M1	3.0	18	1500	16.5	75
174	I25015	KND180STM25015	4.0	25	1500	24.5	100
175	I2501D	KND180STM25015M	4.0	25	1500	24.5	100
176	I2501B	KND180STM25015E	4.0	25	1500	24.5	100
177	I2501T	KND180STM25015M1	4.0	25	1500	24.5	100
178	I32015	KND180STM32015	5.1	32	1500	31.0	100
179	I3201D	KND180STM32015M	5.1	32	1500	31.0	100
180	I3201B	KND180STM32015E	5.1	32	1500	31.0	100
181	I3201T	KND180STM32015M1	5.1	32	1500	31.0	100
182	I40010	KND180STM40010	4.2	40	1000	24.0	100
183	I4001D	KND180STM40010M	4.2	40	1000	24.0	100
184	I4001B	KND180STM40010E	4.2	40	1000	24.0	100
185	I4001T	KND180STM40010M1	4.2	40	1000	24.0	100
186	I50010	KND180STM50010	5.3	50	1000	32.0	100
187	I5001D	KND180STM50010M	5.3	50	1000	32.0	100
188	I5001B	KND180STM50010E	5.3	50	1000	32.0	100
189	I5001T	KND180STM50010M1	5.3	50	1000	32.0	100
190	I63010	KND180STM63010	6.6	63	1000	37.0	100
191	I6301D	KND180STM63010M	6.6	63	1000	37.0	100
192	I6301B	KND180STM63010E	6.6	63	1000	37.0	100

NO.	Model parameter	Motor model	Rated power (KW)	Zero-speed torque (Nm)	Rated speed (rpm)	Rated current (A)	Driver model (SD310)
193	I6301T	KND180STM63010M1	6.6	63	1000	37.0	100
194	I75010	KND180STM75010	7.8	75	1000	45.0	100
195	I7501D	KND180STM75010M	7.8	75	1000	45.0	100
196	I7501B	KND180STM75010E	7.8	75	1000	45.0	100
197	I7501T	KND180STM75010M1	7.8	75	1000	45.0	100
198	H18025	KND150STM18025	4.0	18	2500	20.0	100
199	H1802D	KND150STM18025M	4.0	18	2500	20.0	100
200	H1802B	KND150STM18025E	4.0	18	2500	20.0	100
201	H1802T	KND150STM18025M1	4.0	18	2500	20.0	100
202	H23025	KND150STM23025	6.0	23	2500	20.0	100
203	H2302D	KND150STM23025M	6.0	23	2500	20.0	100
204	H2302B	KND150STM23025E	6.0	23	2500	20.0	100
205	H2302T	KND150STM23025M1	6.0	23	2500	20.0	100
231	T05030	MIGE110STM05030	1.5	5	3000	6.0	30
232	T06020	MIGE110STM06020	1.2	6	2000	6.8	30
233	T06030	MIGE110STM05030	1.8	6	3000	6.0	30
234	T10015	MIGE110STM10015	1.5	10	1500	6.0	30
235	E05050	KND110STM05050	1.5	5	5000	8.3	30
236	E0505D	KND110STM05050M	1.5	5	5000	8.3	30
237	E0505B	KND110STM05050E	1.5	5	5000	8.3	30
238	E0505T	KND110STM05050M1	1.5	5	5000	8.3	30
239	I10020	KND180STM10020	2.1	10	4000	13.0	30
240	I1002D	KND180STM10020M	2.1	10	4000	13.0	30
241	I1002B	KND180STM10020E	2.1	10	4000	13.0	30
242	I1002T	KND180STM10020M1	2.1	10	4000	13.0	30

Explanations of motor model parameter

<table>
<tr><th>C</th><th>0103</th><th>0</th></tr>
<tr>
<td>Foundation code
KND motor
<table>
<tr><td>C</td><td>80</td></tr>
<tr><td>D</td><td>90</td></tr>
<tr><td>E</td><td>110</td></tr>
<tr><td>F</td><td>130</td></tr>
<tr><td>H</td><td>150</td></tr>
<tr><td>I</td><td>180</td></tr>
</table>
HUADA motor
<table>
<tr><td>L</td><td>80</td></tr>
<tr><td>P</td><td>110</td></tr>
<tr><td>Q</td><td>130</td></tr>
<tr><td>U</td><td>150</td></tr>
</table>
</td>
<td>The first 3 bits×0.1 is rated torque，the last bit×1000 is thousand's place of rated speed.

For example, 0103 indicates the rated torque is 1.0Nm; thousand's place of rated speed is 3.
0482 indicates the rated torque is 4.8Nm; thousand's place of rated speed is 2.</td>
<td>Digit:
Use 2500p/r incremental encoders (including saving-line and non-saving-line). Number of this bit indicates hundred’s place of rated speed.
Letter:
B: Use 17-bit single circle mechanical absolute encoders (without battery)
D: Use 17-bit single circle or 16-bit multi-circle absolute encoders (battery type)
T: use 17-bit single circle or 12-bit multi-circle mechanical absolute encoders (without battery)</td>
</tr>
</table>

PA00 can be used to selecte motor model:

Leftmost bit	Middle bit (motor manufacturer)		Rightmost (encoder type)	
3（fixed）	0	Reserved	0	Incremental encoder (0)
	1	Reserved	1	Battery type multi-circle absolute encoder (D)
	2	KND motors	2	Single circle absolute encoder (B)
	3	HUADA motors	3	Mechanical multi-circle absolute encoder (T)
	4	MEGE motors	4	Reserved
	8	All motors	5	All encoders

2. Driver Parameter List

NO.	Description	Default	Mini.	Maxi.	Unit
00	Operation password	315	0	65535	—
01	Motor model selection	—	—	—	—
02	Main software version (read only)	—	—	—	—
03	The default monitoring item when power-on	SPEED	—	—	—
04	Control mode selection	POS	—	—	—
05	Gain of velocity circulation	40	1	200	Hz
06	Integral time constant of velocity circulation	25	1	1000	ms
07	Band width of the torque filter	160	1	4000	Hz
08	Rightmost bit: Monitoring function for abnormality of closed loop 0: Closed 1: Open 2nd bit: — 3rd bit: — Leftmost bit: —	0001	—	—	—
09	Gain of position circulation	40	1	200	1/s
10	Feedforward factor of position circulation	0	0	100	%
11	Band width of the feedforward filter of velocity circulation	1000	50	2000	Hz
12	Numerator of electric gear ratio	1	1	32767	—
13	Denominator of electronic gear ratio	1	1	32767	—
14					
15	Reverse the rotation direction of motors	0	0	1	—
16	The range used to judge the positioning completion	1	0	10000	0.001r
17	Threshold value to judge position deviation alarm	2000	0	10000	0.001r
18	Delay time when performing the	1.0	0.0	1000.	s

NO.	Description	Default	Mini.	Maxi.	Unit
	single-axis positioning			0	
19	Position command exponential filtering time	0	0	1000	ms
20	Percentage of maximum motor speed (corresponding to rated motor speed)	120	50	300	%
21	Speed in D-SPD mode	0	0	Rated speed of a motor ×1.2	rpm
22	Time constant of the double position feedback filter	1000	0	1000	ms
23					
24					
25	Absolute value of acceleration speed in A-POS mode	10	1	500	r/s^2
26	Zero drift of motor encoders	Related to motors	0	65535	—
27					
28					
29	Speed 1 of single-axis positioning	0	— 5000	5000	rpm
30	Speed 2 of single-axis positioning	0	— 5000	5000	rpm
31	Speed 3 of single-axis positioning	0	— 5000	5000	rpm
32	Speed 4 of single-axis positioning	0	— 5000	5000	rpm
33	Enable the driver by force	OFF	OFF	ON	—
34	Torque limit value in negative direction	300	0	300	%
35	Torque limit value in positive direction	300	0	300	%
36	Incremental encoder error detection	0	0	1	—

NO.	Description	Default	Mini.	Maxi.	Unit
37	The absolute value of speed when VCMP signal is active	0	0	5000	rpm
38	The fluctuation of speed when VCMP signal is active	10	0	5000	rpm
39					
40	Time constant of acceleration in SPD & D-SPD mode	0	0	1000	ms
41	Time constant of deceleration in SPD & D-SPD mode	0	0	1000	ms
42					
43	Upper speed limitation in TOR mode	500	0	5000	rpm
44	Maximum traversing distance in the positive direction	30000	−30000	30000	Determined by PA82.2
45	Maximum traversing distance in the positive direction	−30000			
46	Depth of the 1st trap filters	900	1	1000	—
47	Depth of the 2nd trap filters	900	1	1000	—
48	Velocity monitoring coefficient	150	100	600	%
49	Position command 1 in A-POS control mode	0	−30000	30000	Determined by PA77.2
50	Position command 2 in A-POS control mode				
51	Position command 3 in A-POS control mode				
52	Position command 4 in A-POS control mode				
53					
54	Simulated states of input signals	0000	—	—	—
55	Rigidity of servo systems	4	0	12	—
56	Load inertia ratio	100	50	800	%
57	Reverse the polarity of output signals	0000	—	—	—

NO.	Description	Default	Mini.	Maxi.	Unit
58	Delay time from the beginning of external brake working to cutting off the controlling of motors	0	0	500	10 ms
59	Reverse the polarity of input signals	0000	—	—	—
60	Gain of friction compensation (%)	100	10	600	%
61	Factor of friction compensation (%)	0	0	100	%
62	Friction compensation parameter	0	0	100	%
63					
64					
65	Numerator of gear ratio between motor and leadscrew (Turned circles of motor)	1	1	32767	—
66	Denominator of gear ratio between motor and leadscrew (Turned circles of rotary table)	1	1	32767	—
67					
68					
69					
70	Servo bus (KSN) node address	1	1	16	—
71	Monitoring item 1 of servo bus (KSN)	0	0	999	—
72	Monitoring item 2 of servo bus (KSN)	0	0	999	—
73	Rightmost bit: When low voltage of external battery of absolute encoders happens, the drivers will output 0: Alarms (Default) 1: Warnings 2nd bit: — 3rd bit: TU3 mode for incremental encoders 0: Search Z signal manually 1: Search Z signal automatically	0000	—	—	—

NO.	Description	Default	Mini.	Maxi.	Unit
	Leftmost bit: Rotary table function 0: Invalid 1: Valid				
74					
75					
76					
77	Rightmost bit: Open phase (Er010) check 0: Permitted 1: Forbidden 2nd bit: Velocity monitor 0: Closed 1: Open 3rd bit: Unit of single-axis positioning 0: 1r 1: 0.1r 2: 0.01r 3: 0.001r Leftmost bit: Position deviation (Er004) check 0: Permitted 1: Forbidden	0000	—	—	—
78	Maximum distance before stop when overtravel happens	5.00	0.00	100.00	r
79	Rightmost bit: Method for stopping when overtravel happens 0: Cut off the power to motors after deceleration (Er.038) 1: Do not cut off the power to motors after deceleration 2: Cut off the power to motors immediately (Er.038) 3: Controlled by host controllers	0000	—	—	—

NO.	Description	Default	Mini.	Maxi.	Unit
	2nd bit: Source of feed forward torque 0: From internal of servo drivers 1: From the command of servo bus (KSN) 3rd bit: Friction compensation function switch 0: OFF 1: ON Leftmost bit: Exchange the position of input signals of CCWI and CWI 0: Normal 1: Exchange				
80	1st frequency of trap filters	4000	100	4000	Hz
81	Quality factors of 1st trap filters	47	1	100	—
82	Rightmost bit: Software overtravel limit function 0: OFF 1: ON 2nd bit: Hardware overtravel limit function 0: OFF 1: ON 3rd bit: Setting unit of software overtravel limit 0: Setting unit from host controller ×1000 1: Setting unit from host controller ×10000 Leafmost bit: —	0000	—	—	—
83	2nd frequency of trap filters	4000	100	4000	Hz
84	Quality factors of 2nd trap filters	47	1	100	—
85	Grating ruler types	0	0	2	—

NO.	Description	Default	Mini.	Maxi.	Unit
86	Installation direction of grating rulers	0	0	1	—
87	Pitches of ball screws	6	1	100	mm
88	Maximum position deviation of grating rulers and encoders	100	1	60000	um
89	Resolution of grating rulers	250	1	60000	nm
90	Upper limitation of motors' speed when performing –tU1	1500	500	4000	rpm
91	Maximum rotation cycles when performing –tU1	4	1	9	r
92	Feedback coefficient of accelerations	0	0	1000	%
93	Feed forward coefficient of toque	0	0	600	%
94	Band width of feed forward filter of torque	1000	50	2000	Hz
95					
96					
97					
98					
99					

Update Record

NO.	Time	Updated content
1	2013/09/30	(1) Explanations of parameters PA08.0 PA60 PA61 PA62 and PA79.2 are added in chapter 4.1; Maximum value of PA90 is modified to 4000. (2) Error/alarm explanations for Er045, AL153~AL159 and AL161 are added in chapter 5.1. (3) Display sequence of DP options is adjusted in chapter 6.2. (4) Parameter setting methods for rotary table is updated in chapter 7.10. (5) Explanations for friction compensation function is added in chapter 7.11. (6) Motor model list set in PA00 is added in Appendix 1.
2	2014/10	(1) 12 models of motors correspond to sequence number 231 ~ 242 are added in <Appendix 1. Parameter list of motor model>. (2) Error/alarm monitoring for low voltage of encoder battery is added in chapter 7.3.10， and related parameters are updated.
3	2015/01	(1) Content related to SD311 (supported grating ruler type) is added.

Version: 2015-01