Contents

Chapter 1 Product Acceptance & Model Description

1.1 Product Acceptance

1.1.1 Items for Acceptance (Wires Included)

Table 1-1 Product acceptance

Item for Acceptance	Remark
Whether the model of a delivered CD series servo system is consistent with the specified model	Check the nameplate of a servo motor and that of a servo driver
Whether the accessories included in the packing list are complete	Check the packing list
Whether any breakage occurs	Check the external appearance completely for any losses that are caused by transportation
Whether any screws are loose	Check for loose screws with a screwdriver
Whether the motor wiring is correct	Purchase motor accessory packages if no wirings are purchased

1.1.2 Nameplate of Servo Driver

Fig. 1-1 Nameplate of a servo driver

1.1.3 Nameplate of Servo Motor

Fig. 1-2 Nameplate of a servo motor

1.2 Component Names

1.2.1 Component Names of CD420/CD430/CD620 Servo Driver

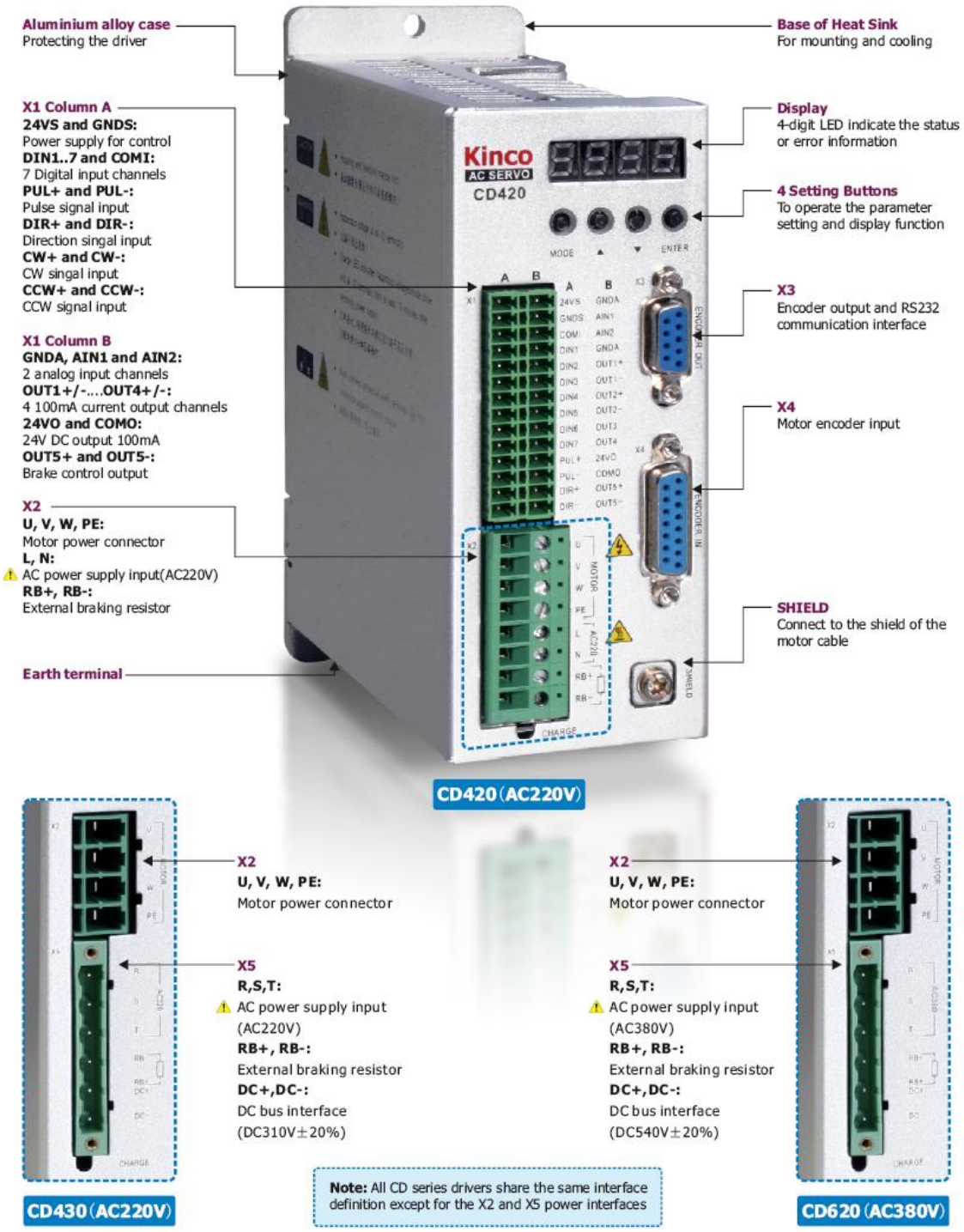


Fig. 1-3 Component Names of CD420/CD430/CD620 Servo Driver

1.2.2 Component Names of CD422/CD432/CD622 Servo Driver

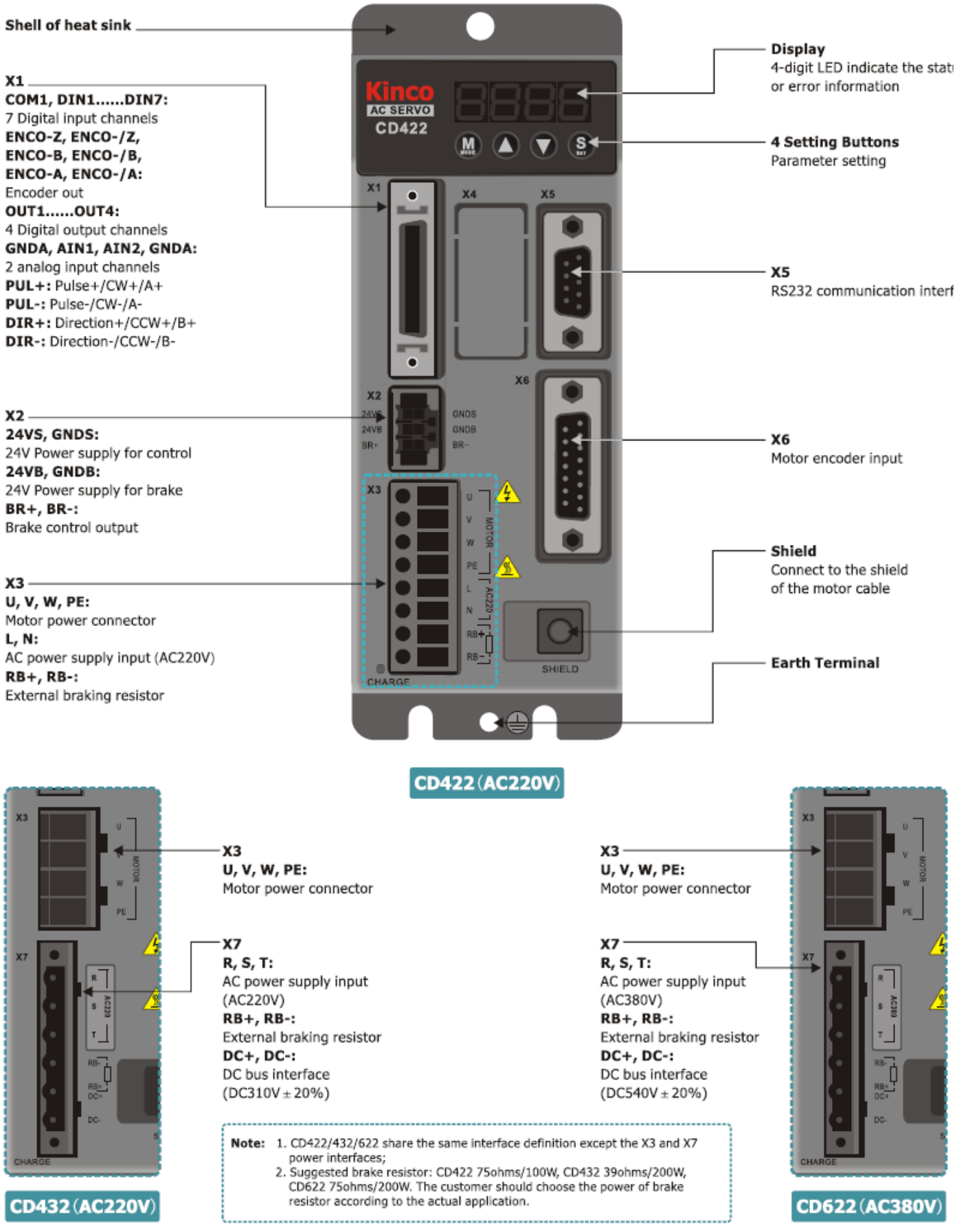


Fig. 1-4 Component Names of CD422/CD432/CD622 Servo Driver

1.2.3 Component Names of Servo Motor

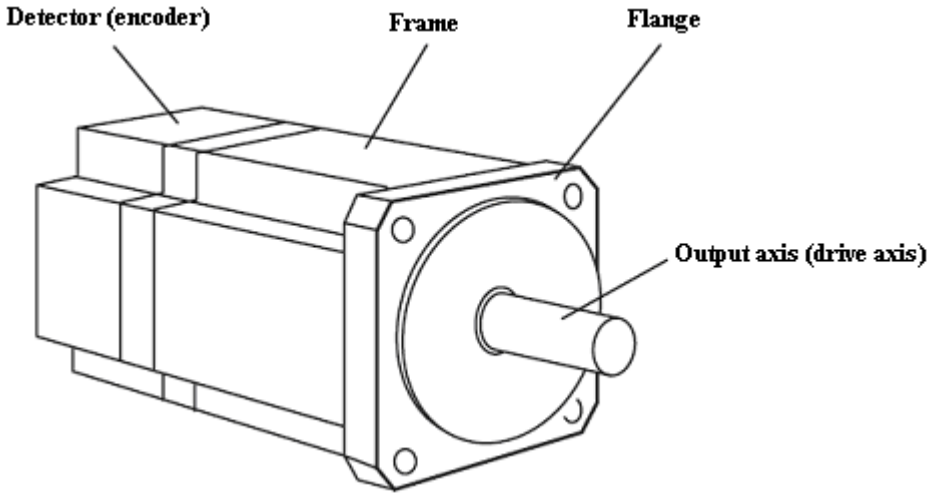


Fig. 1-5 Component names of a servo motor (brakes excluded)

1.3 Model Description of Servo Motors and Drivers

1.3.1 Servo Drivers

CD422-AA-000 Note: Users select the motor themselves

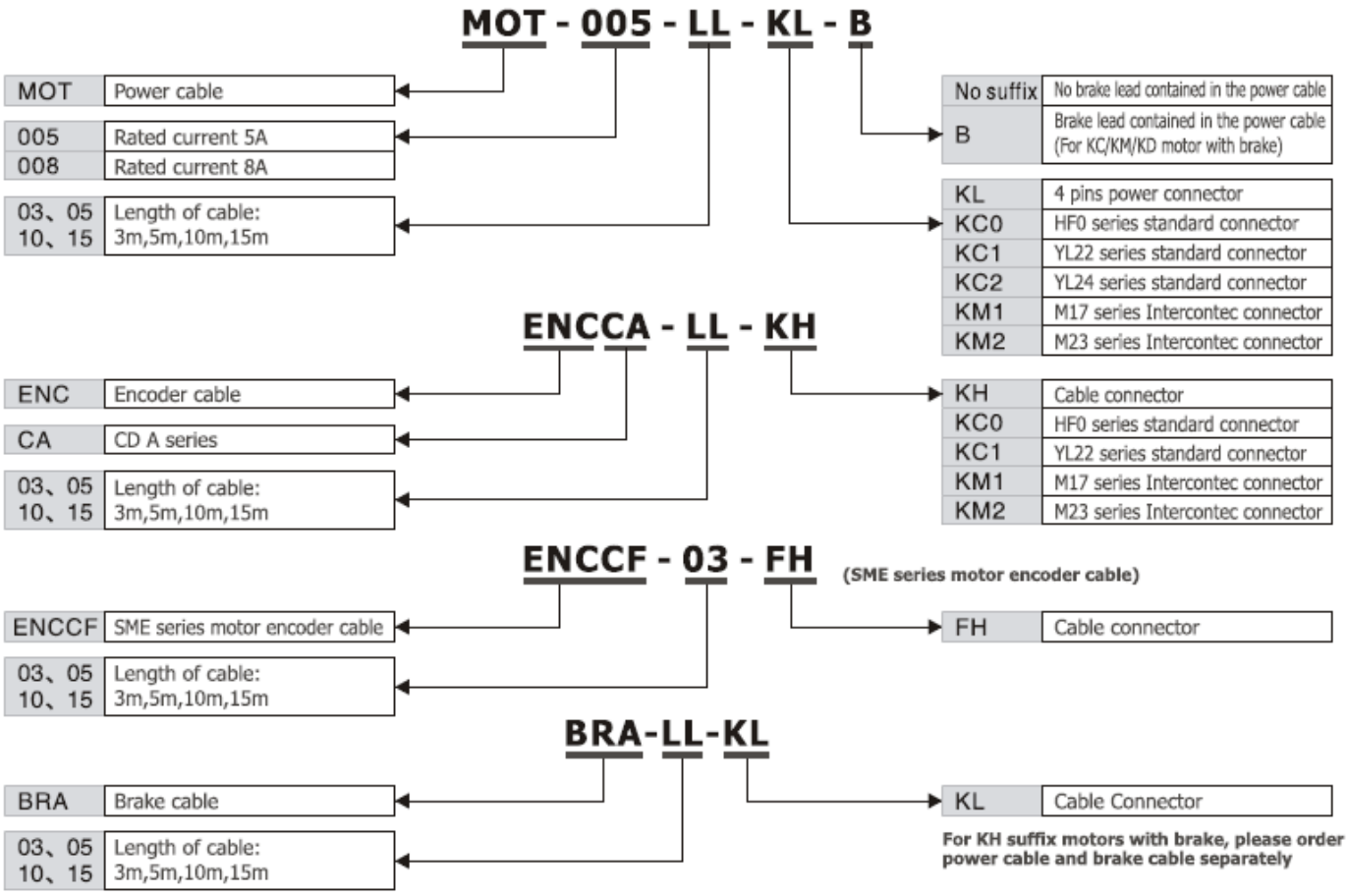
CD	CD series
4	Power supply input AC220V
6	Power supply input AC380V
2	Size of driver
000	Software version
AA	Standard version
2	CD Generation 2

1.3.2 Servo Motors

SMH 60S-0040-30AAK-3LKH

SMH	SMH series
SME	SME series
60	Flange size 60*60mm
S	Small inertia
D	Medium inertia
H	High inertia
0040	Rated power 40*10(W)
30	Rated speed 30*100(RPM)
A	2500PPR incremental encoder
A	Without brake
B	With brake
K	With Keyway
A	Without keyway
H	Direct cable connector
N	HFO series standard connector
C	YL series standard connector
M	2xM17 series Intercontec connector
E	2xM23 series Intercontec connector
D	M17+M23 (Power M23 Intercontec connector, Encoder M17 Intercontec connector)
K	History code
D	DC70V
L	AC220V
H	AC380V
F	50 Pole pairs
3	3 Pole pairs
4	4 Pole pairs

1.3.3 Power,Brake and Encoder cable of Motors



Chapter 2 Precautions and Installation Requirements

A Kinco CD series servo driver is installed on a base. If a driver is not installed properly, some faults may occur. To avoid this, install the driver by abiding by the following precautions.

2.1 Precautions

1. Tightly fasten the screws that fix the motor;
2. Make sure to tightly fasten all fixed points when fixing the driver;
3. Do not tighten the cables between the driver and the motor/encoder;
4. Use a coupling shaft or expansion sleeve to ensure that both the motor shaft and equipment shaft are properly centered;
5. Do not mix conductive materials (such as screws and metal filings) or combustible materials (such as oil) into the servo driver;
6. Avoid the servo driver and servo motor from dropping or striking because they are precision equipment;
7. For safety, do not use any damaged servo driver or any driver with damaged parts.

2.2 Environmental Conditions

Table 2-1 Environmental conditions

Environment	Condition
Temperature	Operating temperature: 0°C - 40°C (ice free) Storage temperature: - 10°C - 70°C (ice free)
Humidity	Operating humidity: below 90% PH (non-condensing) Storage humidity: below 90% PH (non-condensing)
Air	Indoor (No direct sunlight), no corrosive gas or combustible gas No oil vapor or dust
Height	Below 1000 m above the sea level
Vibration	5.9 m/s2

2.3 Mounting Direction & Spacing

2.3.1 Precautions

1. To prevent possible faults, install a servo driver in a proper direction;
2. To prevent possible faults, ensure that the space between a servo driver and the inner wall of the control cabinet as well as that between the servo driver and the neighboring driver are the same as specified space..

2.3.2 Servo Driver Installation

1. Installing a servo driver:

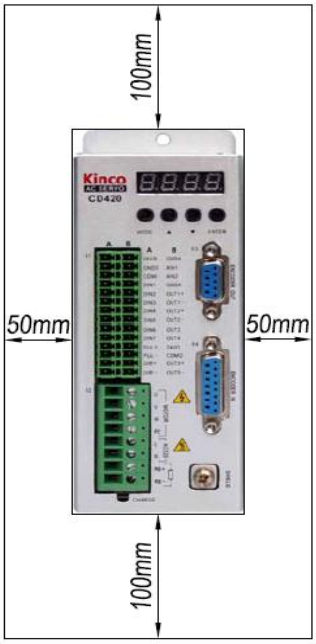


Fig. 2-1 Installing a servo driver

2. Installing multiple servo drivers:

Ensure that there is enough space between a servo driver and the inner wall of a control cabinet. Additionally, install cooling fans at the upper part of the servo driver. To prevent localized overheating of the environmental temperature on the servo driver, you need to keep an even temperature in the control cabinet.

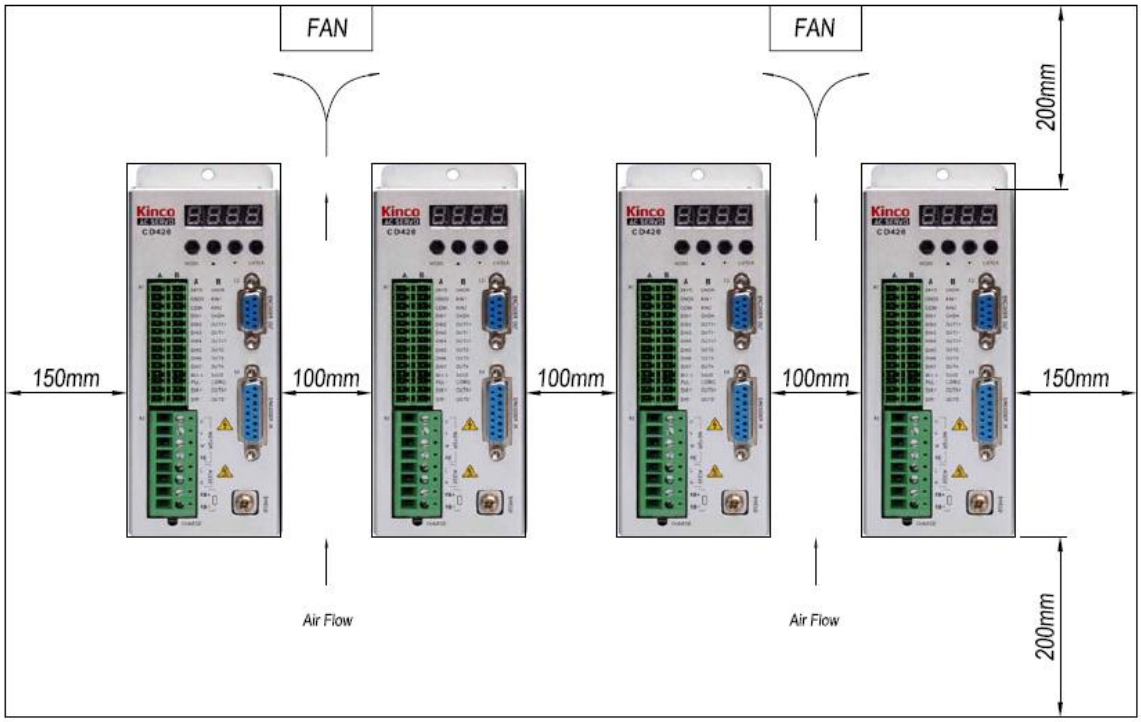


Fig. 2-2 Installing multiple servo drivers

3. Other Cases

Install the servo driver vertically on a wall.

Take fully into account heat dissipation when using any heating components (such as braking resistors) so that the servo driver is not affected.

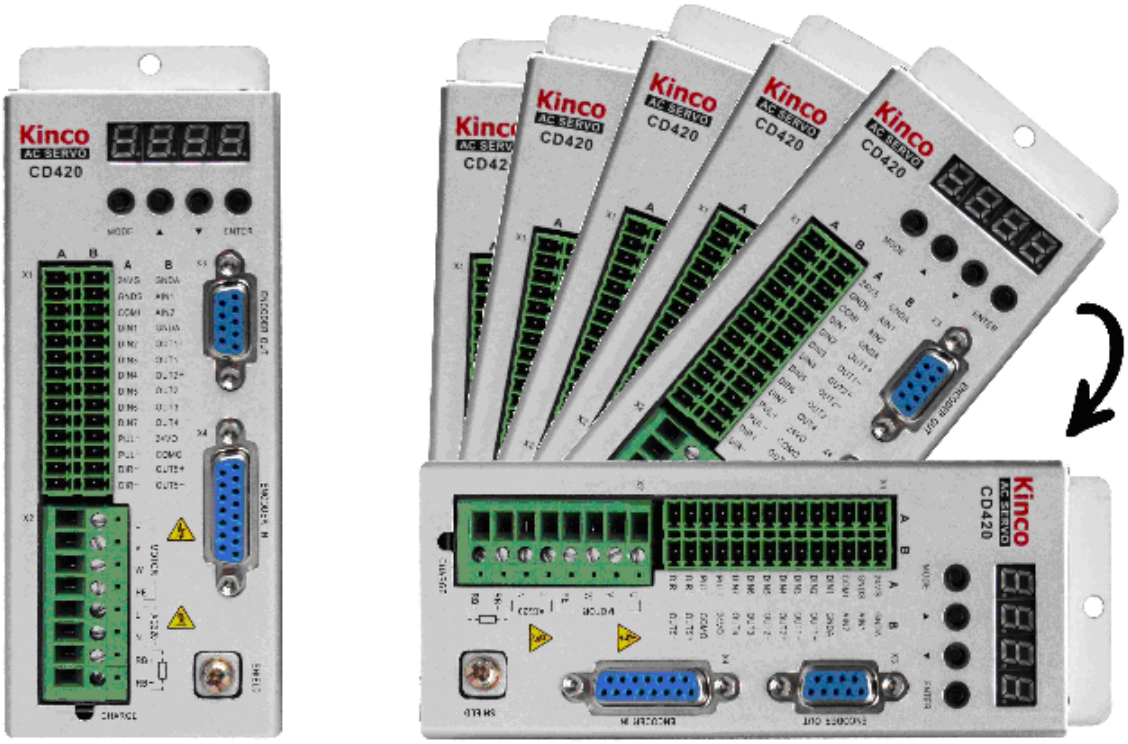


Fig. 2-3 Installation direction

Chapter 3 Interfaces and Wirings of CD Driver

3.1 Interfaces of CD2 Driver

3.1.1 Interfaces of CD422/432/622

Table 3-1 Interfaces of CD422/432/622

Interface	Driver	Symbol	Function	
X1	CD422 CD432 CD622	COMI	Common terminal of digital inputs	
		DIN1～DIN7	Digital inputs. Valid signal:12.5V～24V.Invalid signal:<5V	
		OUT1+	Digital output 1+	
		OUT1-	Digital output 1-	
		OUT2+	Digital output 2+	
		OUT2-	Digital output 2-	
		OUT3	Digital output 3	
		OUT4	Digital output 4	
		COMO	Common terminal of digital outputs	
		GND	Ground signal	
		ENCO-Z	Motor encoder output interface	
		ENCO-/Z		
		ENCO-B		
		ENCO-/B		
		ENCO-A		
		ENCO-/A		
		AIN1	Analog signal input 1. Input impedance: 200 K	
		GNDA	Ground signal of analog	
		AIN2	Analog signal input 2. Input impedance: 200 K	
		GNDA	Ground signal of analog	
		PUL+	Pulse or positive pulse interface (+)	Input voltage range：5V～24V
		PUL-	Pulse or positive pulse interface (-)	
		DIR+	Direction or negative pulse interface (+)	
		DIR-	Direction or negative pulse	

			interface (-)
X2		24VS/GNDS	Logic power supply:24 V ± 15% ,>0.5A
		24VB/GNDB	Power supply for brake ,DC18~30V 2A
		BR+/BR-	Brake interface
X3	CD422	U/V/W/PE	Motor cable interface
		L/N	Main power supply（Single-phase AC220V）
		RB+/RB-	Braking resistor interface
	CD432/CD622	U/V/W/PE	Motor cable interface
X5	CD422 CD432 CD622	RS232	RS232 interface
X6		ENCODER IN	Encoder cable interface
X7	CD432 CD622	R/S/T	Main power supply（CD432：Single phase or 3-phase AC220V，CD622：3-phase AC380V）
		RB+/RB-	Braking resistor interface
		DC+/DC-	DC bus power supply(Cannot use together with R/S/T)

3.1.2 Wiring Diagram of CD2 Driver

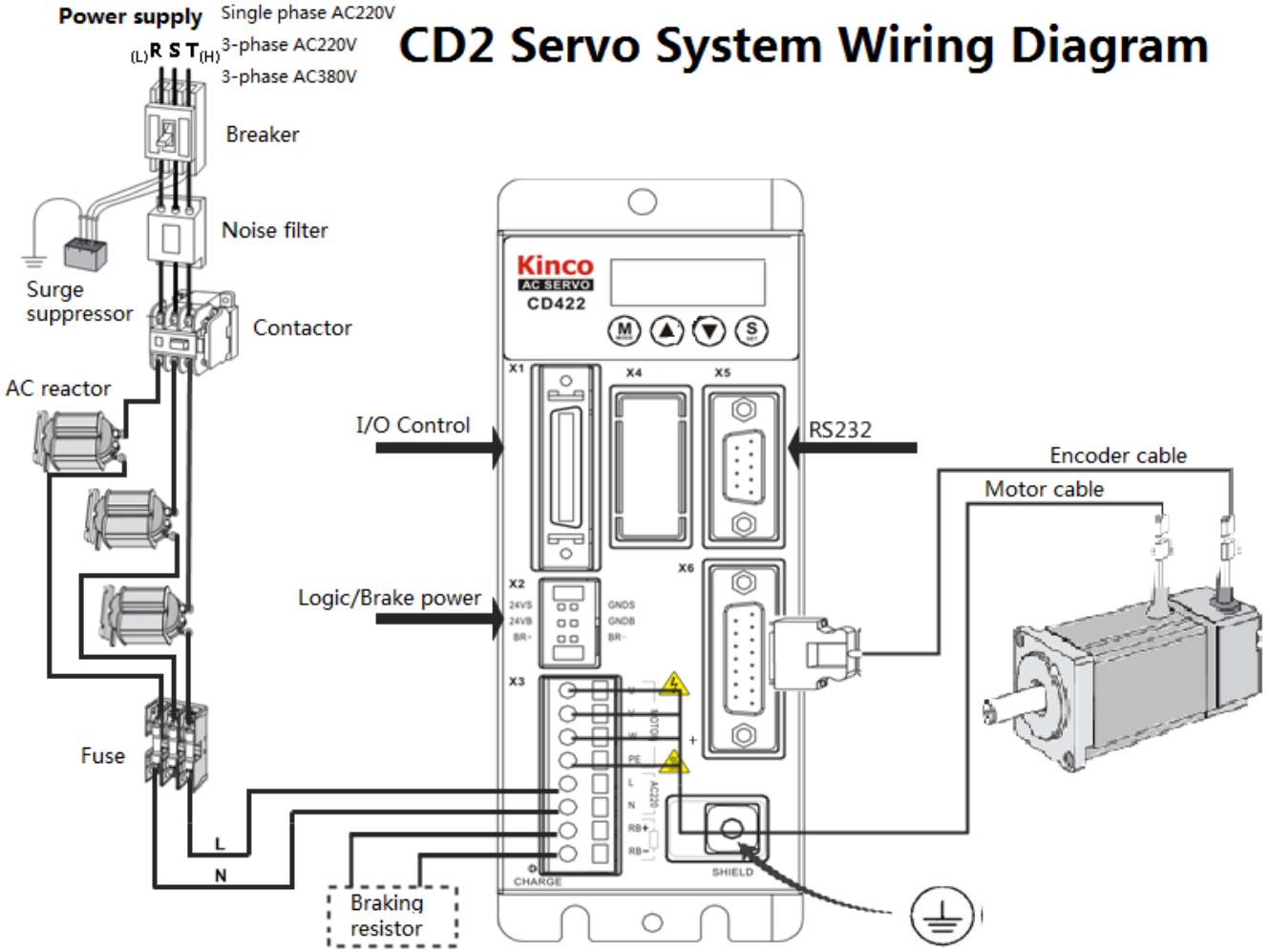


Fig.3-1 Wiring diagram of CD2 driver

3.1.3 X1 inteface of CD2 Driver

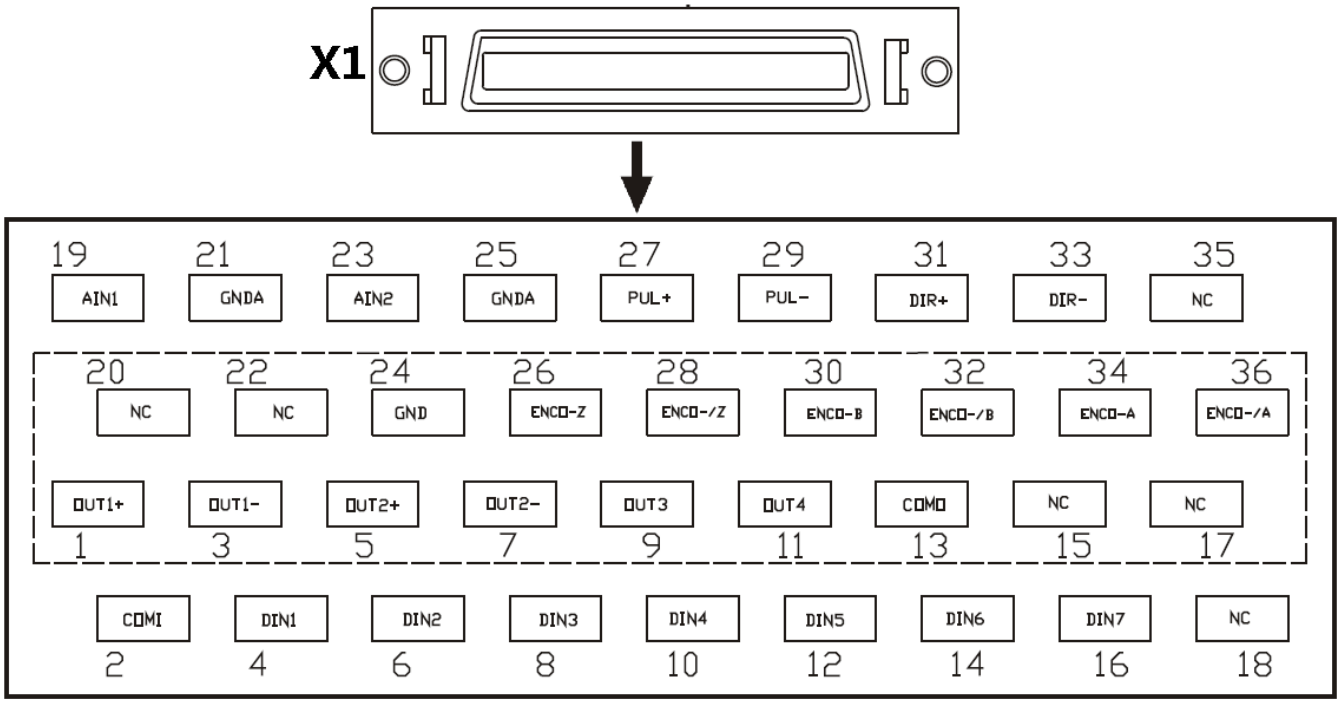


Fig.3-2 X1 interface of CD2 driver

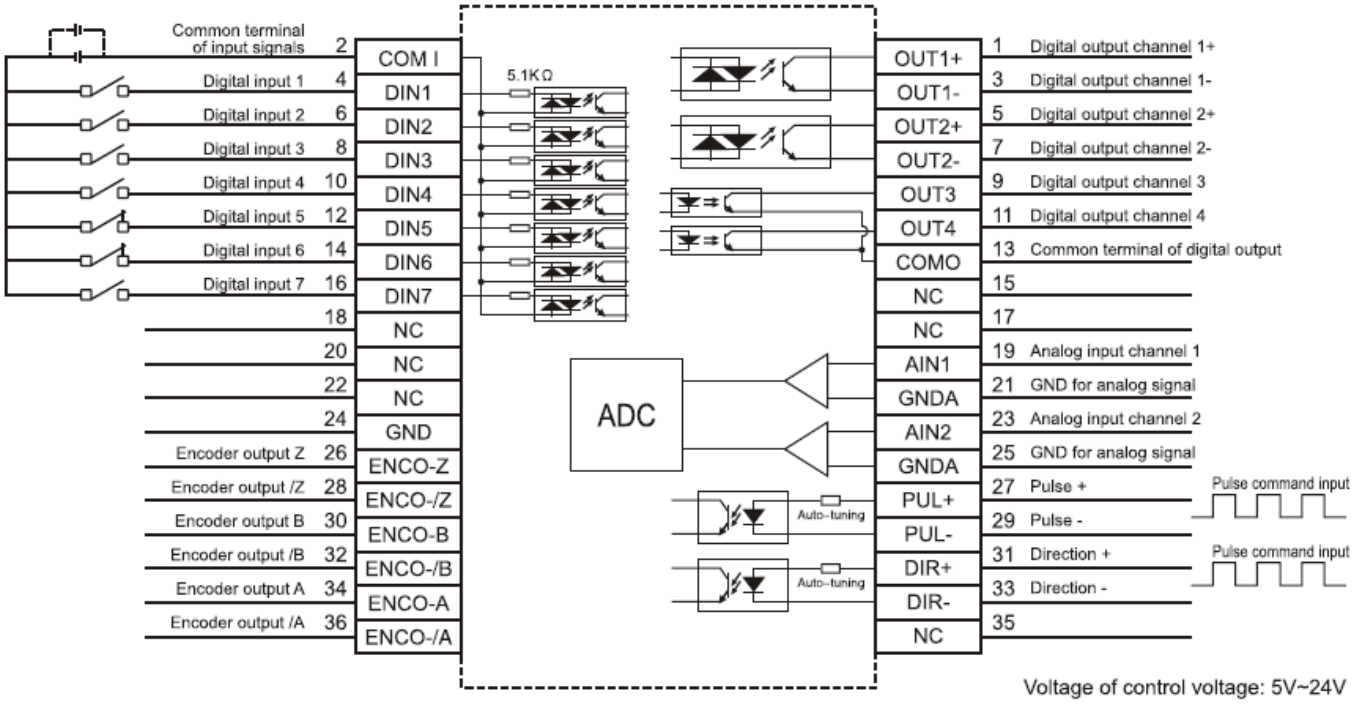


Fig.3-3 Wiring diagram of X1 interface of CD2 driver

3.1.4 Power Interface of CD2 Driver（CD422/X3、CD432/CD622/X3 and X7）

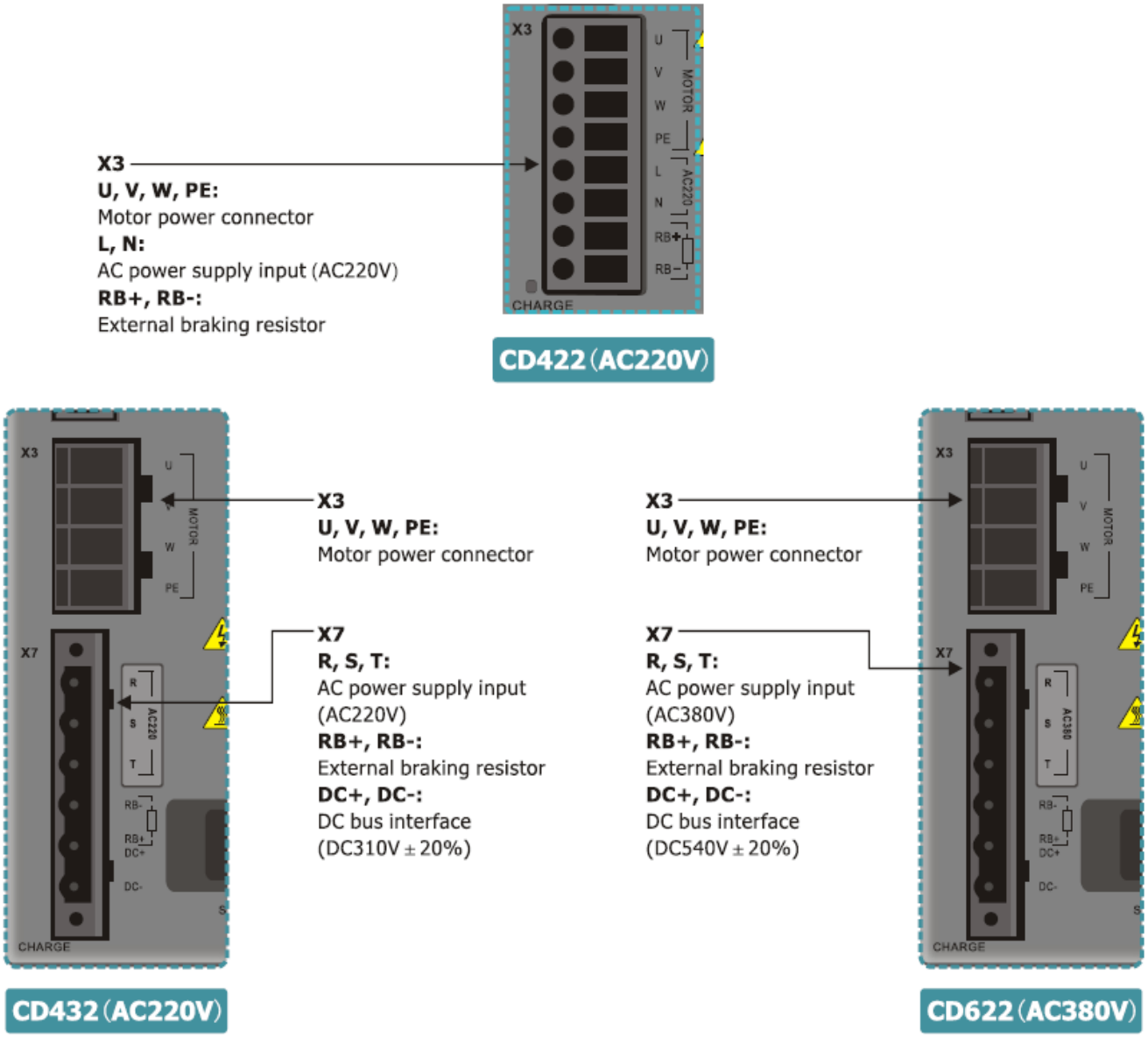
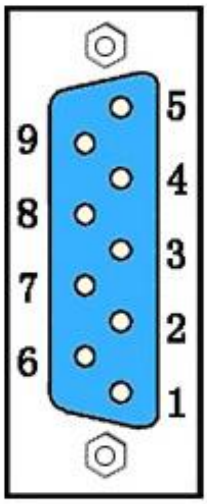


Fig.3-4 Power interface of CD2 driver

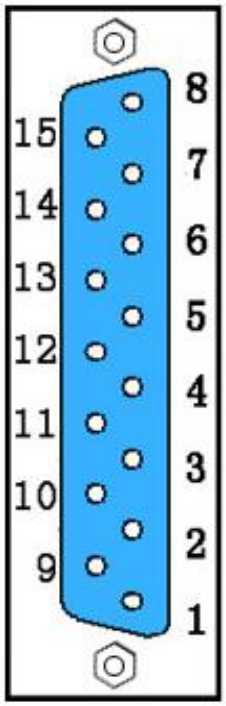
3.1.5 X5 and X6 Interfaces of CD2 Driver

3.1.5.1 X5 Interface



Interface	Pin No.	Signal	Description	Function
X5 (9-pin female connector)	1	NC	N/A	RS232 communication interface
	2	TX	To transmit data	
	3	RX	To receive data	
	4	NC	N/A	
	5	GND	Ground of signal	
	6	NC	N/A	
	7	NC	N/A	
	8	NC	N/A	
	9	NC	N/A	

3.1.5.2 X6 Interface



Interface	Pin No.	Signal	Description	Function
X6 (15-pin female connector)	1	+5V	To output 5 V voltage	Input interface of encoder in motor
	9	GND	0 V	
	8	PTC_IN	N/A	
	2	A	To input phase-A signals of encoder	
	10	/A		
	3	B	To input phase-B signals of encoder	
	11	/B		
	4	Z	To input phase-Z signals of encoder	
	12	/Z		
	5	U	To input phase-U signals of encoder	
	13	/U		
	6	V	To input phase-V signals of encoder	
	14	/V		
	7	W	To input phase-W signals of encoder	
	15	/W		

3.2 Interfaces of CD Driver

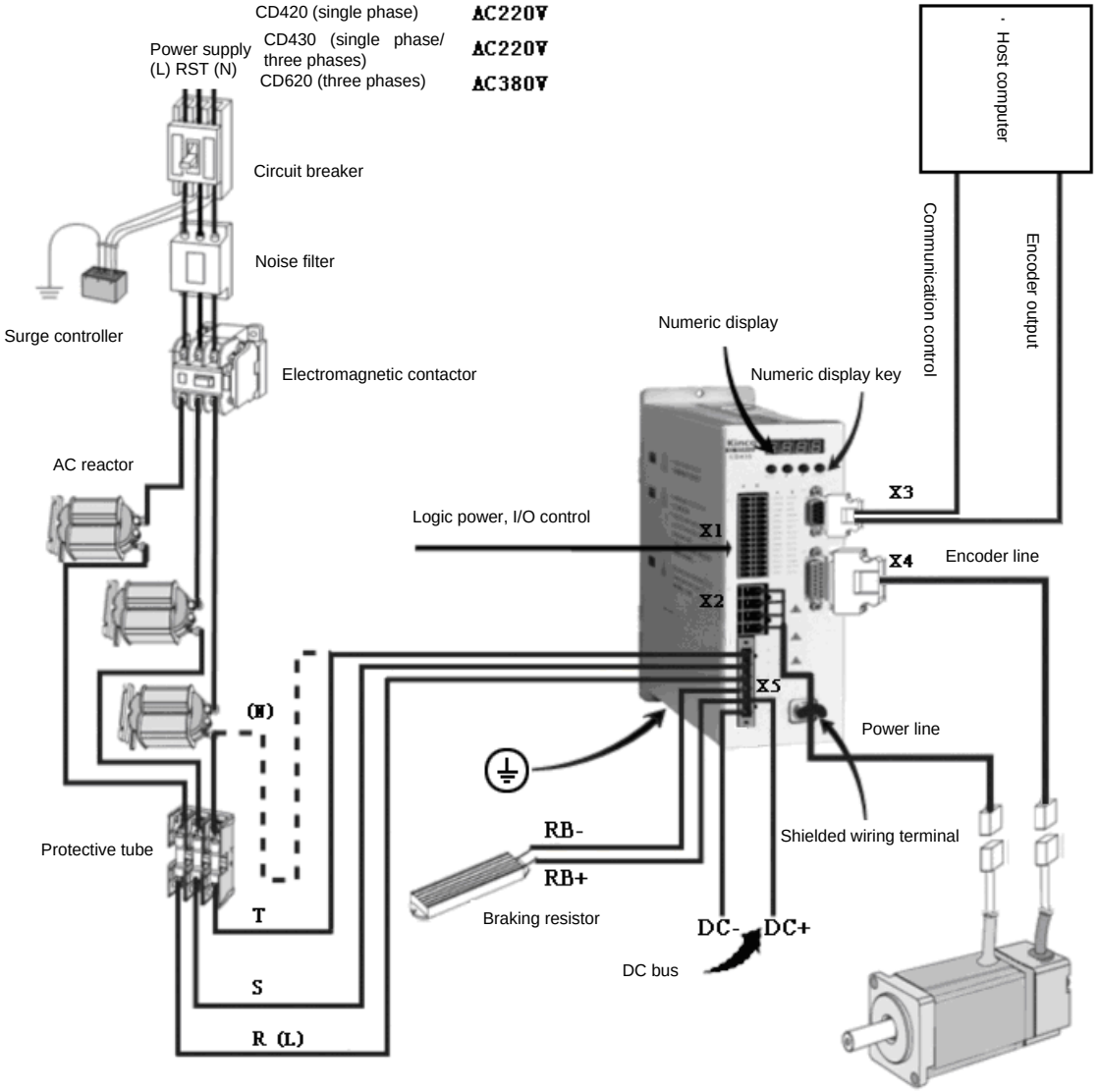
3.2.1 Interfaces of CD420/430/620

Table 3-2 Interfaces of CD driver

<table>
<tr><th>Interface</th><th>Applicable Driver</th><th colspan="2">Symbol</th><th colspan="2">Function</th></tr>
<tr><td rowspan="20">X1</td><td rowspan="20">CD420
CD430
CD620</td><td rowspan="12">A</td><td>24VS</td><td colspan="2" rowspan="2">External logic power (24 V +/- 15%) interface with a minimum of 0.5 A current output</td></tr>
<tr><td>GNDS</td></tr>
<tr><td>COMI</td><td colspan="2">Common port of digital input signals</td></tr>
<tr><td>DIN1</td><td colspan="2" rowspan="8">Digital input interface
Valid signal: 12.5 V ~ 24 V
Invalid signal: less than 5 V</td></tr>
<tr><td>DIN2</td></tr>
<tr><td>DIN3</td></tr>
<tr><td>DIN4</td></tr>
<tr><td>DIN5</td></tr>
<tr><td>DIN6</td></tr>
<tr><td>DIN7</td></tr>
<tr><td>PUL+</td><td>Pulse or positive pulse interface (+)</td><td rowspan="4">Input voltage range: 3 V to 5 V
If the input voltage is 24 V, the interface is cascaded to the 2K resistance.</td></tr>
<tr><td>PUL-</td><td>Pulse or positive pulse interface (-)</td></tr>
<tr><td>DIR+</td><td>Direction or negative pulse interface (+)</td></tr>
<tr><td>DIR-</td><td>Direction or negative pulse interface (-)</td></tr>
<tr><td rowspan="10">B</td><td>GNDA</td><td colspan="2">Analog signal ground</td></tr>
<tr><td>AIN1</td><td colspan="2">Analog signal input interface 1. Input impedance: 200 K</td></tr>
<tr><td>AIN2</td><td colspan="2">Analog signal input interface 2. Input impedance: 200 K</td></tr>
<tr><td>GNDA</td><td colspan="2">Analog signal ground</td></tr>
<tr><td>OUT1+</td><td>Digital output interface 1+</td><td rowspan="6">Maximum output current: 100 mA
Withstanding voltage:24V</td></tr>
<tr><td>OUT1-</td><td>Digital output interface 1-</td></tr>
<tr><td>OUT2+</td><td>Digital output interface 2+</td></tr>
<tr><td>OUT2-</td><td>Digital output interface 2-</td></tr>
<tr><td>OUT3</td><td>Digital output interface 3</td></tr>
<tr><td>OUT4</td><td>Digital output interface 4</td></tr>
<tr><td>24VO</td><td colspan="2">Power input port of digital output signals 5</td></tr>
<tr><td>COMO</td><td colspan="2">Common port of digital output signals</td></tr>
</table>

			OUT5+	Digital output interface 5+	Maximum output current: 800 mA
			OUT5-	Digital output interface 5-	
X2	CD420	U/V/W/PE		Power cable interface of a motor	
		L/N		Main power interface (single-phase 220 VAC)	
		RB+/RB-		Braking resistor interface	
	CD430 CD620	U/V/W/PE		Power cable interface of a motor	
X3	CD420 CD430 CD620	ENCODER OUT		Signal output interface of a motor encoder	
		RS232		RS232 interface that communicates with a host PC or controller	
X4	CD420 CD430 CD620	ENCODER IN		Encoder interface of a motor	
X5	CD430 CD620	R/S/T		Main power interface (single-phase or three-phase AC 220V for CD430 and three-phase AC 380 V for CD620)	
		RB+/RB-		Braking resistor interface	
		DC+/DC-		DC bus interface(Cannot use together with R/S/T)	
-----	CD420 CD430 CD620	SHIELD		Fixed terminal for the shielded wires of motor cables	

3.2.2 External Wirings of CD Driver



Note: For the CD420/CD430/CD620, all interfaces are the same except for X2 and X5 power interfaces. For details, see Figure 3-4.

Fig. 3-5 External wirings of a CD driver

3.2.3 X1 Interface of CD Driver

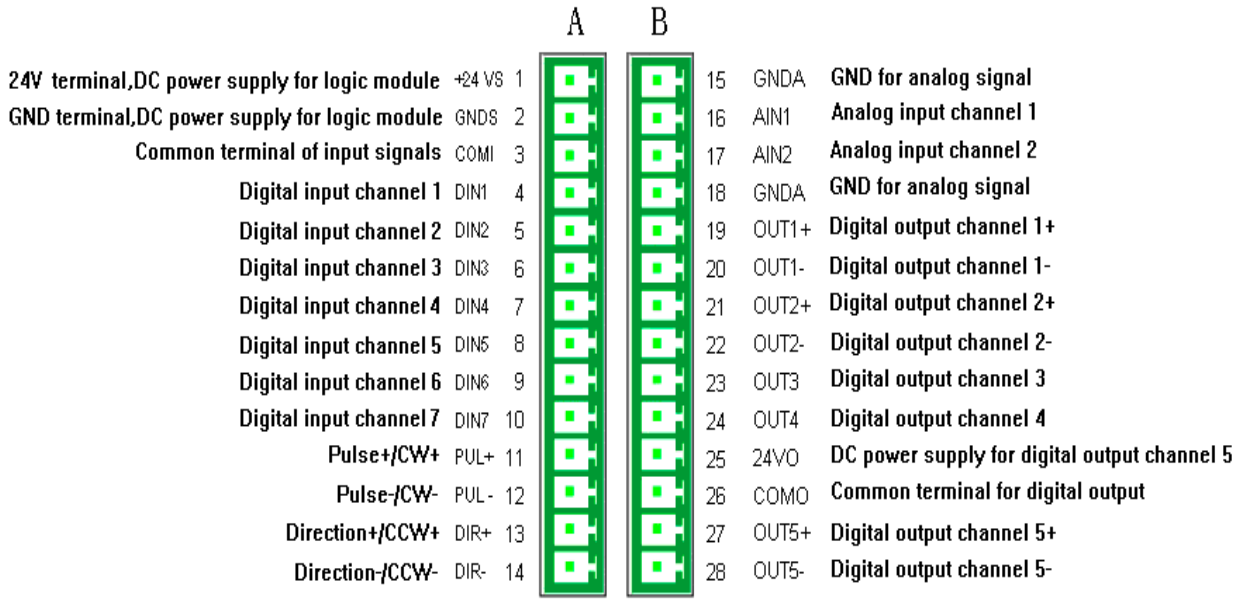


Fig. 3-6 X1 interface of a CD driver

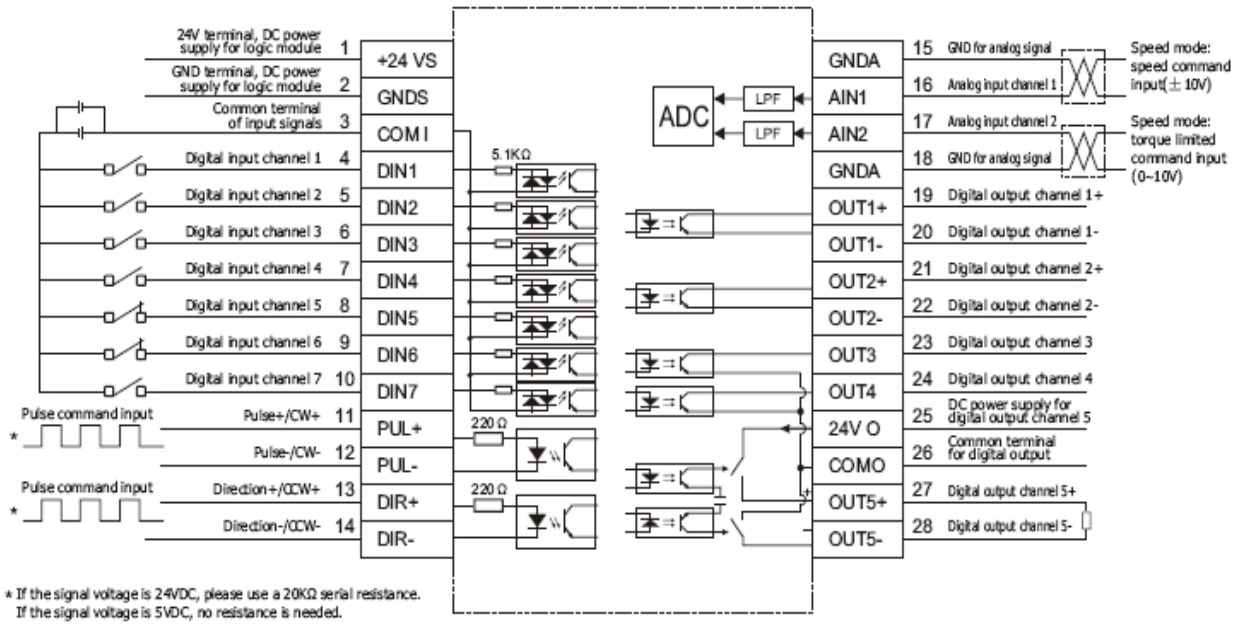


Fig. 3-7 Wirings of the X1 interface of a CD driver

3.2.4 Power Interfaces (CD420/X2, CD430/CD620/X2 and X5) of CD Driver

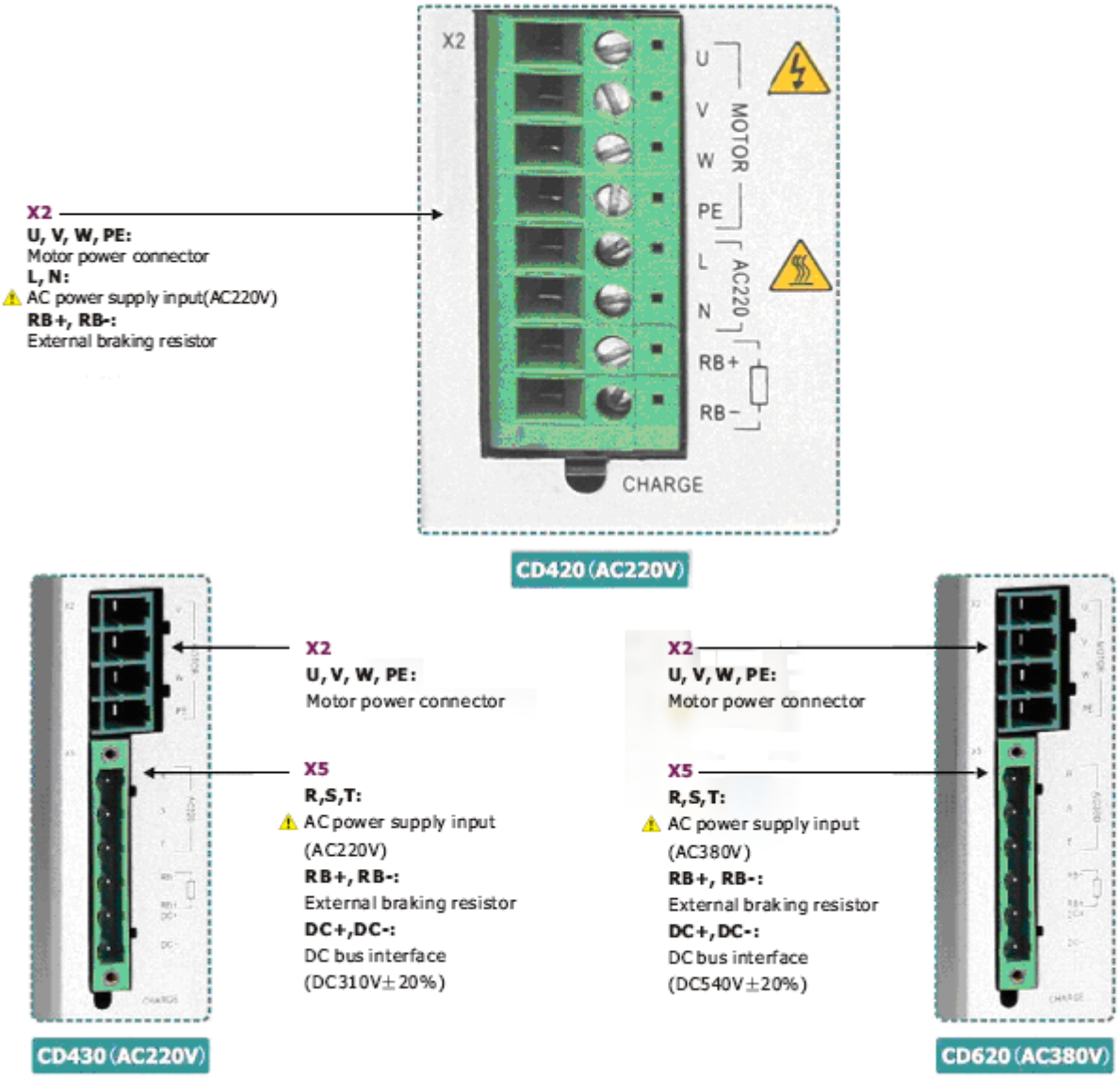
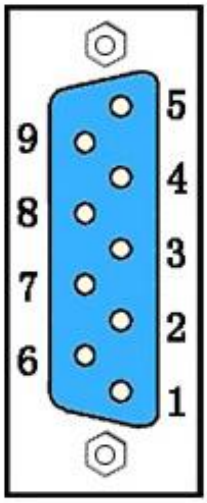


Fig. 3-8 Power interfaces of a CD driver

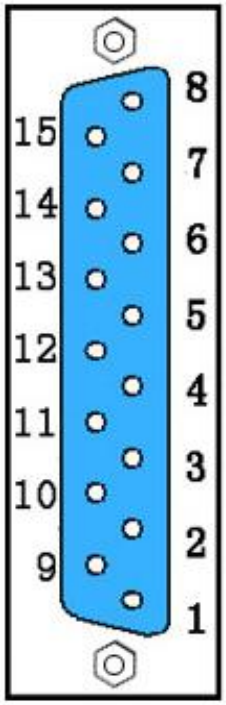
3.2.5 X3/X4 Interfaces of CD Driver

3.2.5.1 X3 Interface



Interface	Pin No.	Signal	Description	Function
X3 (9-pin female connector)	1	RXD	To receive data	RS232 communication interface
	5	TXD	To transmit data	
	6	GND	Ground of signal	
	2	A	To output phase-A signal of encoder	Output interface of encoder in motor
	7	/A		
	3	B	To output phase-B signal of encoder	
	8	/B		
	4	N	To output index signal(Z signal) of encoder	
	9	/N		

3.2.5.2 X4 Interface



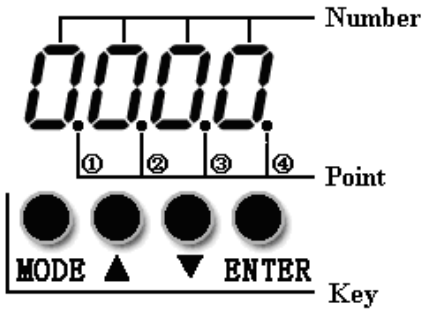
Interface	Pin No.	Signal	Description	Function
X4 (15-pin female connector)	1	+5V	To output 5 V voltage	Input interface of encoder in motor
	9	GND	0 V	
	8	NC	N/A	
	2	A	To input phase-A signals of encoder	
	10	/A		
	3	B	To input phase-B signals of encoder	
	11	/B		
	4	N	To input phase-Z signals of encoder	
	12	/N		
	5	U	To input phase-U signals of encoder	
	13	/U		
	6	V	To input phase-V signals of encoder	
	14	/V		
	7	W	To input phase-W signals of encoder	
	15	/W		

Chapter 4 Digital Operation Panel

4.1 Introduction

A digital operation panel functions to set user parameters in a servo driver, execute instructions, or display parameters. Table 4-1 describes all display contents and functions of the digital operation panel.

Table 4-1 Display contents and functions of a digital operation panel



Number/ Point/Key	Function
①	Indicates whether data is positive or negative. If it is on, it indicates negative; otherwise it indicates positive.
②	1. Distinguishes the current object group and the address data in this object group during parameter settings. 2. Indicates the higher 16 bits of the current 32-bit data when internal 32-bit data is displayed in real time. 3. Indicates the earliest error when history records of errors (F007) are displayed.
③	1. Indicates a data display format when parameters are displayed and adjusted in real time. If it is on, it indicates the data is displayed in hexadecimal; otherwise it indicates the data is displayed in decimal. 2. Indicates the latest error when the history records of errors (F007) are displayed.
④	1. If it is on, it indicates that internal data is currently displayed. 2. If it flickers, it indicates that the power part of the driver is in the working status.
MODE	1. Switches basic menus. 2. During the adjustment of parameters, short presses the key to move the bit to be adjusted, and long presses the key to return to the previous state.
▲	Presses ▲ to increase set values; long presses ▲ to increase numbers promptly.
▼	Presses ▼ to decrease set values; long presses ▼ to decrease numbers promptly.
ENTER	1. Enters the selected menu by pressing this key. 2. Keeps current parameters in the enabled status. 3. Confirms input parameters after parameters are set. 4. Long presses this key to switch to higher/lower 16 bits when internal 32-bit data is displayed in real time.
P..L	Activates position positive limit signals.
n..L	Activates position negative limit signals.

Pn.L	Activates position positive/negative limit signals.
Overall Flicking	Indicates that an error occurs on the driver, and is in the alarm state.

If the parameter adjusting display mode is featured by the decimal system:

When the units place is flickering, press ▲ to add 1 to the current value; press ▼ to deduct 1 from the current value. When the tens place is flickering, press ▲ to add 10 to the current value; press ▼ to deduct 10 from the current value. When the hundreds place is flickering, press ▲ to add 100 to the current value; press ▼ to deduct 100 from the current value. When the thousands place is flickering, press ▲ to add 1000 to the current value; press ▼ to deduct 1000 from the current value.

If the parameter adjusting display mode is featured by the hexadecimal system:

When the units place is flickering, press ▲ to add 1 to the current value; press ▼ to deduct 1 from the current value. When the tens place is flickering, press ▲ to add 0X10 to the current value; press ▼ to deduct 0X10 from the current value. When the hundreds place is flickering, press ▲ to add 0X100 to the current value; press ▼ to deduct 0X100 from the current value. When the thousands place is flickering, press ▲ to add 0X1000 to the current value; press ▼ to deduct 0X1000 from the current value.

When adjusting decimal parameters, the display mode is automatically switched to the hexadecimal system if the data is greater than 9999 or less than -9999. In this case, the 3rd decimal point from left to right is highlighted.

4.2 Operation on Digital Operation Panel

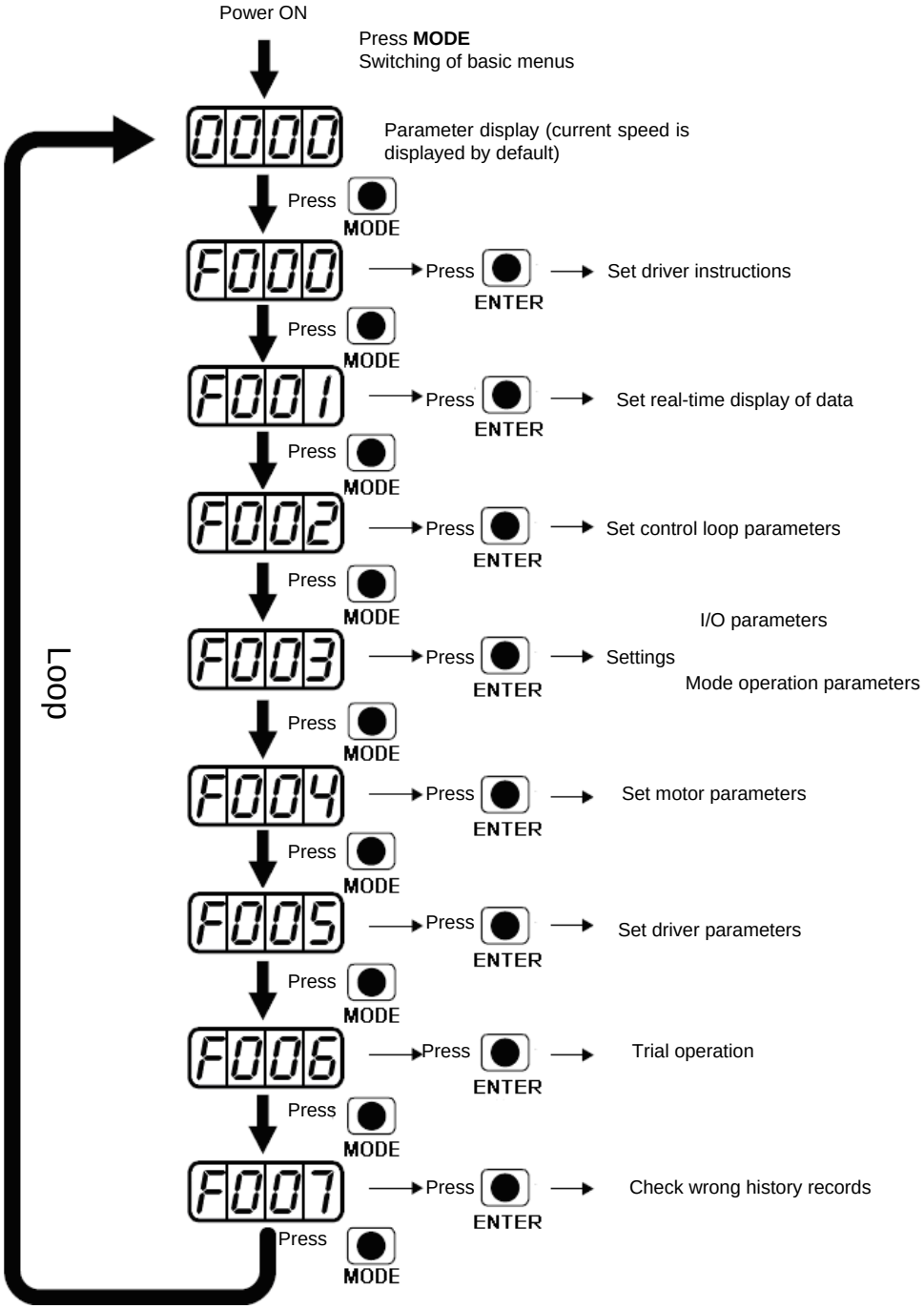


Fig. 4-1 Operation on a digital operation panel

Note: If a non real-time display interface is displayed for the control panel, and no key operation occurs, the real-time display interface is automatically skipped after 20 seconds to avoid misoperation.

Example 4-1: Set the denominator of electronic gear ratio to 10000 with number system switching

1. Press **MODE**. The main menu is displayed. Choose **F003**.

2. Press **ENTER**. The interface for selecting addresses is displayed.
3. Press ▲ to adjust data as **d3.35**.
4. Press **ENTER** to display the current value **d3.35**. Press **ENTER** again to modify the value d3.35. In this case, the 1st number at the right side is flickering. Short press **MODE** for three times to move to the first position on the left. Then press ▲. The value is increased to 9000. In this case, the current data is decimal.
5. Press ▲ again. The content of numeric display changes to “271.0”, and the 3rd decimal point (from left to right) flickers. In this case, the data is hexadecimal. Press **ENTER** to confirm the current value. The 1st decimal point on the right flickers. In this case, the denominator of the electronic gear ratio is modified to 10000.

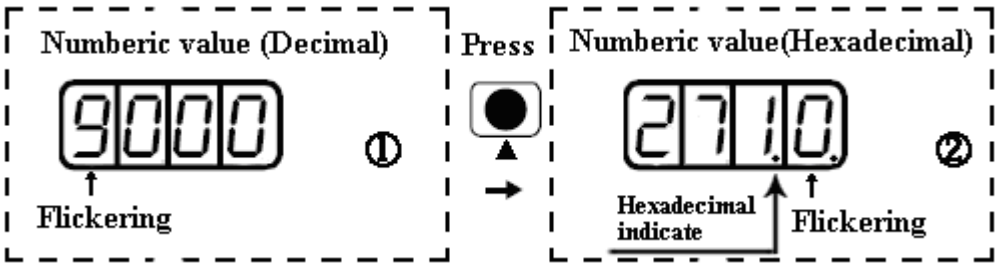


Fig. 4-2 Number system conversion

Example 4-2: Set the speed to 1000 RPM/-1000 RPM with separate regulation of bits

1. Press **MODE**. The main menu is displayed. Choose **F000**.
2. Press **ENTER**. The interface for selecting addresses is displayed.
3. Press ▲ to adjust data as **d0.02**.
4. Press **ENTER** to display the current value d0.02. Press **ENTER** again to modify the value d0.02. In this case, the 1st number at the right side is flickering.
5. Short press **MODE** for three times to move to the 1st position on the left. Press ▲ to modify the value to 1. Press **ENTER** to confirm the current value. The 1st decimal point on the right flickers. In this case, the speed is 1000 RPM.
6. Press ▼ to modify the value to -1. In this case, the 1st decimal point on the left flickers, indicating that the current data is negative. Press **ENTER** to confirm the current value. The 1st decimal point on the right flickers. In this case, the speed is -10000 RPM.

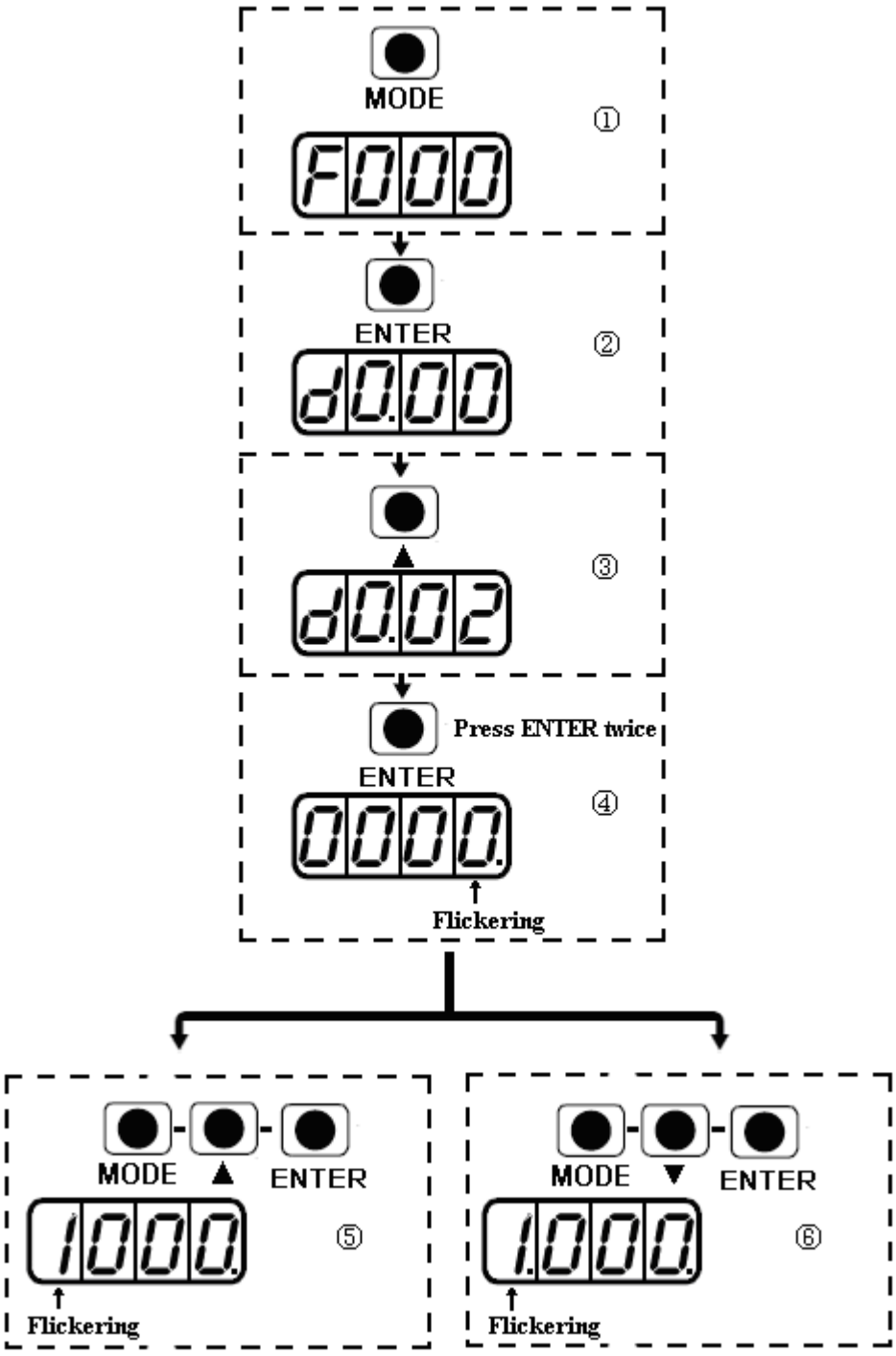


Fig. 4-3 Separate regulation of bits

Chapter 5 Motor Selection,Trial Operation and Parameter List

5.1 Driver and motor configuration

There is no default motor type set in driver,so users need to set the motor model before using the driver.Please refer to the selection table when setting the motor model.

PC	**LED**	**Motor Model**	**Suitable Servo**		
LED Code:d4.19			**CD420/CD422**	**CD430/CD432**	**CD620/CD622**
K@	404.b	Do not configure motor	Display FFF.F if not enable		
			Display 800.0 if enable		
K0	304.b	SMH60S-0020-30A■K-3LK□	√		
K1	314.b	SMH60S-0040-30A■K-3LK□	√		
K2	324.b	SMH80S-0075-30A■K-3LK□	√		
K3	334.b	SMH80S-0100-30A■K-3LK□		√	
K4	344.b	SMH110D-0105-20A■K-4LK□		√	
K5	354.b	SMH110D-0125-30A■K-4LK□		√	
K6	364.b	SMH110D-0126-20A■K-4LK□		√	
K7	374.b	SMH110D-0126-30A■K-4HK□			√
K8	384.b	SMH110D-0157-30A■K-4HK□			√
K9	394.b	SMH110D-0188-30A■K-4HK□			√
KB	424.b	SMH130D-0105-20A■K-4HK□		√	√
KC	434.b	SMH130D-0157-20A■K-4HK□		√	√
KD	444.b	SMH130D-0210-20A■K-4HK□			√
KE	454.b	SMH150D-0230-20A■K-4HK□			√
E0	304.5	SME60S-0020-30A■K-3LK□	√		
E1	314.5	SME60S-0040-30A■K-3LK□	√		
E2	324.5	SME80S-0075-30A■K-3LK□	√		
S0	305.3	130D-0105-20AAK-2LS	√	√	√
S1	315.3	130D-0157-20AAK-2LS		√	
S2	325.3	130D-0157-15AAK-2LS		√	
S3	335.3	130D-0200-20AAK-2HS			√

S4	345.3	130D-0235-15AAK-2HS			√
F8	384.6	85S-0045-05AAK-FLFN	√		
		85S-0045-05AAK-FLFO-KT	√		

Note： ■=A: No brake □= H：Direct cable connector √：Recommended Configuration of Servo and Motor

=B: With brake =N：HFO series standard connector

= C：YL22 series standard connector

= M：2*M17 series Intercontec connector

= D： M17+M23 (Power M23 Intercontec connector, Encoder M17 Intercontec connector)

Kinco servo does not configure motor in default setting. Customers should configure it when they get a new servo.

1. Customers have the data file（**No need to configure motor**）

Use the CD-PC software to download data file to servo driver, then driver and motor can work normally. Please contact us if there is any problem after downloading. In CD-PC, click the **Extend-->Write Driver Config**. Then open the data file (For example, name.cdi), write it to driver.

Note: You should download the new version software from our website: http://www.kinco.cn/en/

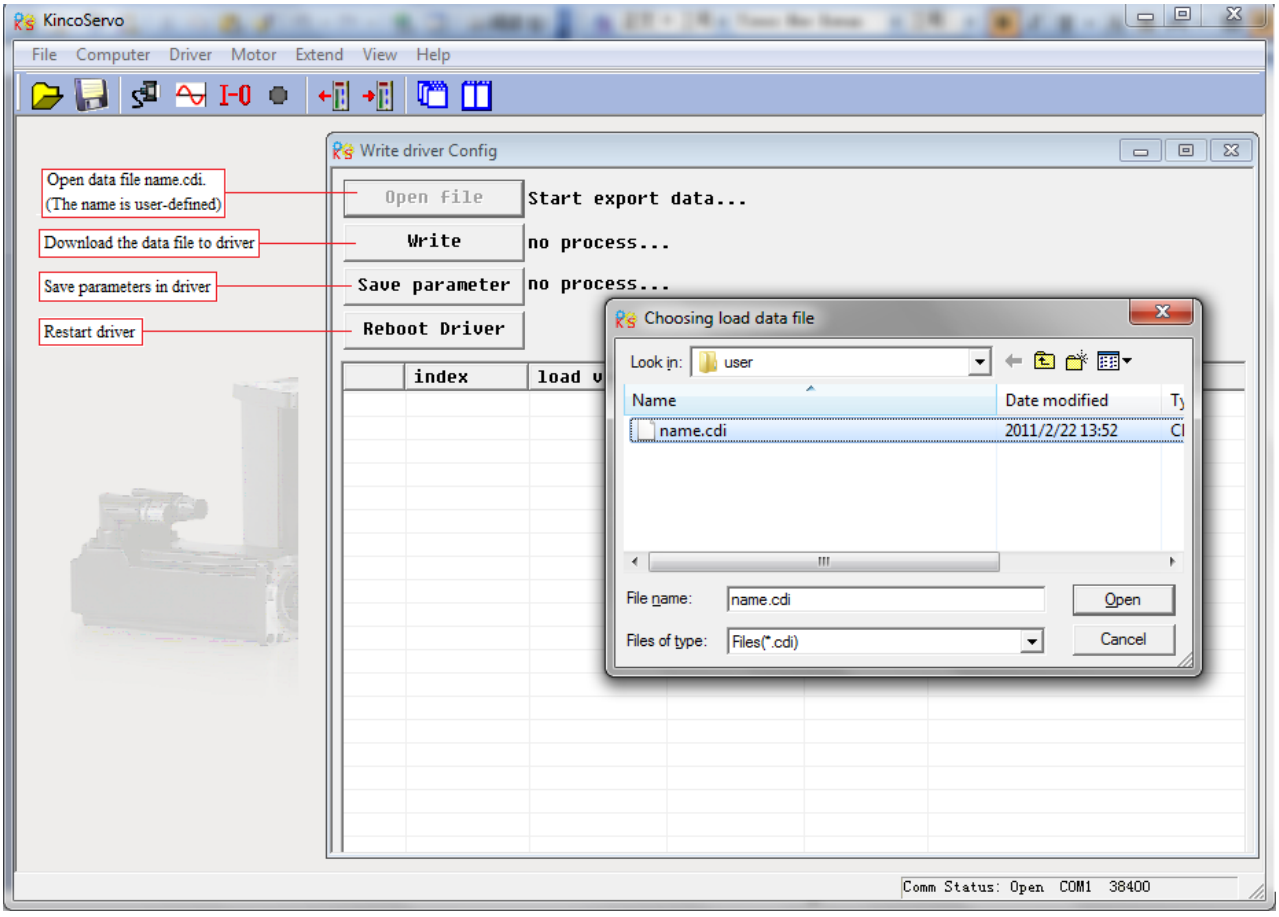


Fig.5-1 Data file downloading

2. Customers do not have data file（**They need configure motor model in servo**）

Customers can configure the motor's model according to servo/motor configuration table mentioned above, then set the parameters according to the application. If the motor's model do not configure properly, the driver and motor may not work normally. You can configure motor model via keys on servo or CD-PC software.

（1）Configure Motor（Keys Operation）

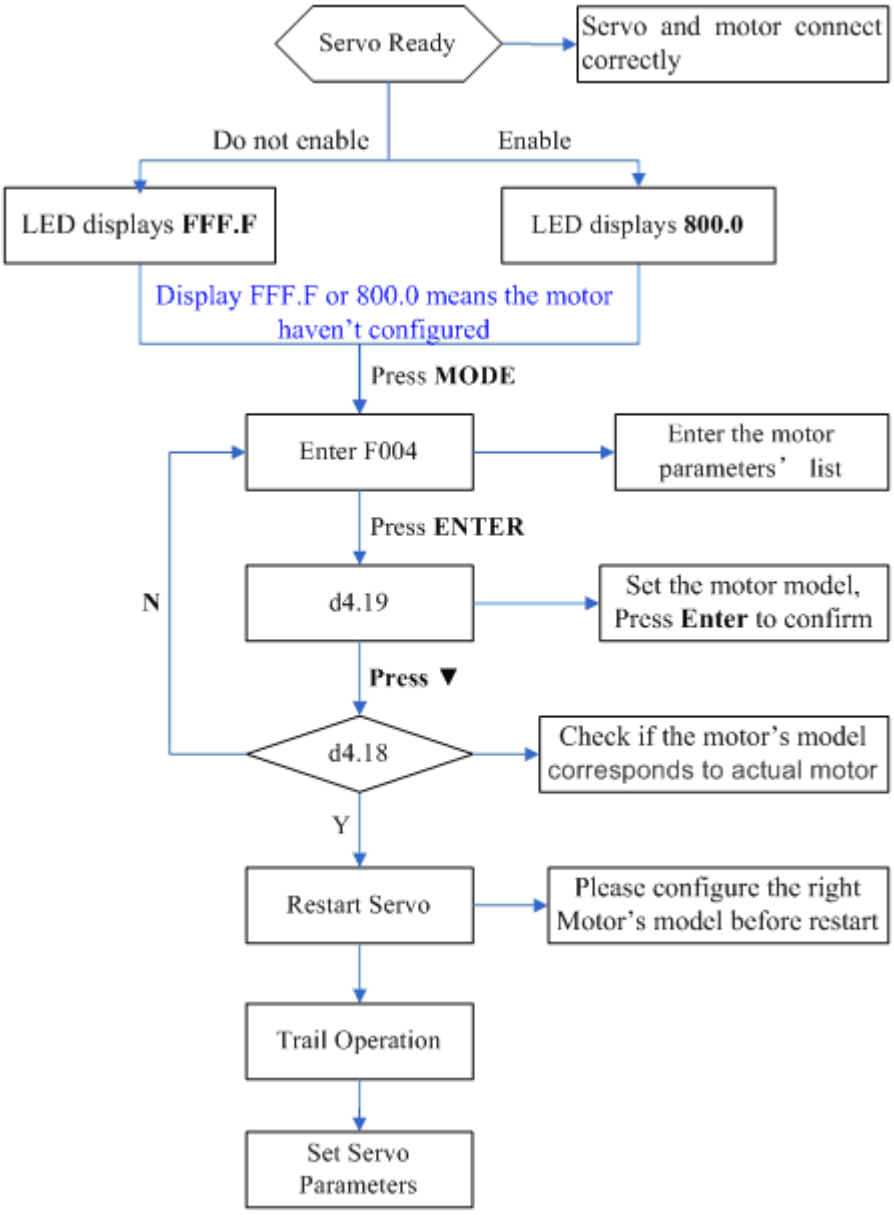


Fig.5-2 Flow chart for configuring motor by key

Please configure the right motor's model before restart. If customers want to reset the motor model, they should set D4.19 to 303.0 (Press ENTER to confirm) and then d4.00 to 1(Save motor parameters), after restart the servo they can reset motor model and servo parameters according to the above chart

(2) Configure Motor (**CD-PC Software Operation**)

Connect the servo to PC, open the CD-PC, then Menu—Driver—Control Panel—F004, in the F004, in the F004, set the 19th operation: **Motor Num** (Please refer to the servo and motor configuration table), after that press Enter to confirm, then restart servo.

Please configure the right Motor's model before restart. If the customers want to reset the motor model, they should set D4.19 (Motor Num in F004) to 00(Press ENTER to confirm), then enter the

Initialize/Save page, click the **Save motor parameters.** After restart the servo, they can reset the motor model and set servo parameters.

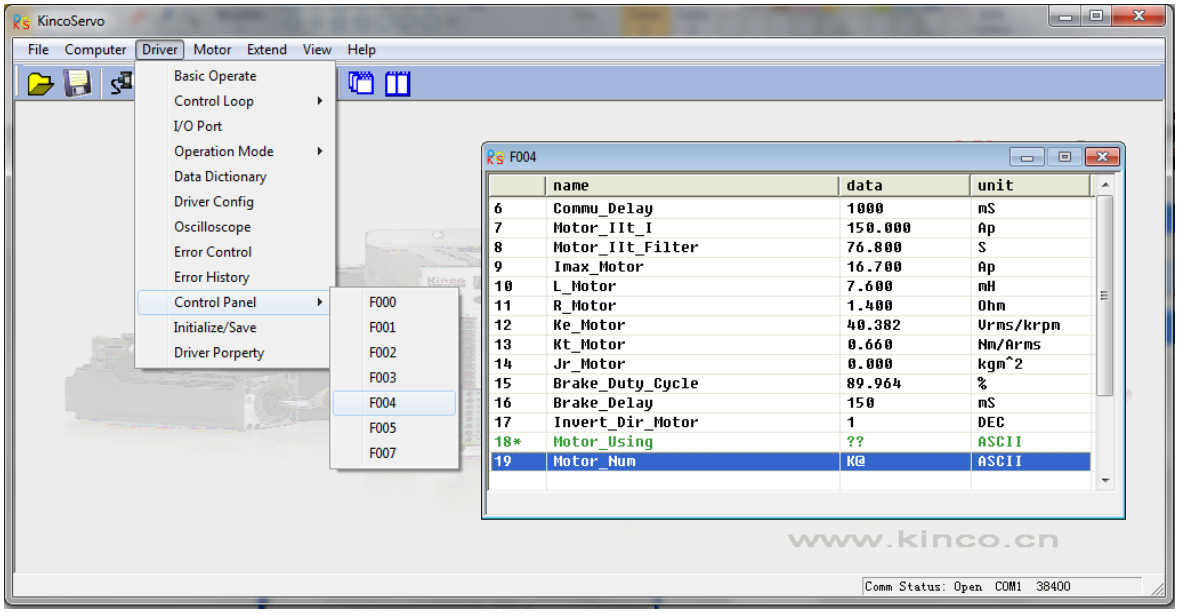


Fig.5-3 Configure motor by software

5.2 Trial Operation

5.2.1 Objective

The trial operation allows you to test whether the driver works properly, and whether the motor runs stably.

5.2.2 Precautions

1. Ensure that the motor is running without load. If the motor flange is fixed on the machine, ensure that the motor shaft is disconnected from the machine.
2. Ensure that motor cables, motor encoder cables, and power circuits (power lines and control power lines) are properly connected. For details, see Chapter 3.
3. During the trial operation, if you long press ▲ or ▼ when the motor is running, pulse signals, digital input signals, and analog signals of the external controller are temporarily unavailable, so safety must be ensured.
4. During the trial operation, the system automatically adopts the instantaneous speed mode, that is, the “-3” mode.
5. After the trial operation, Group F006 exits automatically. To enter Group F006 again, you must re-activate the trial operation.
6. If motor/encoder cables are wrongly connected, the actual rotation speed of the motor may be the possible maximum rotation speed, or the rotation speed is 0 and the actual current value is the maximum value. In this case, make sure to release the button; then check cable connection and test it again.

7. Don’t use trial operation if the keys are broken.

5.2.3 Operating Steps

1. Press **MODE** to enter Group F004. Select the object address “d4.18”, and check the motor type.
2. Press **MODE** to enter Group F000. Select the object address “d0.02”, and set the target speed to “SpeedDemand_RPM".
3. Press **MODE** to enter Group F006. Arrange a test for keys, with the default value of d6.40. Firstly, press ▼ to adjust the data to d6.31. Then, press ▼, the data automatically changes to “d6.15”. Finally, press ▲ to adjust the data to d6.25.
4. Press **ENTER** to activate trial operation. In this case, the numeric display is “adc.d”, and the motor shaft releases. When long pressing ▲ or ▼, the motor automatically locks, and runs according to “+SpeedDemand_RPM” or “-SpeedDemand_RPM” separately. During the trial operation, the numeric displays the motor speed in real time.

5.2.4 Diagram of Trial Operation

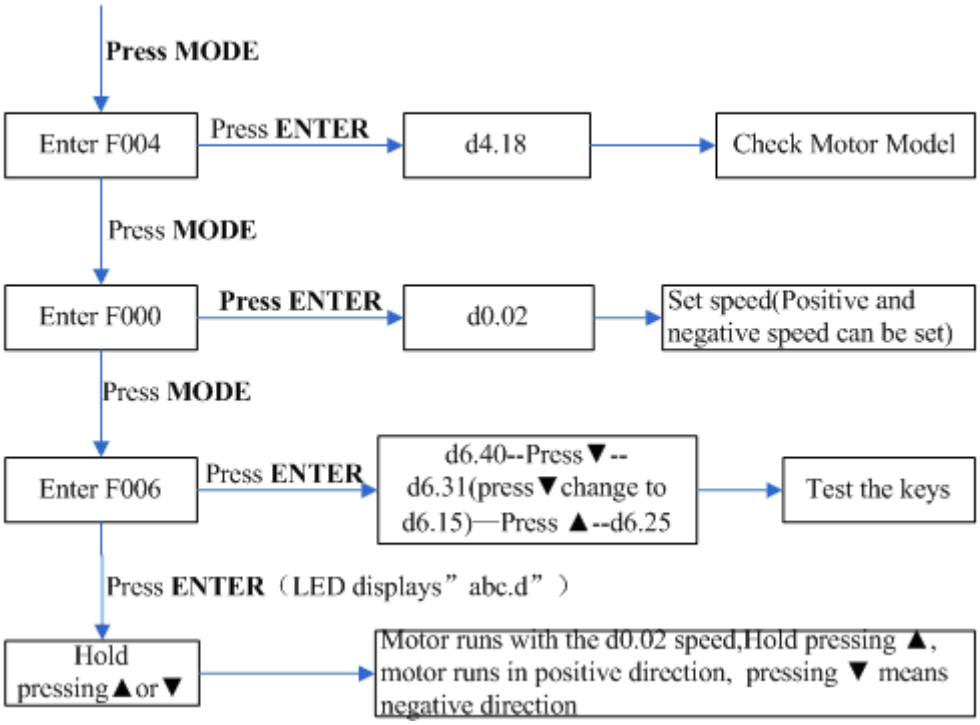


Fig.5-4 Flow chart for trial operation

5.3 Description of Parameters

Group F000 represents an instruction group, and the parameters in this group cannot be saved.

The address d4.00 is used to save the motor parameters set for Group F004. Note that this group of parameters must be set when customers choose third-party motors, but these parameters need not to be set for the motors delivered and configured by our company. d2.00, d3.00 and d.5.00 represent the same address, and are used to save all setup parameters except those of motors (Group

F001/F002/F003/F004/F005). Three numeric objects (d2.00/d3.00/d5.00) are developed to facilitate customers.

Parameter List: Group F000 (To Set Driver Instructions)

Numeric Display	Internal Address	Variable Name	Meaning	Default Value	Range
d0.00	60600008	Operation_Mode	0.004 (-4): Pulse control mode, including pulse direction (P/D) and double pulse (CW/CCW) modes. 0.003 (-3): instantaneous speed mode 0001 (1): Internal position control mode 0003 (3): Speed mode with acceleration/deceleration 0004 (4): Torque mode Note: Only applied in the working mode where no external signals control the driver.	-4	N/A
d0.01	2FF00508	Control_Word_Easy	000.0: Releases the motor 000.1: Locks the motor 001.0: Clears errors Note: Only applied in the situation where enabling a driver or wrong resetting is not controlled by external signals. After the wrong reset of the driver, the motor must be enabled again.	0	N/A
d0.02	2FF00910	SpeedDemand_RPM	Sets the motor's target rotation speed when the driver works in the "-3" or "3" mode and the address d3.28 is set to 0 (without external analog control).	0	N/A
d0.03	60710010	CMD_q	Sets input torque instructions (current instructions) when the driver works in the "4" mode and the address d3.30 is set to 0 (without external analog control).	0	-2047~2047
d0.04	2FF00A10	Vc_Loop_BW	Sets the velocity loop bandwidth. The unit is Hz. This variable can only be set after auto tuning is performed properly; otherwise the actual bandwidth goes wrong, which causes abnormal working of the driver. If the auto tuning result is abnormal, setting this parameter may also cause abnormal working of the driver. Note: This parameter cannot be applied	0	0~600

			when auto tuning is unavailable. After setting this parameter, apply d2.00 to save the settings as required.		
d0.05	2FF00B10	Pc_Loop_BW	Sets the position loop bandwidth. The unit is Hz. Note: After setting this parameter, apply d2.00 to save the settings as required.	0	N/A
d0.06	2FF00C10	Tuning_Start	If the variable is set to 11, auto tuning starts. All input signals are neglected during auto tuning. The variable is automatically changed to 0 after auto tuning is completed. Sets the variable to other values to end auto tuning.	0	N/A

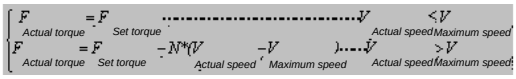
Parameter List: Group F001 (To Set Real-Time Display Data)

Numeric Display	Internal Address	Variable Name	Displayed Content
d1.00	2FF00F20	Soft_Version_LED	Software version of numeric display
d1.01	2FF70020	Time_Driver	Accumulated working time of the driver (S)
d1.02	2FF01008	Motor_IIt_Rate	Ratio of real iit to the maximum iit of a motor
d1.03	60F61210	Motor_IIt_Real	Actual data of motor overheat protection $I_{rms} = \frac{\sqrt{Motor\_IIt\_Real*512}}{2047} * \frac{I_{peak}}{\sqrt{2}}$
d1.04	2FF01108	Driver_IIt_Rate	Ratio of real iit to the maximum iit of a driver
d1.05	60F61010	Driver_IIt_Real	Actual data of driver overheat protection
d1.06	2FF01208	Chop_Power_Rate	Ratio of actual power to rated power of a braking resistor
d1.07	60F70D10	Chop_Power_Real	Actual power of a braking resistor
d1.08	60F70B10	Temp_Device	Temperature of a driver (°C)
d1.09	60790010	Real_DCBUS	Actual DC bus voltage
d1.10	60F70C10	Ripple_DCBUS	Fluctuating value of the bus voltage (Vpp)
d1.11	60FD0010	Din_Status	Status of an input port
d1.12	20101410	Dout_Status	Status of an output port
d1.13	25020F10	Analog1_out	Filter output of external analog signal 1
d1.14	25021010	Analog2_out	Filter output of external analog signal 2
d1.15	26010010	Error_State	Error state
d1.16	26020010	Error_State2	Error state word 2
d1.17	60410010	Status_Word	Driver status word
d1.18	60610008	Operation_Mode_Buff	Efficient working mode of a driver

d1.19	60630020	Pos_Actual	Actual position of a motor
d1.20	60FB0820	Pos_Error	Position following error
d1.21	25080420	Gear_Master	Count of input pulses before electronic gear
d1.22	25080520	Gear_Slave	Count of executed pulses after electronic gear
d1.23	25080C10	Master_Speed	Pulse speed entered by the master axis (pulse/mS)
d1.24	25080D10	Slave_Speed	Pulse speed of the slave axis (pulse/mS)
d1.25	606C0010	Real_Speed_RPM	Real speed (rpm) Internal sampling time: 200 mS
d1.26	60F919	Real_Speed_RPM2	Real speed (0.01 rpm) Internal sampling time: 200 mS
d1.27	60F91A10	Speed_1mS	Speed data (inc/1 mS) Internal sampling time: 1 mS
d1.28	60F60C10	CMD_q_Buff	Internal effective current instruction
d1.29	60F61710	I_q	Actual current $I_{rms} = \frac{I\_q}{2047} * \frac{I_{peak}}{\sqrt{2}}$
d1.30	60F90E10	K_Load	Load parameter
d1.31	301004	Z_Capture_Pos	Position data captured by encoder index signals

Parameter List: Group F002 (To Set Control Loop Parameters)

Numeric Display	Internal Address	Variable Name	Meaning	Default Value	Range
d2.00	2FF00108	Store_Loop_ Data	1: Stores all control parameters except motor parameters 10: Initializes all control parameters except motor parameters	0	N/A
d2.01	60F90110	Kvp	Sets the response speed of velocity loop	100	0~32767
d2.02	60F90210	Kvi	Time used to adjust speed control to compensate minor errors	2	0~16384
d2.03	60F90308	Notch_N	Notch/filtering frequency setting for a velocity loop, used to set the frequency of the internal notch filter, so as to eliminate the mechanical resonance produced when the motor drives the machine. The formula is F=Notch_N*10+100. For example, if the mechanical resonance frequency is F = 500 Hz, the parameter should be set to 40.	45	0~90
d2.04	60F90408	Notch_On	Enable or disable the notch filter 0: Disable the trap filter 1: Enable the trap filter	0	N/A

d2.05	60F90508	Speed_Fb_N	You can reduce the noise during motor operation by reducing the feedback bandwidth of velocity loop. When the set bandwidth becomes less, the motor responds slower. The formula is F=Speed_Fb_N*20+100. For example, to set the filter bandwidth to "F = 500 Hz", you need to set the parameter to 20.	45	0~45
d2.06	60F90608	Speed_Mode	0: Speed response after traveling through a low-pass filter 1: Direct speed response without filtering 2: Feedback on output feedback	0	N/A
d2.07	60FB0110	Kpp	Proportional gains on position loop Kpp	1000	0~16384
d2.08	60FB0210	K_Speed_FF	0 indicates no feedforward, and 256 indicates 100% feedforward	256	0~256
d2.09	60FB0310	K_Acc_FF	The data is inversely proportional to the feedforward	7FF.F	32767~10
d2.10	2FF00610	Profile_Acce_16	To set trapezoidal acceleration (rps/s) in the "3" and "1" modes	610	0~2000
d2.11	2FF00710	Profile_Dece_16	To set trapezoidal acceleration (rps/s) in the "3" and "1" modes	610	0~2000
d2.12	60F60110	Kcp	To set the response speed of the current loop and this parameters does not require adjusting	N/A	N/A
d2.13	60F60210	Kci	Time used to adjust current control to compensate minor errors	N/A	N/A
d2.14	60730010	CMD_q_Max	Indicates the maximum value of current instructions	N/A	N/A
d2.15	60F60310	Speed_Limit_Factor	The factor that limits the maximum speed in the torque mode  V the maximum speed complies with d2.24 Max_Speed_RPM parameter settings	10	0~1000
d2.16	607E0008	Invert_Dir	Runs polarity reverse 0: Counterclockwise indicates the forward direction 1: Clockwise indicates the forward direction	0	N/A
d2.17	60F90E10	K_Load	Indicates load parameters	N/A	20~15000
d2.18	60F90B10	Kd_Virtual	Indicates the kd of observers	1000	0~32767
d2.19	60F90C10	Kp_Virtual	Indicates the kp of observers	1000	0~32767
d2.20	60F90D10	Ki_Virtual	Indicates the ki of observers	0	0~16384
d2.21	60F91010	Sine_Amplitude	Proper increase in this data will reduce the tuning error, but machine vibration will become severer. This data can be adjusted properly according to actual conditions of machines. If	64	0~1000

			the data is too small, the auto tuning error becomes greater, or even causes a mistake.		
d2.22	60F91110	Tuning_Scale	It is helpful to reduce the auto tuning time by reducing the data, but the result may be unstable.	128	0~16384
d2.23	60F91210	Tuning_Filter	Indicates filter parameters during auto-tuning	64	1~1000
d2.24	60800010	Max_Speed_ RPM	Limits the maximum rotation speed of motors	5000	0~6000
d2.25	2FFOOE10	Max_Followin g_ Error_16	Max.following error=100* Max_following_ error_16	100	/
d2.26	60FB0510	Pos_Filter_N	Average filter parameter	1	/

Parameter List: Group F003 (To Set Input/Output & Pattern Operation Parameters)

Numeric Display	Internal Address	Variable Name	Meaning	Default Value	Range
d3.00	2FF00108	Store_Loop_Data	1: Stores all control parameters except motor parameters 10: Initializes all control parameters except motor parameters	0	N/A
d3.01	20100310	Din1_Function	000.1: Driver enable 000.2: Driver fault reset 000.4: Operation mode control 000.8: P control for velocity loop 001.0: Position positive limit 002.0: Position negative limit 004.0: Homing signal 008.0: Reverse speed demand 010.0: Internal speed control 0 020.0: Internal speed control 1 800.1: Internal speed control 2 040.0: Internal position control 0 080.0: Internal position control 1 800.2: Internal position control 2 800.4 Multi Din 0 800.8 Multi Din 1 801.0 Multi Din 2 802.0 Gain switch 0 804.0 Gain switch 1 100.0: Quick stop 200.0: Start homing 400.0: Activate command	000.1	N/A
d3.02	20100410	Din2_Function		000.2	N/A
d3.03	20100510	Din3_Function		000.4	N/A
d3.04	20100610	Din4_Function		000.8	N/A
d3.05	20100710	Din5_Function		001.0	N/A
d3.06	20100810	Din6_Function		002.0	N/A
d3.07	20100910	Din7_Function		004.0	N/A

d3.08	20100110	Dio_Polarity	Sets IO polarity	0	N/A
d3.09	2FF00810	Dio_Simulate	Simulates input signals, and enforce output signals for outputting	0	N/A
d3.10	20000008	Switch_On_Auto	Automatically locks motors when drivers are powered on 0: No control 1: Automatically locks motors when drivers are powered on	0	N/A
d3.11	20100F10	Dout1_Function	000.1: Ready 000.2: Error 000.4: Position reached 000.8: Zero velocity 001.0: Motor brake 002.0:Velocity reached 004.0: Index 008.0: The maximum speed obtained in the torque mode 010.0: PWM ON 020.0: Position limiting 040.0: Reference found 080.0: Reserved 100.0: Multi Dout 0 200.0: Multi Dout 1 400.0: Multi Dout 2	000.1	N/A
d3.12	20101010	Dout2_Function		000.2	N/A
d3.13	20101110	Dout3_Function		00a.4	N/A
d3.14	20101210	Dout4_Function		000.8	N/A
d3.15	20101310	Dout5_Function		001.0	N/A
d3.16	20200D08	Din_Mode0	If a digital input is defined as Operation mode control,then this operation mode is selected when the input signal is invalid	-4	N/A
d3.17	20200E08	Din_Mode1	If a digital input is defined as Operation mode control,then this operation mode is selected when the input signal is valid	-3	N/A
d3.18	20200910	Din_Speed0_RPM	Multi-speed control: 0 [rpm]	0	N/A
d3.19	20200A10	Din_Speed1_RPM	Multi-speed control: 1 [rpm]	0	N/A
d3.20	20200B10	Din_Speed2_RPM	Multi-speed control: 2 [rpm]	0	N/A
d3.21	20200C10	Din_Speed3_RPM	Multi-speed control: 3 [rpm]	0	N/A
d3.22	25020110	Analog1_Filter	Used to smooth the input analog signals F (Filter Frequency) = 4000/ (2π* Analog1_Filter) T (Time Constant) = Analog1_Filter/4000 (S)	5	1~127
d3.23	25020210	Analog1_Dead	Sets dead zone data for external analog signal 1	0	0~8192
d3.24	25020310	Analog1_Offset	Sets offset data for external analog signal 1	0	-8192~8192
d3.25	25020410	Analog2_Filter	Used to smooth the input analog signals Filter frequency: f=4000/(2π* Analog1_Filter)	5	1~127

			Time Constant: T = Analog1_Filter/4000 (S)		
d3.26	25020510	Analog2_Dead	Sets dead zone data for external analog signal 2	0	0~8192
d3.27	25020610	Analog2_Offset	Sets offset data for external analog signal 2	0	-8192~8192
d3.28	25020708	Analog_Speed_Con	Chooses analog-speed channels 0: Invalid analog channel 1: Valid analog channel 1 (AIN1) 2: Valid analog channel 2 (AIN2) 10～17：AIN1 for “Din_Speed (X-10)” 20～27：AIN2 for “Din_Speed (X-20)” Valid in mode -3, 3 and 1.	0	N/A
d3.29	25020A10	Analog_Speed_Factor	Sets the proportion between analog signals and output speed	1000	N/A
d3.30	25020808	Analog_Torque_Con	Chooses analog-torque channels 0: Invalid analog channel 1: Valid analog channel 1 (AIN1) 2: Valid analog channel 2 (AIN2) Valid mode 4	0	N/A
d3.31	25020B10	Analog_Torque_Factor	Sets the proportion between analog signals and output speed (current)	1000	N/A
d3.32	25020908	Analog_MaxT_Con	0: No control 1: Max. torque controlled by AIN 1 2: Max. torque controlled by AIN 2	0	N/A
d3.33	25020C10	Analog_MaxT_Factor	Indicates the max torque factor on analog signal control	8192	N/A
d3.34	25080110	Gear_Factor	Indicates the numerator to set electronic gears when the operation mode is -4	1000	-32767~32767
d3.35	25080210	Gear_Divider	Indicates the denominator to set electronic gears when the operation mode is -4	1000	1~32767
d3.36	25080308	PD_CW	0: Double pulse (CW/CCW) mode 1. Pulse Direction (P/D) mode 2.Incremental encoder mode Note: To change this parameter, you need to save it with the address “d5.00”, and restarts it later.	1	N/A
d3.37	25080610	PD_Filter	To flat the input pulse. Filter frequency: f=1000/(2π* PD_Filter) Time constant: T = PD_Filter/1000 Unit: S Note: If you adjust this filter parameter during the operation, some pulses may be lost.	3	1~32767
d3.38	25080810	Frequency_Check	Indicates the limitation on pulse input frequency (k Hz)	600	0~600

d3.39	25080910	Position_Reach_Time	Indicates the position reached time window in the pulse mode Unit: mS	10	0~32767
d3.40	2FF10108	Din_Position_Select_L	To select which parameter will be set. 0. Din_Pos0 1. Din_Pos1 2. Din_Pos2 3. Din_Pos3 4. Din_Pos4 5. Din_Pos5 6. Din_Pos6 7. Din_Pos7	0	N/A
d3.41	2FF10210	Din_Position_M	Refer to d3.42	0	-32767~32767
d3.42	2FF10310	Din_Position_N	Din_Pos L(Pulse number) = Din_Position_M *10000+ Din_Position_N	0	-32767~32767
d3.43	20200F10	Din_Control_Word	Input “Enable” signal controls the control word.	0	N/A
d3.44	20201810	Din_Speed4_RPM	Multi-speed control: 4 [rpm]	0	N/A
d3.45	20201910	Din_Speed5_RPM	Multi-speed control: 5 [rpm]	0	N/A
d3.46	20201A10	Din_Speed6_RPM	Multi-speed control: 6 [rpm]	0	N/A
d3.47	20201B10	Din_Speed7_RPM	Multi-speed control: 7 [rpm]	0	N/A

Parameter List: Group F004 (To Set Motor Parameters)

Numeric display	Internal Address	Variable Name	Meaning
d4.00	2FF00308	Store_Motor_Data	1: Stores the set motor parameters
d4.01	64100110	Motor_Num	Host computer (ASCII code) numerical display (hexadecimal) “00”..... ....303.0 Note: To change this parameter, you need to save it with the address “d4.00”, and restart it later.
d4.02	64100208	Feedback_Type	Type of encoders 001.1: Differential ABZ and differential UVW signals 001.0: Differential ABZ and UVW signals of TTL 000.1: ABZ of TTL and differential UVW signals 000.0: ABZ of TTL and UVW signals of TTL
d4.03	64100508	Motor_Poles	Number of motor poles pairs [2p]
d4.04	64100608	Commu_Mode	Searching excitation mode
d4.05	64100710	Commu_Curr	Searching excitation current [dec]
d4.06	64100810	Commu_Delay	Delay in searching excitation [mS]
d4.07	64100910	Motor_Ilt_I	Indicates current settings on overheat protection of motors

			Ir[Arms]*1.414*10
d4.08	64100A10	Motor_Ilt_Filter	Indicates time settings on overheat protection of motors Time: N*256/1000 Unit: S
d4.09	64100B10	Imax_Motor	Indicates max peak current of motors I[Apeak]*10
d4.10	64100C10	L_Motor	Indicates phase inductance of motors L[mH]*10
d4.11	64100D08	R_Motor	Indicates phase resistance of motors R[Ω]*10
d4.12	64100E10	Ke_Motor	Indicates the reverse electromotive force of motors Ke[Vp/krpm]*10
d4.13	64100F10	Kt_Motor	Indicates the torque coefficient of motors Kt[Nm/Arms]*100
d4.14	64101010	Jr_Motor	Indicates the rotor inertia of motors Jr[kgm^2]*1 000 000
d4.15	64101110	Brake_Duty_Cycle	Indicates the duty cycle of contracting brakes 0~2500[0…100%]
d4.16	64101210	Brake_Delay	Indicates the delay time of contracting brakes Default value: 150 ms
d4.17	64101308	Invert_Dir_Motor	Indicates the rotation direction of motors
d4.18	64101610	Motor_Using	Current using motor type. **PC Software Numeric Display Model** "K0".....304.B……...SMH60S-0020-30 "K1".....314.B……SMH60S-0040-30 "K2".....324.B……SMH80S-0075-30 "K3".....334.B……SMH80S-0100-30 "K4".....344.B……SMH110D-0105-20 "K5".....354.B……SMH110D-0125-30 "K6".....364.B……...SMH110D-0126-20 "K7"…….....374.B……SMH110D-0126-30 "K8"……...384.B.....SMH110D-0157-30 "K9".....394.B……...SMH110D-0188-30 “KB"……...424.B……....SMH130D-0105-20 “KC"……...434.B……SMH130D-0157-20 “KD"……...444.B……SMH130D-0210-20 “KE"……...454.B……..SMH150D-0230-20 "S0"……...305.3……130D-0105-20AAK-2LS "S1".....315.3……..130D-0157-20AAK-2LS "S2"……...325.3……130D-0157-15AAK-2LS "S3".....335.3……130D-0200-20AAK-2HS "S4".....345.3……..130D-0235-15AAK-2HS "F8"……...384.6……..85S-0045-05AAK-FLFN "E0".....304.5……..SME60S-0020-30

			"E1".....314.5…….....SME60S-0040-30 "E2".....324.5……..SME80S-0075-30
d4.19	64101410	Motor_Num	The same function as d4.01.But it is specially used for configuring motor at the first time,and needn’t restart driver.

Parameter List: Group F005 (To Set Driver Parameters)

Numeric Display	Internal Address	Variable Name	Meaning	Default Value
d5.00	2FF00108	Store_Loop_Data	1: Stores all control parameters except motor parameters 10: Initializes all control parameters except motor parameters	0
d5.01	100B0008	ID_Com	Station No. of Drivers Note: To change this parameter, you need to save it with the address “d5.00”, and restart driver later.	1
d5.02	2FE00010	RS232_Bandrate	Sets the baud rate of a serial port 540 19200 270 38400 90 115200 Note: To change this parameter, you need to save it with the address “d5.00”, and restart driver later.	270
d5.03	2FE10010	U2BRG	Sets the baud rate of the serial port 540 19200 270 38400 90 115200 You need not restart driver.	270
d5.04	60F70110	Chop_Resistor	Indicates the values of braking resistors	0
d5.05	60F70210	Chop_Power_Rated	Indicates the nominal power of a braking resistor	0
d5.06	60F70310	Chop_Filter	Indicates the time constant of a braking resistor Time: N*256/1000 Unit: S	60
d5.07	25010110	ADC_Shift_U	Indicates data configuration of U phase shift Note:Factory parameters	N/A
d5.08	25010210	ADC_Shift_V	Indicates data configuration of V phase shift Note:Factory parameters	N/A
d5.09	30000110	Voltage_200	ADC original data when DC bus voltage is 200 V Note:Factory parameters	N/A
d5.10	30000210	Voltage_360	ADC original data when DC bus voltage is 360 V Note:Factory parameters	N/A
d5.11	60F60610	Comm_Shift_UVW	Indicates the excitation pointer of a motor	N/A

			Note:Factory parameters	
d5.12	26000010	Error_Mask	Indicates error masks Note:Factory parameters	FFF.F
d5.13	60F70510	RELAY_Time	Indicates the relay operating time of capacitor short-circuits Unit: mS Note:Factory parameters	150
d5.14	2FF00408	Key_Address_F001	Sets numeric display data	N/A
d5.15	65100B10	RS232_Loop_Enable	0：1 to 1.　　1：1 to N	N/A
d5.16	2FFD0010	User_Secret	User password.16bits.	0～65535

Chapter 6 Operation on Input/Output Ports

KINCO CD servo driver has 7 digital input ports (a digital input port can receive high-level or low-level signals, depending on whether high-level or low-level signals are chosen at the COM terminal) and 5 digital output ports,OUT1-OUT4 ports can drive 100 mA load, and OUT5 port can drive 800 mA load, and can directly drive the internal contracting brake device(CD2 driver doesn't have OUT5.There are terminals BR+、BR-、24VB、GND in X2 port which are used for motor brake.It can drive 500mA load). You can freely configure all functions on digital input/output ports according to application requirements.

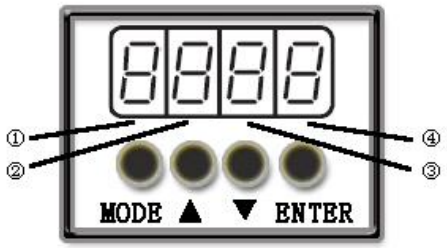
6.1 Digital Input Signals

6.1.1 Polarity Control on Digital Input Signals

Table 6-1: Simplified IO polarity setting variables

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.08	Dio_Polarity	Sets IO polarity	0	N/A

Table 6-2 Polarity setting methods for digital input signals



①	②	③	④
Input/output port selection 0: Output port 1: Input port	Channel selection Input: 1-7 Output: 1-5	Reserved	0: The input port is valid when no current passes the port, and the output port is valid when the switch tube is open.. 1: The input port is valid when the current passes the port, and the output port is valid when the switch tube is closed. Other: Check the current status

Example 6-1: Polarity Setting for Digital Input Signal DIN1

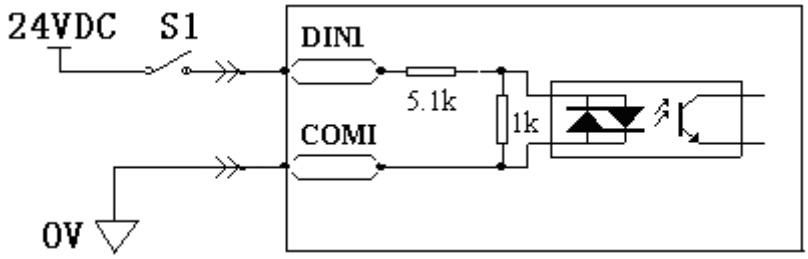


Fig. 6-1 Polarity setting for digital input signal DIN1

Table 6-3 Polarity setting for digital input signal DIN1

①	②	③	④
Input/output port selection Set to 1 (input port selected)	Channel selection Set to 1 (DIN 1 selected)	Reserved	0: D1N1 is enabled when S1 opens 1: D1N1 is enabled when S1 closes

Namely, if d3.08 is set to “110.0”, it indicates that DIN1 is enabled when no current passes the input port; if d3.08 is set to “110.1”, it indicates that DIN1 is enabled when any current passes the input port.

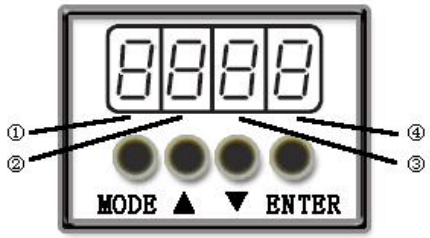
6.1.2 Simulation of Digital Input Signals

Table 6-4 IO simulation variable

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.09	Dio_Simulate	Simulates input signals, and enforces output signals for outputting	0	N/A

Dio_Simulate (IO simulation) is for the software to simulate inputting of a valid signal. “1” indicates that the input signal is valid, and “0” indicates that the input signal is invalid.

Table 6-5 Settings on simulation of digital input signals



①	②	③	④
Input/output port selection 0: output port 1: input port	Channel selection Input: 1-7 Output: 1-5	Reserved	0: No input signal is simulated, and no output signal is compulsorily outputted 1: Input signal is simulated, and output signal is outputted compulsorily Other: Check the current status

Example 6-2: Simulate digital input DIN1

Table 6-6: Simulate digital input DIN1

①	②	③	④
Input/output port selection Set to 1 (input port selected)	Channel selection Set to 1 (DIN 1 selected)	Reserved	0: Invalid DIN1 simulation 1: Valid DIN1 simulation

Namely, if d3.09 is set to “110.0”, it indicates that no DIN1 input signals are simulated; if d3.09 is set to “110.1”, it indicates that DIN1 input signals are simulated.

6.1.3 Status Display of Digital Input Signals

Table 6-7 Variables for status display of digital input signals

Numeric Display	Variable Name	Meaning
d1.11	Din_Status	Status of input ports

Din_Status (hexadecimal) is used to display the status of the actually input external signals in real time.

6.1.4 Addresses & Functions of Digital Input Signals

Table 6-8 Addresses & default functions of digital input signals

Numeric Display	Variable Name	Meaning	Default Value
d3.01	Din1_Function	000.1: Driver enable 000.2: Driver fault reset 000.4: Operation mode control 000.8: P control for velocity loop 001.0: Position positive limit 002.0: Position negative limit 004.0: Homing signal 008.0: Reverse speed demand 010.0: Internal speed control 0 020.0: Internal speed control 1 800.1: Internal speed control 2 040.0: Internal position control 0 080.0: Internal position control 1 800.2: Internal position control 2 800.4 Multi Din 0 800.8 Multi Din 1 801.0 Multi Din 2 802.0 Gain switch 0 804.0 Gain switch 1 100.0: Quick stop 200.0: Start homing	000.1 (Driver enable)
d3.02	Din2_Function		000.2 (Driver fault reset)
d3.03	Din3_Function		000.4 (Operation mode control)
d3.04	Din4_Function		000.8 (P control for velocity loop)
d3.05	Din5_Function		001.0 (Position positive limit)
d3.06	Din6_Function		002.0 (Position negative limit)
d3.07	Din7_Function		004.0 (Homing signal)

		400.0: Activate command	

Note:DinX_Function (X ranges from 1 to 7) is used to define the functions of digital input ports. User can freely define the functions of the digital input ports according to actual applications.

Table 6-9 Meaning of defined functions of digital input signals

Function	Meaning
Disable	Used to cancel the function of this digital input.
Driver enable	By default, the driver enable signal is valid, and the motor shaft is locked.
Driver fault reset	Signals on the rising edge are valid, and alarms are cleared.
Operation mode control	To switch between two operation modes. You can freely determine the operation modes corresponding to valid signals and invalid signals by performing settings through d3.16 Din_Mode0 (choose 0 for operation mode) of Group F003 and Din_Mode1 (choose 1 for operation mode) of Group F003.
P control for velocity loop	Indicates the control on stopping integration in velocity loop. The control is applied in the occasion where high-speed system stop occurs, but overshooting is not expected. Note: In the “-3” mode, if the signal is valid, fixed errors occur between the actual speed and target speed.
Position positive limit	Indicates the limit of forward running of motors (normally closed contact by default). By default, the driver regards position positive limits as valid, and polarity can be modified to adjust to normally open switches.
Position negative limit	Indicates the limit of inverted running of motors (normally closed contact by default). By default, the driver regards position negative limits as valid, and polarity can be modified to adjust to normally open switches.
Homing signal	To find origins of motors.
Reverse speed demand	To reverse the target speed in the speed mode ("-3" or “3”).
Internal speed control 0	To control internal multiple speeds. Note: For details, see Section 7.5 Internal Multi-Speed Control.
Internal speed control 1	
Internal speed control 2	
Internal position control 0	To control internal multiple positions. Note: For details, see Section 7.4 Internal Multi-Position Control.
Internal position control 1	
Internal position control 2	
Multi Din 0	To switch multiple electronic gear
Multi Din 1	
Multi Din 2	
Gain switch 0	To switch multiple gain parameters(P-gain of velocity loop,i-gain of velocity loop,p-gain of position loop)
Gain switch 1	
Quick stop	When the signal is valid, the motor shaft releases. After the signal is removed, the driver requires re-enabling.
Start homing	When the rising edge of the signal is detected,it will start homing command.

Activate command	When the rising edge of the signal is detected,it will activate the internal position control

Example 6-3: Driver Enable Setting

Requirement: The “driver enable” function is controlled through an external digital output port. In this example, the digital input port DIN1 is defined as the “driver enable” function. Table 6-10 shows the setup method.

Table 6-10 Digital Input Port DIN1 Defined as the “Driver Enable” Function

Numeric Display	Variable Name	Parameter Settings
d3.01	Din1_Function	Set to 000.1
d3.00	Store_Loop_Data	Set to 1

Note: Any digital output of DIN1-7 can be defined as “driver enable”, and is set to 000.1, that is, bit 0 is valid.

Requirement: Enable the function of automatically powering on the driver by setting internal parameters in drivers instead of external digital input ports. Table 6-11 describes the setup method.

Table 6-11 Enabling the function of automatically powering on the driver by setting internal parameters in drivers

Numeric Display	Variable Name	Parameter Settings
d3.01- d3.07	DinX_ Function (1~7)	None of the digital input port can be set to 000.1, that is, the Enable function is not controlled by any digital input port.
d3.10	Switch_On_Auto	Set to 1
d3.00	Store_Loop_Data	Set to 1

Example 6-4: Disabling Position Positive/Negative Limit Settings

When the driver is delivered, the DIN5 of the motor is the position positive limit and DIN6 is the position negative limit by default. If there are no external position positive/negative limit switches, this function must be disabled so that the servo driver can work properly. Table 6-12 describes the setup method.

Table 6-12: Disabling position positive/negative limit settings

Numeric Display	Variable Name	Parameter Settings
d3.05	Din5_Function	Change the default value 001.0 (position positive limit) to 000.0
d3.06	Din6_Function	Change the default value 002.0 (position negative limit) to 000.0
d3.00	Store_Loop_Data	Set to 1

Example 6-5: Operation Mode Control on Drivers

Requirements: Defines the input port DIN3 as the operation mode control on drivers, and the operation mode is “-4” (pulse control mode) when DIN3 fails, and is “-3” (instantaneous speed mode) when DIN3 is valid. Table 6-13 describes the setup method.

Table 6-13 Settings on operation mode control on drivers

Numeric Display	Variable Name	Parameter Settings
d3.03	Din3_Function	Set to 000.4
d3.16	Din_Mode0	Set to 0.004 (-4)
d3.17	Din_Mode1	Set to 0.003 (-3)
d3.00	Store_Loop_Data	Set to 1

Note: If the driver is required to operate in some mode with power on, one of the digital input must be set as function “Operation Mode Control”. Then you can set the operation modes that require in the parameters d3.16 or d3.37 in Group F003.

6.1.5 Wirings of Digital Input Port

1. NPN wiring diagram (to the controller that supports low level output)

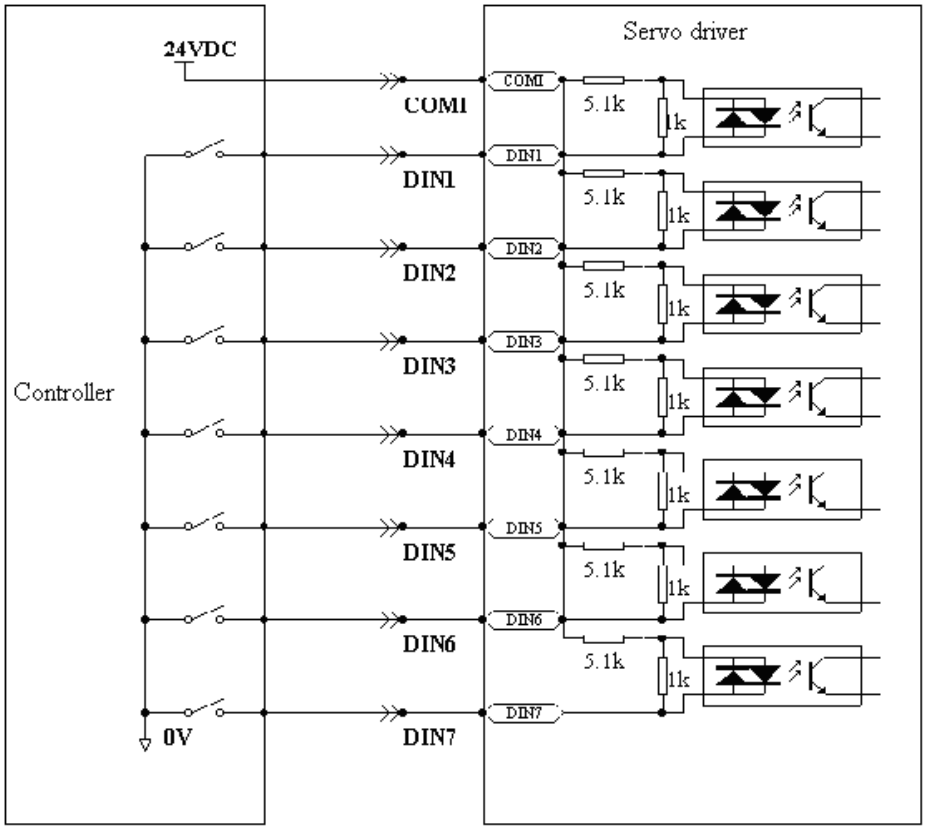


Fig. 6-2 NPN wiring diagram (to the controller that supports low level output)

2. PNP wiring diagram (to the controller that supports high level output)

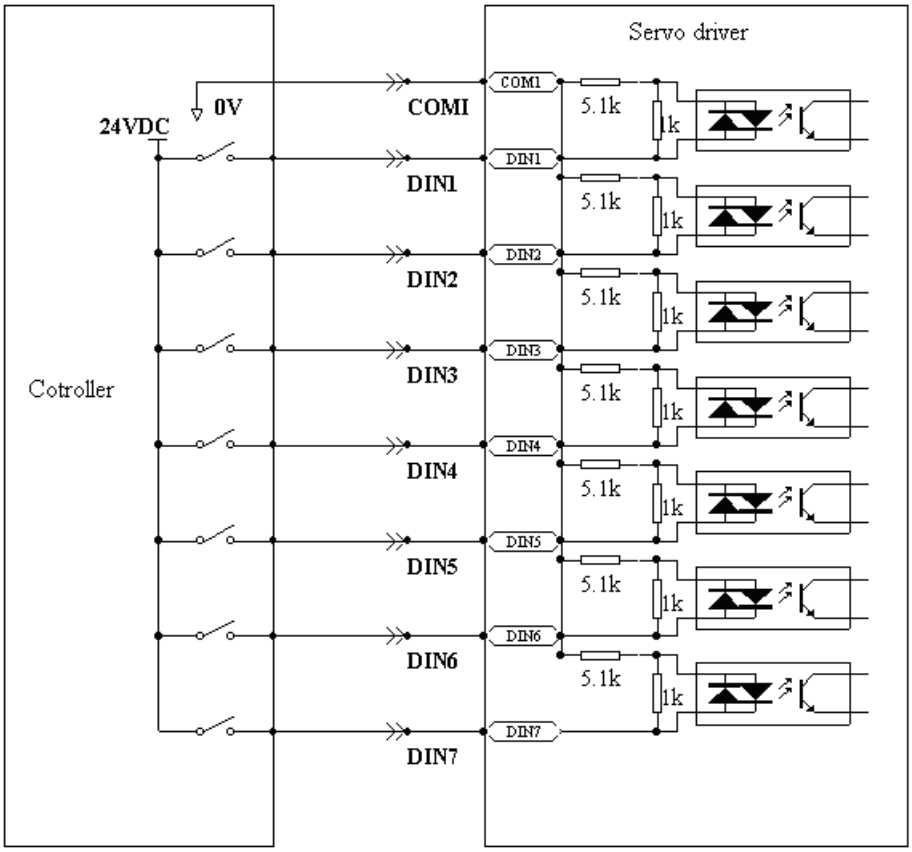


Fig. 6-3 PNP wiring diagram (to the controller that supports high level output)

6.2 Digital Output Signals

6.2.1 Polarity Control on Digital Output Signals

Table 6-14 Variables for setting simplified IO polarity

Numeric Display	**Variable Name**	**Meaning**	**Default Value**	**Range**
d3.08	Dio_Polarity	Sets IO polarity	0	N/A

Dio_Polarity (simplified IO polarity settings) is used to set the polarity of valid digital output signals. The number “1” indicates normally open, and “0” indicates normally close.Default is 1.

6.2.2 Simulation of Digital Output Signals

Table 6-15 IO simulation variables

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.09	Dio_Simulate	Simulates input signals, and the output signal is	0	N/A

		outputted compulsorily		

Dio_Simulate (IO simulation) is to simulate the output of a valid signal. The number “1” indicates that the output signal is valid, and “0” indicates that the output signal is invalid.

6.2.3 Status Display of Digital Output Signals

Table 6-16 Variables for status display of digital output signals

Numeric Display	Variable Name	Meaning
d1.12	Dout_Status	Status of an output port

Din_Status (hexadecimal) displays the status of actual external output signals in real time.

6.2.4 Addresses and Functions of Digital Output Signals

Table 6-17 Addresses and default functions of digital output signals

Numeric Display	Variable Name	Meaning	Default Value
d3.11	Dout1_Function	000.1: Ready 000.2: Error 000.4: Position reached 000.8: Zero velocity 001.0: Motor brake 002.0:Velocity reached 004.0: Index 008.0: The maximum speed obtained in the torque mode 010.0: PWM ON 020.0: Position limiting 040.0: Reference found 080.0: Reserved 100.0: Multi Dout 0 200.0: Multi Dout 1 400.0: Multi Dout 2	000.1 (Ready)
d3.12	Dout2_Function		000.2 (Error)
d3.13	Dout3_Function		00a.4 (Position reached/Velocity reached/Max. velocity limit)
d3.14	Dout4_Function		000.8 (Zero velocity)
d3.15	Dout5_Function		001.0 (Motor brake)

DinX_Function (X ranges from 1 to 5) is used to define the functions of digital output ports. User can freely define the functions of digital output ports according to actual applications.

Table 6-18 Meanings of the functions defined by digital output signals

Function	**Meaning**
Disable	Cancel the function of this digital output
Ready	The driver is ready for operation.
Error	Alarm signals are output, indicating that the driver is faulty.
Position reached	In the “-4” mode of pulse control, the target position data keeps unchanged in the window (d3.39) of the time of reaching the target position, and position errors are within the window of

	reaching the target position.
Zero velocity	After the motor is enabled, it is outputted when the motor speed is 0.
Motor brake	The driver enables the motor, and contracting brake output is valid.
Velocity reached	In the “-3” or "3” internal speed control mode, signals are output after they reach the target speed.
Index	Z phase signal output (the speed should not be too high).
Max. velocity limit	In the “4” analog – torque mode, signals are output after the max restricted speed is reached.
PWM ON	The driver enables the motor.
Motor limiting	Motor is in the status of position limiting.
Reference found	Homing is finished.
Multi Dout 0	Position reach for internal multiple position mode.
Multi Dout 1	
Multi Dout 2	

Example 6-6: “Ready” settings

Requirement: The digital output port 1 is defined as the “Ready” function. For details on settings, see Table 6-19.

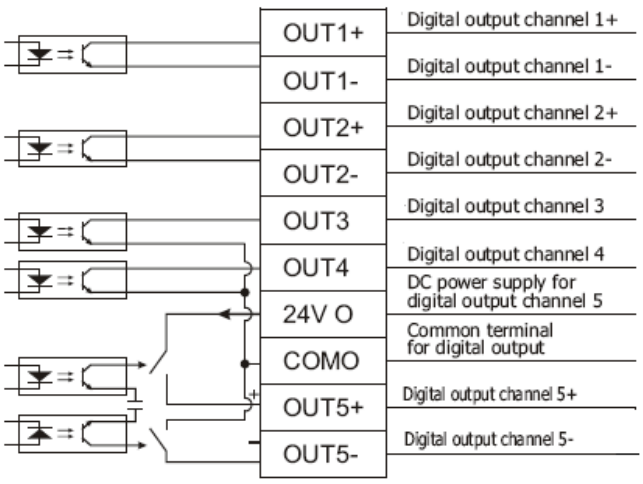
Table 6-19: “Ready” settings

Numeric Display	Variable Name	Parameter Settings
d3.11	Dout1_Function	Set to 000.1
d3.00	Store_Loop_Data	Set to 1

6.2.5 Wiring of Digital Output Port

1. Internal circuit diagram of digital output ports

(1)CD Servo



(2) CD2 Servo

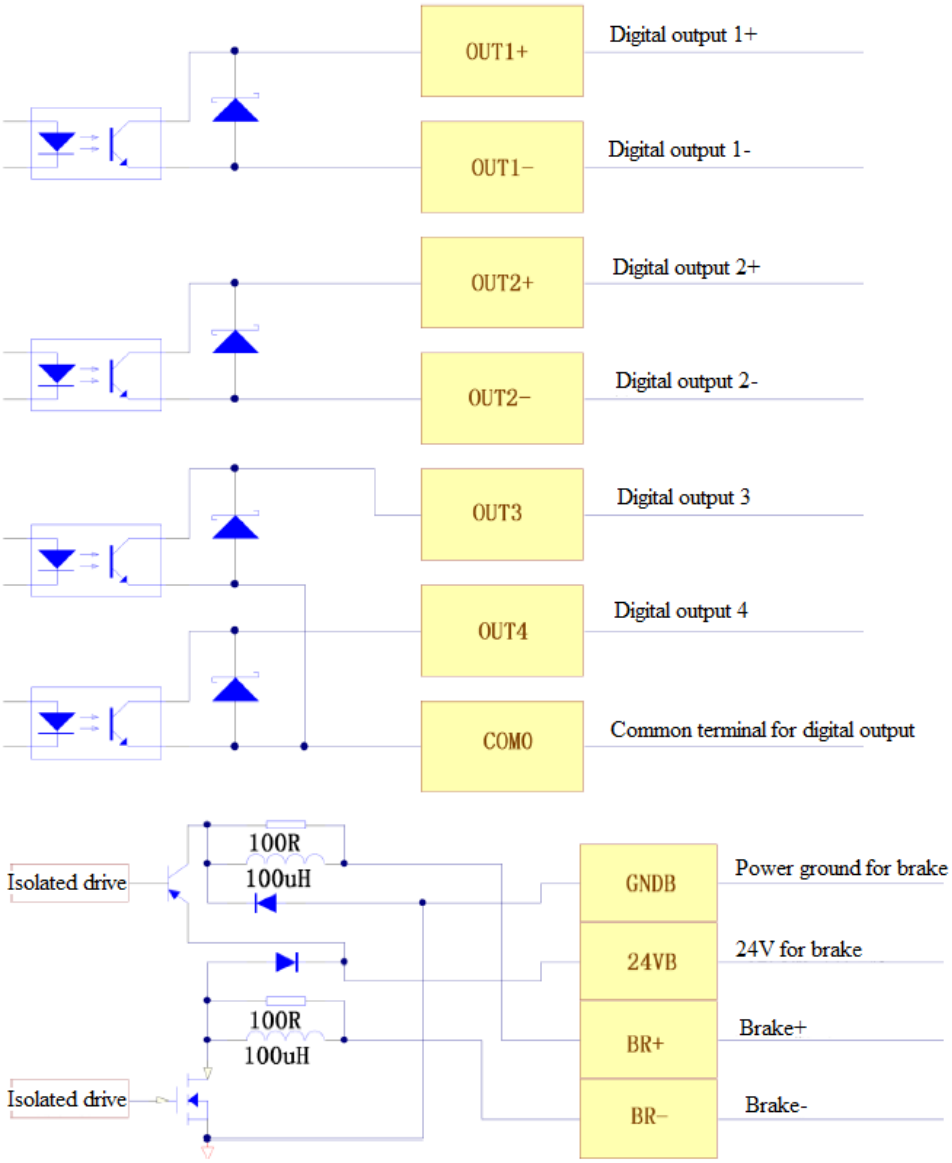


Fig. 6-4 Internal circuit diagram of digital output ports

Note: To apply the OUT3 or OUT4 port, the COMO port must be connected. To apply the OUT5 port, both the 24VO and COMO ports must connect to the external input power.(CD2 driver don't have OUT5,it uses BR+、BR-、24VB、GNDB for motor brake)

2. NPN wiring (to controllers that support valid low level input)

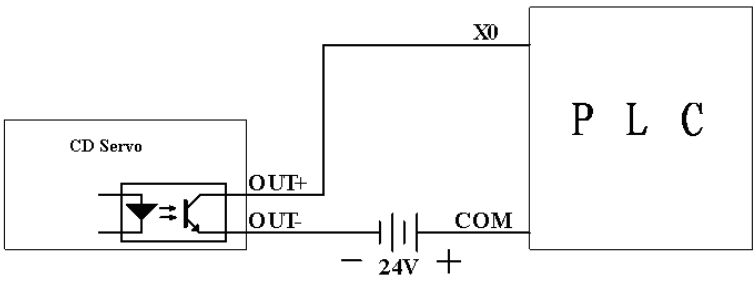


Fig. 6-5 NPN wiring diagram (to controllers that support valid low level input)

3. PNP wiring (to controllers that support valid low level input)

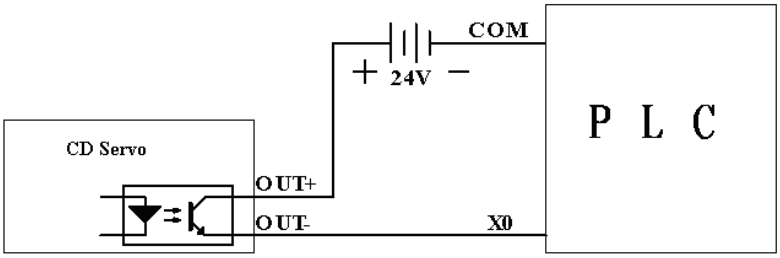
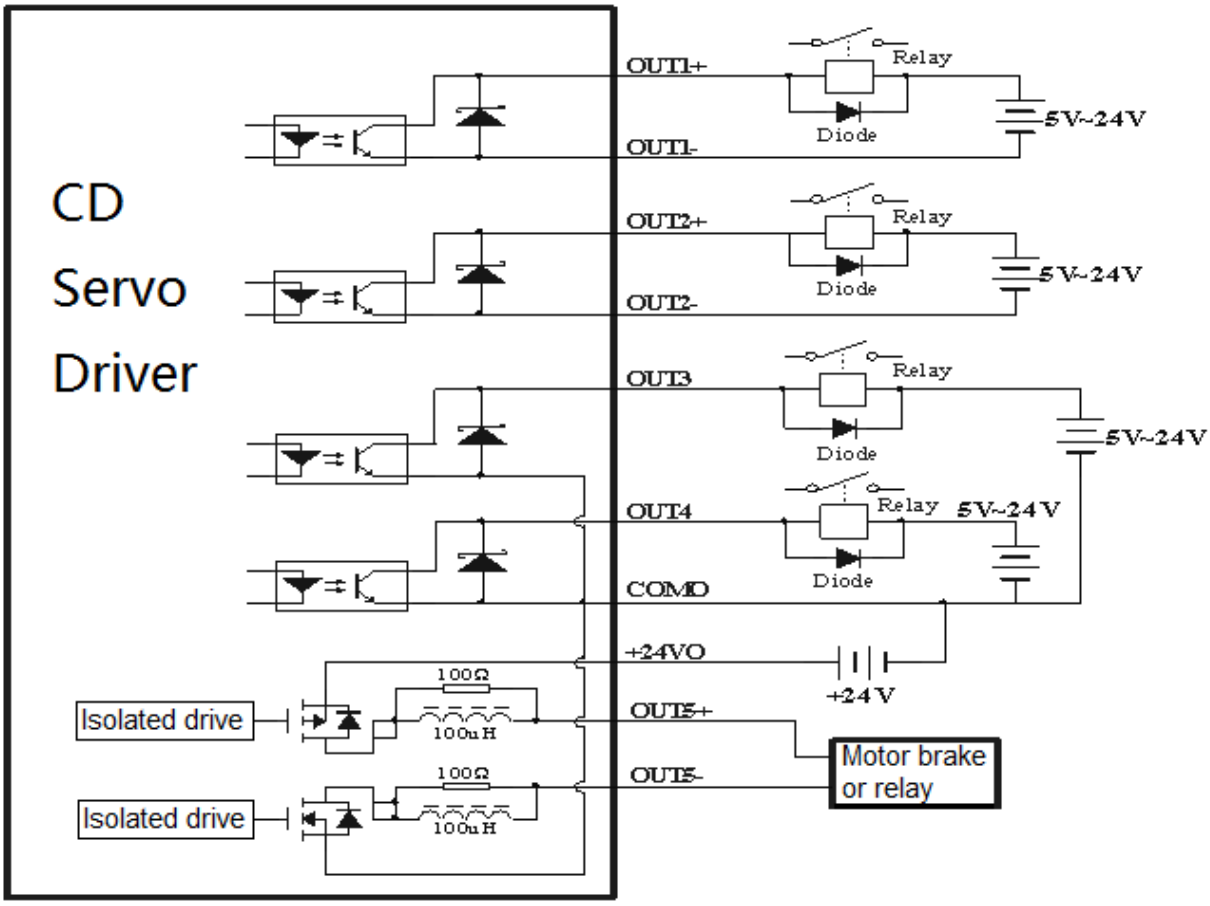


Fig. 6-6 PNP wiring diagram (to controllers that support valid low level input)

4. To connect a relay to the digital output port, do remember to connect a diode in inverse parallel, as shown in Fig. 6-7.



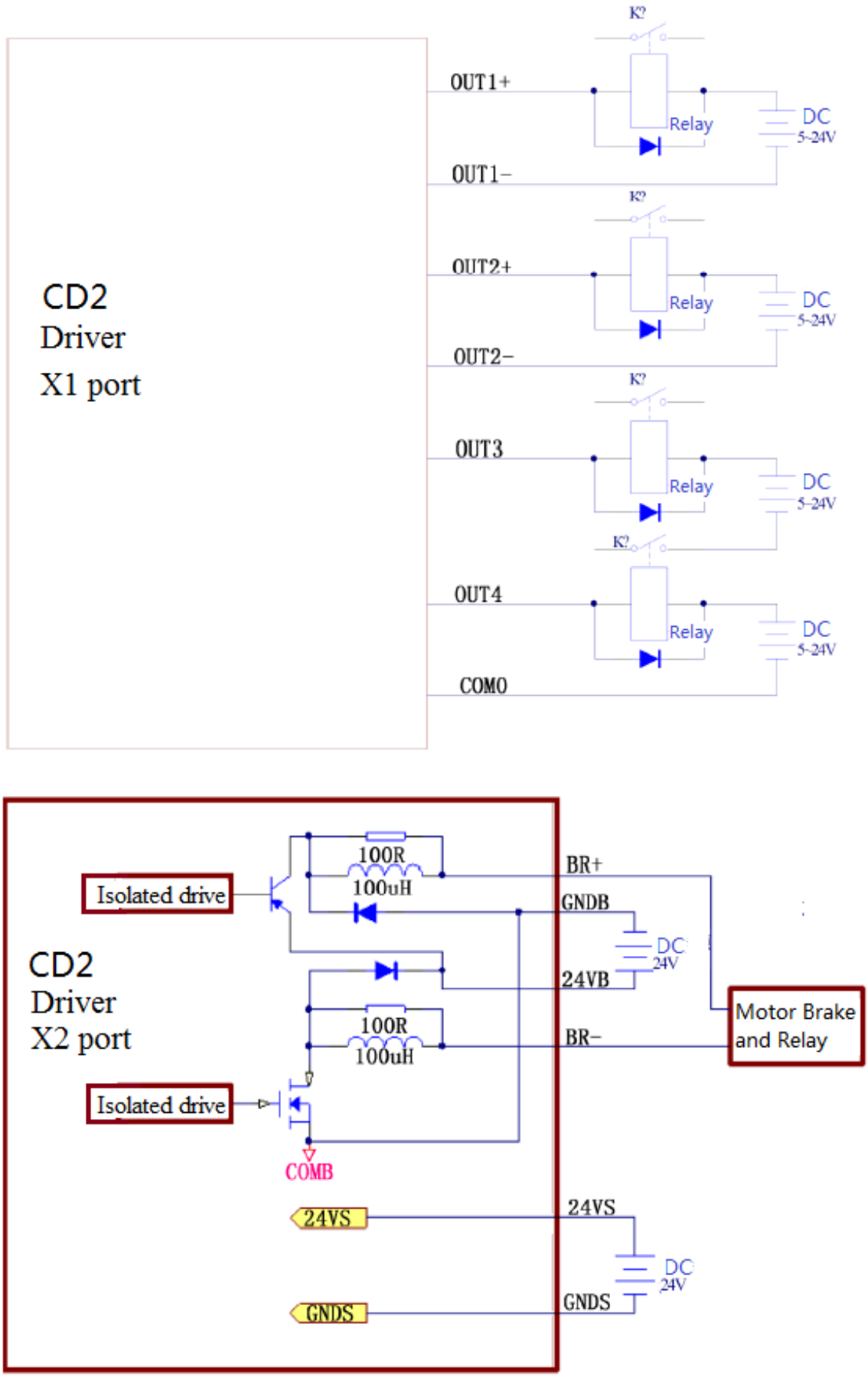


Fig. 6-7 Connect a relay to the digital output port

Chapter 7 Mode Operation

7.1 Pulse Control Mode (“-4” Mode)

7.1.1 Wiring in Pulse Control Mode

1. Wiring diagram of CD2 driver in pulse control mode

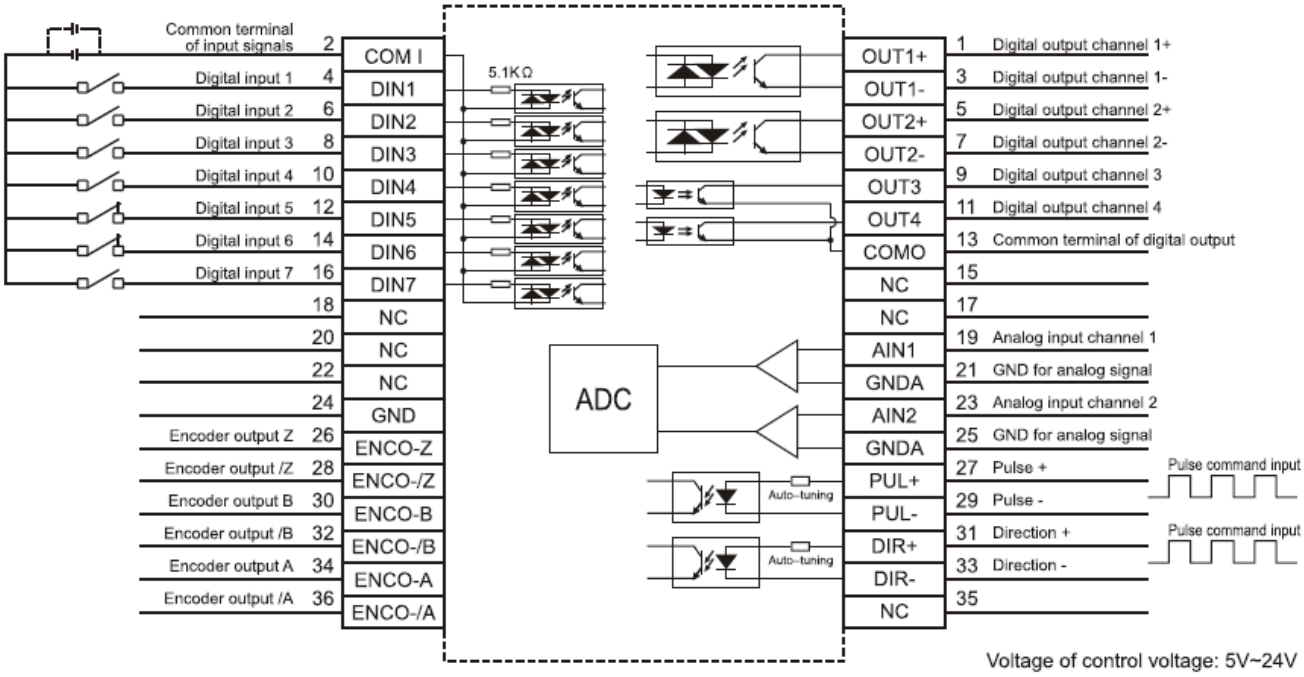


Fig. 7-1 Wiring diagram of CD2 driver in pulse control mode

2.Wiring diagram of CD driver in pulse control mode

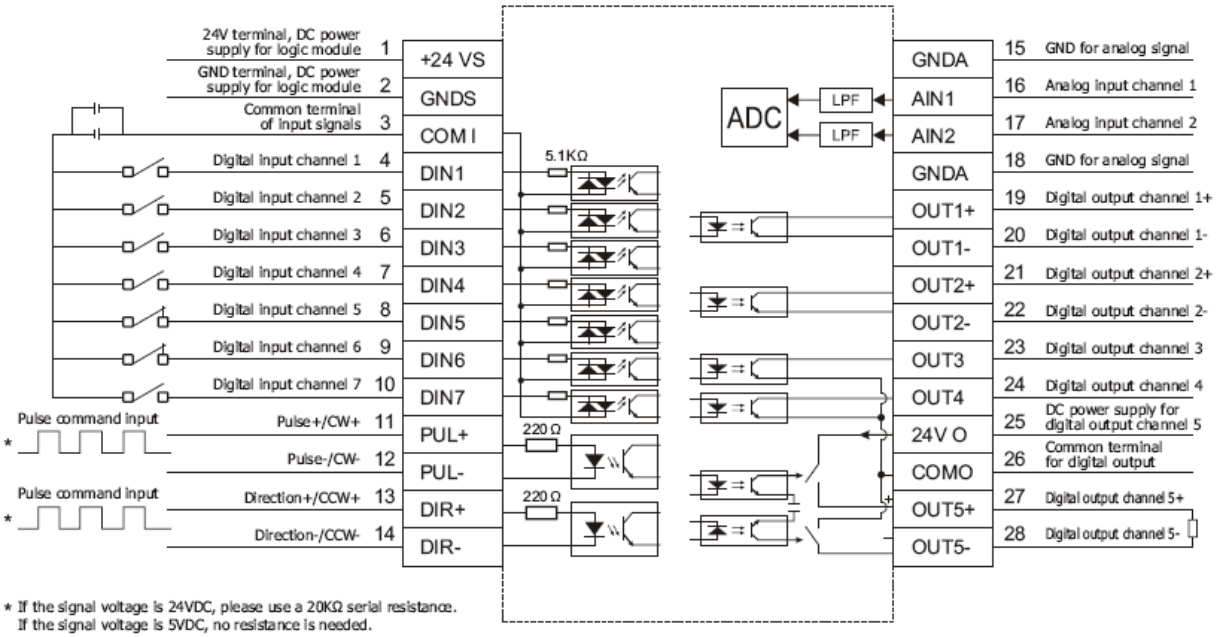


Fig. 7-2 Wiring diagram of CD driver in pulse control mode

3.Common anode connection (to controllers that support valid low level output)

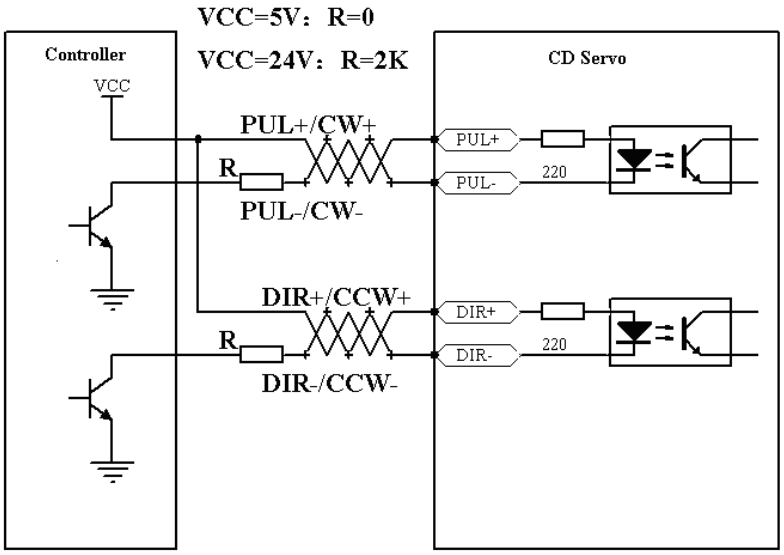


Fig. 7-3 Common anode connection (to controllers that support valid low level output)

Note:CD2 driver can support 5-24VDC input,so it needn't add resistors.

CD driver only support 5VDC input,so it needs to add resistors when using 24VDC input.

4. Common cathode connection (to controllers that support valid high level output)

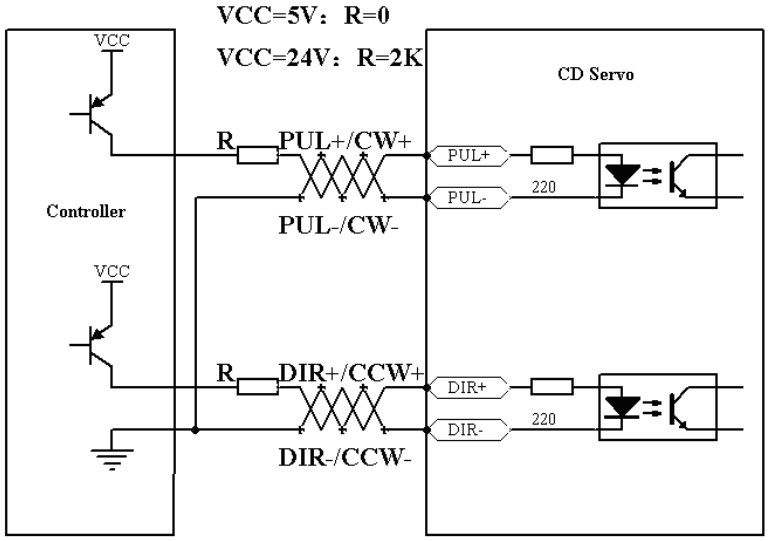


Fig. 7-4 Common cathode connection (to controllers that support valid high level output)

Note:CD2 driver can support 5-24VDC input,so it needn't add resistors.

CD driver only support 5VDC input,so it needs to add resistors when using 24VDC input.

7.1.2 Parameters for Pulse Control Mode

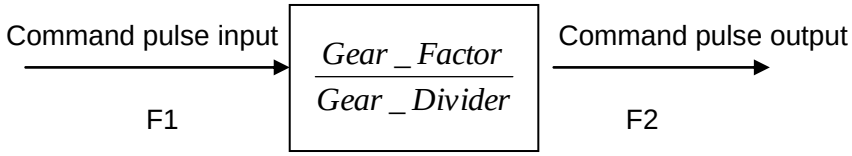
1. Parameters for electronic gear ratio

Table 7-1 Parameters for electronic gear ratio

Numeric Display	Variable Name	Meaning	Default Value	Range

d3.34	Gear_Factor	Numerator of electronic gear 0 in mode -4	1000	-32767~32767
d3.35	Gear_Divider	Denominator of electronic gear 0 in mode -4	1000	1~32767

Parameters for electronic gear ratio are used to set the numerator and denominator of electronic gears when the driver operates in mode -4.



Namely: F2= $\frac{Gear\_Factor}{Gear\_Divider}$ * F1

If the electronic gear ratio is 1:1, 10000 pulses are inputted externally (the resolution of encoders is 2500 PPR, quadruple), and the motor turns a circle. If the electronic gear ratio is 2:1, 10000 pulses are inputted externally, and the motor turns two circles.

Multi electronic gears can be defined by DDIN with function “Multi DinX” as shown in following table.

Multi Din 2	Multi Din 1	Multi Din 0	Descriptions	Parameter	
				Name	Address
0	0	0	Electronic gear 0	Gear_Factor 0	25080110
				Gear_Divider 0	25080210
0	0	1	Electronic gear 1	Gear_Factor 1	25090110
				Gear_Divider 1	25090210
0	1	0	Electronic gear 2	Gear_Factor 2	25090310
				Gear_Divider 2	25090410
0	1	1	Electronic gear 3	Gear_Factor 3	25090510
				Gear_Divider 3	25090610
1	0	0	Electronic gear 4	Gear_Factor 4	25090710
				Gear_Divider 4	25090810
1	0	1	Electronic gear 5	Gear_Factor 5	25090910
				Gear_Divider 5	25090A10
1	1	0	Electronic gear 6	Gear_Factor 6	25090B10
				Gear_Divider 6	25090C10
1	1	1	Electronic gear 7	Gear_Factor 7	25090D10
				Gear_Divider 7	25090E10

The default value of Gear_Factor and Gear_Divider are 1000.

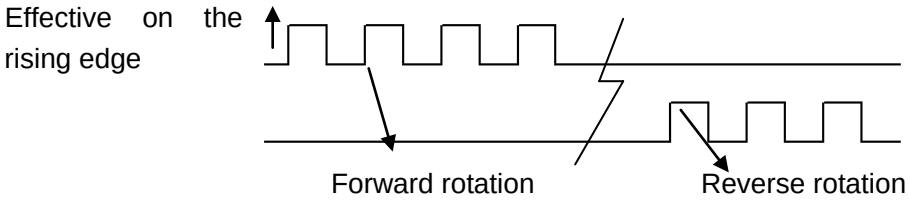
2. Parameters for pulse mode selection

Table 7-2 Parameters for pulse mode selection

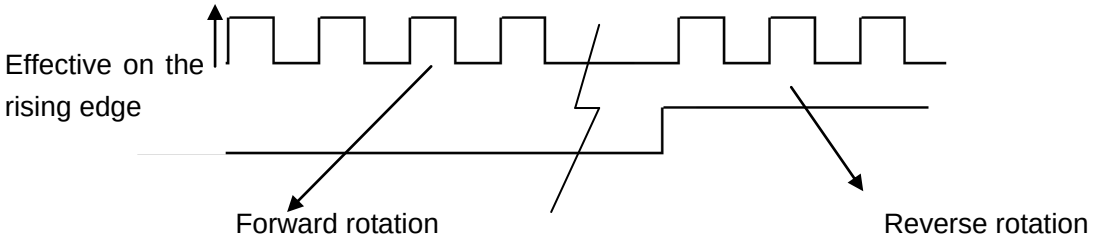
Numeric Display	Variable Name	Meaning	Default Value	Range
d3.36	PD_CW	0: Double pulse (CW/CCW) mode 1. Pulse direction (P/D) mode 2. Incremental encoder mode Note: To change this parameter, you need to save it with d3.00, and restarts it later.	1	N/A

Note: AB phase signals are not supported.

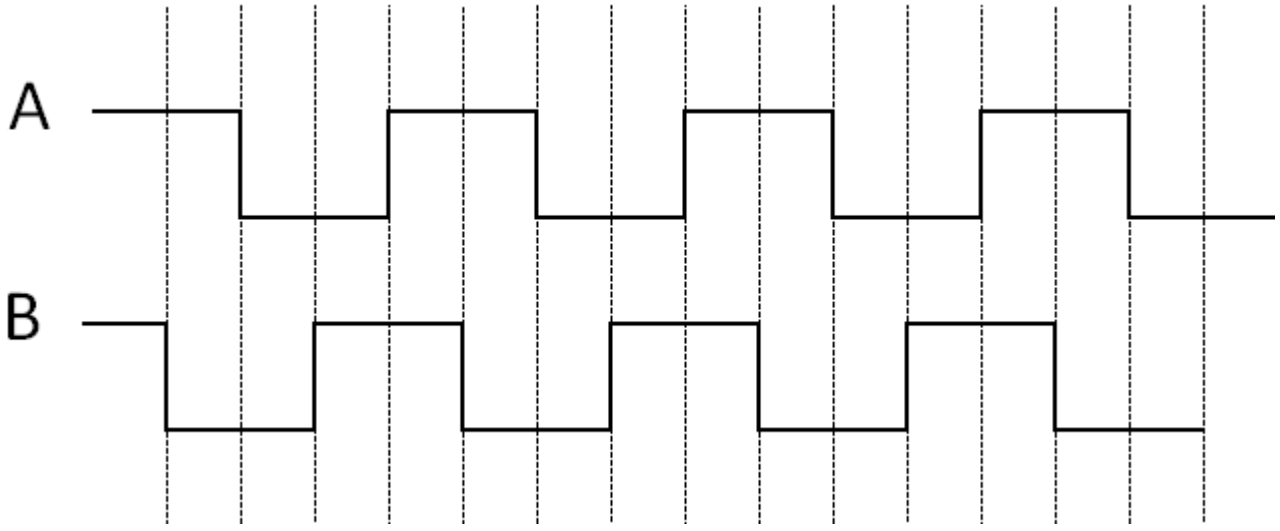
Double pulse (CW/CCW) mode (d3.36 = 0)



Pulse direction (P/D) mode (d3.36 = 1)



Incremental encoder mode (d3.36=2)



3. Parameters for pulse filtering coefficient

Table 7-3 Parameters for pulse filtering coefficient

Numeric Display	**Variable Name**	**Meaning**	**Default Value**	**Range**
d3.37	PD_Filter	Used to smooth the input pulses. Filter frequency: f = 1000/(2π* PD_Filter) Time constant: T = PD_Filter/1000 Unit: S Note: If you adjust this parameter during the operation, some pulses may be lost.	3	1~32767

When a driver operates in the pulse control mode, if the electronic gear ratio is set too high, it is required to adjust this parameter to reduce motor oscillation; however, if the parameter adjustment is too great, motor running instructions will become slower.

4. Parameters for pulse frequency control

Table 7-4 Parameters for pulse frequency control

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.38	Frequency_Check	Indicates the limitation on pulse input frequency (kHz)	600	0~600

5. Parameters for gain control on position loops and velocity loops

Current loops are related to motor parameters (optimal parameters of the selected motor are default for the driver and no adjusting is required).

Parameters for velocity loops and position loops should be adjusted properly according to loading conditions.

During adjustment of the control loop, ensure that the bandwidth of the velocity loop is at least twice of that of the position loop; otherwise oscillation may occur.

Table 7-5 Parameters for gain control on position loops

Numeric Display	Variable Name	Meaning	Default Value	Range
d2.07	Kpp	Indicates the proportional gain Kpp 0 of the position loop	1000	0~16384
d2.08	K_Velocity_FF	0 indicates no feedforward, and 256 indicates 100% feedforward	256	0~256
d2.09	K_Acc_FF	The value is inversely proportional to the feedforward	32767	32767~10
d0.05	Pc_Loop_BW	Sets the bandwidth of the position loop in Hz.	0	/
d2.26	Pos_Filter_N	Average filter parameter	1	/

Proportional gains of the position loop Kpp: If the proportional gain of the position loops increases, the bandwidth of the position loop is improved, thus reducing both the positioning time and following errors. However, too great bandwidth may cause noise or even oscillation. Therefore, this parameter must be set properly according to loading conditions. In the formula Kpp=103* Pc_Loop_BW,Pc_Loop_BW indicates the bandwidth of the position loop. The bandwidth of a position loop is less than or equal to that of a velocity loop. It is recommended that Pc_Loop_BW be less than Vc_Loop_BW /4 (Vc_Loop_BW indicates the bandwidth of a velocity loop).

Velocity feedforward of the position loop K_Velocity_FF : the velocity feedforward of a position loop can be increased to reduce position following errors. When position signals are not smooth, if the velocity feedforward of a position loop is reduced, motor oscillation during running can be reduced. Acceleration feedback of the position loop K_Acc_FF (adjustment is not recommended for this parameter): If great gains of position loops are required, the acceleration feedback K_Acc_FF can be properly adjusted to improve performance.

$$\mathrm{K\_Acc\_FF} = \frac{I_p * K_t * Encoder\_R}{250000 * \sqrt{2} * J_t * \pi}$$ Note: K_Acc_FF is inversely proportional to the acceleration feedforward.

Table 7-6 Parameters for gain control on position loops

Numeric Display	Variable Name	Meaning	Default Value	Range
d2.01	Kvp	Sets the response speed of a velocity loop	100	0~32767
d2.02	Kvi	Adjusts speed control so that the time of minor errors is compensated	2	0~16384
d2.05	Speed_Fb_N	You can reduce the noise during motor operation by reducing the feedback bandwidth of velocity loops (smoothing feedback signals of encoders). When the set bandwidth becomes smaller, the motor responds slower. The formula is F=Speed_Fb_N*20+100. For example, to set the filter bandwidth to "F = 500 Hz", the parameter should be set to 20.	45	0~45

Proportional gain of velocity loop Kvp: If the proportional gain of the velocity loop increases, the responsive bandwidth of the velocity loop also increases. The bandwidth of the velocity loop is directly proportional to the speed of response. Motor noise also increases when the velocity loop gain increases. If the gain is too great, system oscillation may occur.

Integral gain of velocity loop Kvi: If the integral gain of the velocity loop increases, the low-frequency intensity is improved, and the time for steady state adjustment is reduced; however, if the integral gain is too great, system oscillation may occur.

Multiple gains can be defined by DIN with the function “Gain Switch 0” and “Gain Switch 1” as shown in following table.

Gain Switch 1	Gain Switch 0	Descriptions	Parameters	
			Name	Address
0	0	Gain 0	Kvp of Gain 0	60F90110
			Kvi of Gain 0	60F90210
			Kpp of Gain 0	60FB0110
0	1	Gain 1	Kvp of Gain 1	23400410
			Kvi of Gain 1	23400510

			Kpp of Gain 1	23400610
1	0	Gain 2	Kvp of Gain 2	23400710
			Kvi of Gain 2	23400810
			Kpp of Gain 2	23400910
1	1	Gain 3	Kvp of Gain 3	23400A10
			Kvi of Gain 3	23400B10
			Kpp of Gain 3	23400C10

If DIN is defined as “Gain Switch” function,then the parameter “PI_Switch” will disable.
Parameter “PI_Point”(60F92808) is used to display the current gain.
Auto-tuning can only be used to set Gain 0.
Vc_Loop_BW and Pc_Loop_BW are only corresponding to Gain 0.Other Gain needs to set by manual.
“PI_Switch” is used to switch Gain 0 and Gain 1.In mode -4,1 and 3,it will use Gain 1 when “Position reached” signal is valid,and use Gain 0 when “Position reached” signal is invalid.

7.1.3 Examples of Pulse Control Mode

In the pulse control mode, follow the steps below to configure a driver:
Step 1: Confirm whether the functions of the driver require enabling through external digital input ports. To enable the driver through external digital input ports, see Table 6-12 in Example 6-3 for settings. If it is not necessary to enable the driver through external digital input ports, you can disable the enabling control function of external digital input ports by referring to Table 6-13 of Example 6-3, and enable the driver by setting its internal parameters.
Step 2: Confirm whether limit switches are required. By default, the driver operates in the limit status after being powered on. In this case, the numeric display has limit status display. If there is no limit switches, please disable the function of limit switches by referring to Example 6-4.
Step 3: Confirm mode switching bits and operation modes by referring to the settings in Example 6-5. The factory default settings of the driver are as follows: When no signal is inputted on DIN3, the driver operates in the “-4” mode (pulse control mode).
Step 4: After function configuration on digital input ports, it is required to set parameters such as pulse modes and electronic gear ratio.
Step 5: Save parameters.

Example 7-1: Pulse control mode “-4” – enable the driver through external digital input

Requirement: DIN1 is used for enabling the driver, DIN2 is used for error resetting, and DIN3 controls the operation modes of the driver (the mode is “-4” when no signal is inputted, and the mode is “-3” when signal is inputted). Limit switches are unavailable. The pulse form is pulse/direction, and the electronic rear ratio is 2:1. Table 7-7 describes the setup method.
Table 7-7: Pulse control mode “-4” – enable the driver through external digital input

Numeric Display	Variable Name	Meaning	Parameter Settings
d3.01	Din1_Function	Defines the functions of digital input port 1	000.1 (Driver enable)
d3.02	Din2_Function	Defines the functions of digital input port 2	000.2 (Fault reset)
d3.03	Din3_Function	Defines the functions of digital input port 3	000.4 (Operation mode control)
d3.05	Din5_Function	Defines the functions of digital input port 5	The default value 001.0 changes to 000.0 (position positive limits are disabled)
d3.06	Din6_Function	Defines the functions of digital input port 6	The default value 002.0 changes to 000.0 (position negative limits are disabled)
d3.16	Din_Mode0	Select this operation mode when input signals are invalid	Set to 0.004 (-4) mode (pulse control mode)
d3.17	Din_Mode1	Select this operation mode when input signals are valid	Set to 0.003 (-3) mode (instantaneous speed mode)
d3.34	Gear_Factor	Indicates the numerator to set electronic gears in the “-4” operation mode (pulse control mode)	Set to 2000
d3.35	Gear_Divider	Indicates the denominator to set electronic gears in the “-4” operation mode (pulse control mode)	Set to 1000
d3.36	PD_CW	0: Double pulse (CW/CCW) mode 1. Pulse direction (P/D) mode Note: To change this parameter, you need to save it with the address “d3.00”, and restarts it later.	Default value is 1 (pulse direction)
d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

Example 7-2 Pulse control mode “-4” – enable the driver automatically after driver power on

Requirement: The auto power-on function of the driver is enabled, DIN2 is used for error resetting, and DIN3 controls the operation modes of a driver (the mode is “-4” when no signal is inputted, and the mode is “3” when signal is inputted). Limit switches are unavailable. The pulse form is pulse/direction, and the electronic rear ratio is 1:2. Table 7-8 describes the setup method.

Table 7-8 Pulse control mode “-4” – enable driver automatically after driver power on

Numeric Display	Variable Name	Meaning	Parameter Settings

d3.01- d3.07	DinX_ Function (1~7)	Defines the functions of digital input ports 1-7	None of the digital input port can be set to 000.1, that is, the Enable function is not controlled by any digital input port.
d3.02	Din2_Function	Defines the functions of digital input port 2	000.2 (Error resetting)
d3.03	Din3_Function	Defines the functions of digital input port 3	000.4 (Control on operation modes for the driver)
d3.05	Din5_Function	Defines the functions of digital input port 5	The default value 001.0 changes to 000.0 (position positive limits are disabled)
d3.06	Din6_Function	Defines the functions of digital input port 6	The default value 002.0 changes to 000.0 (position negative limits are disabled)
d3.10	Switch_On_Auto	0: No control 1:Automatically locks the motor when the driver is powered on	Set to 1
d3.16	Din_Mode0	Select this operation mode when input signals are invalid	Set to 0.004 (-4) mode (pulse control mode)
d3.17	Din_Mode1	Select this operation mode when input signals are valid	Set to 0.003 (-3) mode (instantaneous speed mode)
d3.34	Gear_Factor	Indicates the numerator to set electronic gears in the “-4” operation mode (pulse control mode)	Set to 1000
d3.35	Gear_Divider	Indicates the denominator to set electronic gears in the “-4” operation mode (pulse control mode)	Set to 2000
d3.36	PD_CW	0: Double pulse (CW/CCW) mode 1. Pulse direction (P/D) mode Note: To change this parameter, you need to save it with the address “d3.00”, and restarts it later.	Default value is 1 (pulse direction)
d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

7.2 Speed Mode (“-3” or “3” Mode)

In the instantaneous speed mode (“-3” mode), the actual speed reaches the target speed instantly. As a contrast, in the speed mode with acceleration/deceleration (“3” mode), the actual speed gradually increases until it reaches the target speed. Both the acceleration and deceleration (trapeziform shape) are configured respectively by d2.10 and d2.11. In the “3" mode, you can set Kpp to enable/disable position loops. If a position loop is enabled, speed oscillation is less than that when the loop is disabled. If Kpp is 0, it indicates that the position loop is closed.

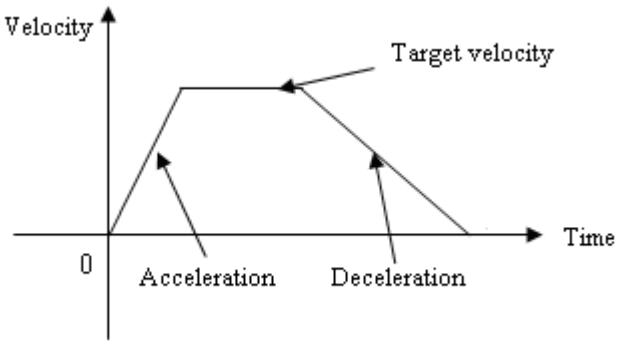


Fig. 7-5 The speed mode “3” with acceleration/deceleration

7.2.1 Wiring in Analog – Speed Mode

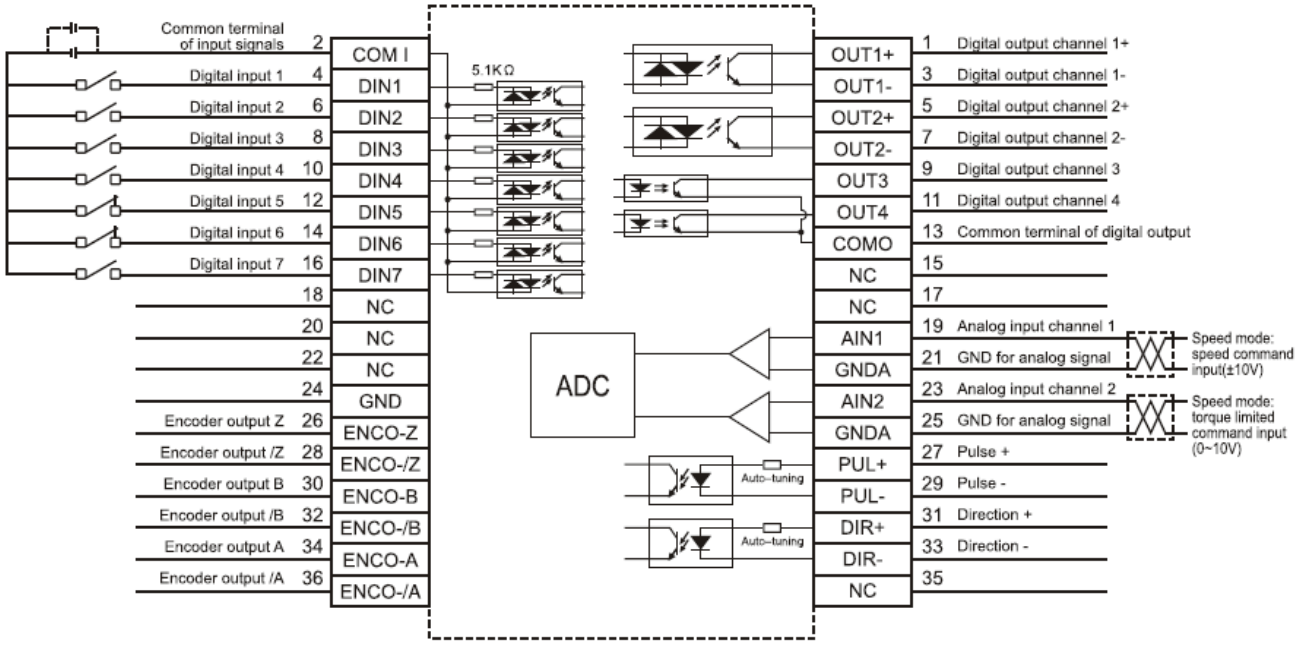


Fig. 7-6 Wiring diagram of CD2 Servo in analog–speed mode

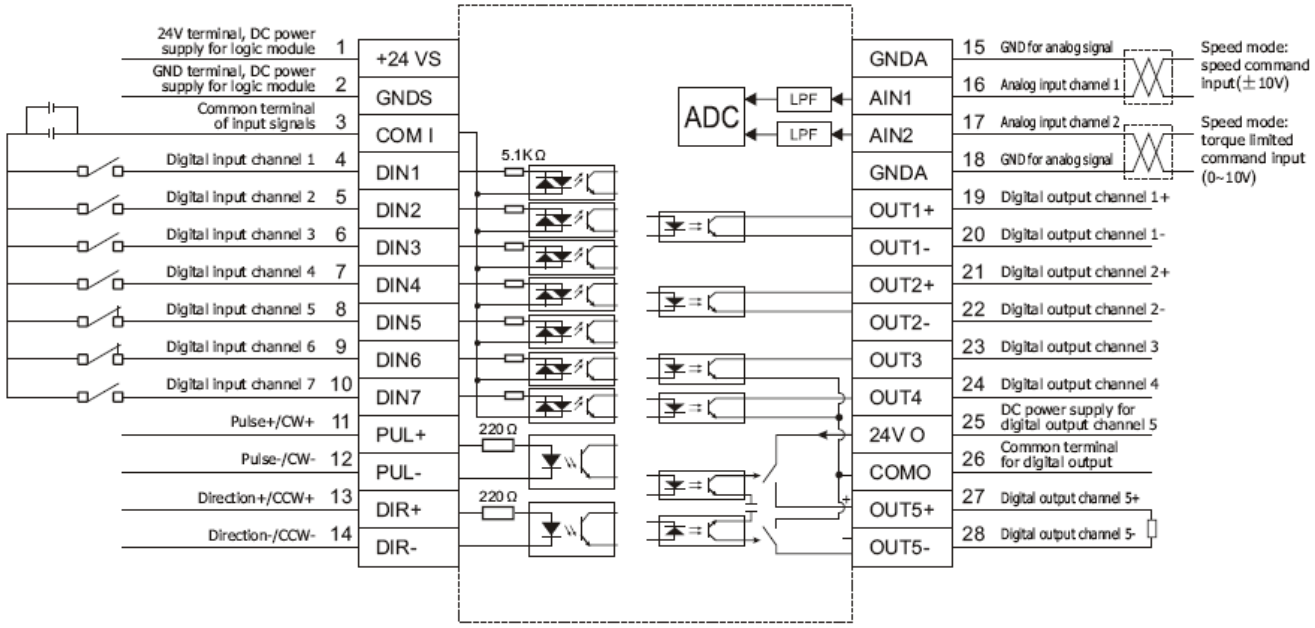


Fig. 7-7 Wiring diagram of CD Servo in analog–speed mode

7.2.2 Parameters for Analog – Speed Mode

Table 7-9 Parameters for analog – speed mode

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.22	Analog1_Filter	Used to smooth the input analog signals. Filter frequency: f=4000/(2π* Analog1_Filter) Time Constant (T) = Analog1_Filter/4000 (S)	5	1~127
d3.23	Analog1_Dead	Sets dead zone data for external analog signal 1	0	0~8192
d3.24	Analog1_Offset	Sets offset data for external analog signal 1	0	-8192~8192
d3.25	Analog2_Filter	Used to smooth the input analog signals. Filter frequency: f=4000/(2π* Analog1_Filter) Time Constant (T) = Analog2_Filter/4000 (S)	5	1~127
d3.26	Analog2_Dead	Sets dead zone data for external analog signal 2	0	0~8192
d3.27	Analog2_Offset	Sets offset data for external analog signal 2	0	-8192~8192
d3.28	Analog_Speed_Con	Chooses analog-speed channels 0: Invalid analog channel 1: Valid analog channel 1 (AIN1) 2: Valid analog channel 2 (AIN2)	0	N/A

		10～17：AIN1 for “Din_Speed (X-10)” 20～27：AIN2 for “Din_Speed (X-20)” Valid in mode -3, 3 and 1.		
d3.29	Analog_Speed_Factor	Sets the proportion between analog signals and output speed	1000	N/A
d3.32	Analog_MaxT_Con	0: No control 1: Max torque that Ain1 can control 2: Max torque that Ain2 can control	0	N/A
d3.33	Analog_MaxT_Factor	Indicates the max torque factor for analog signal control	8192	N/A

When d3.28 is 1 or 2,mode 1 is invalid,mode 3 and -3 are valid.
When d3.28 is 10~17 or 20~27,mode 1,3 and -3 are valid.
When d3.28 is 10~17(AIN1 for “Din_Speed (X-10)”),the corresponding speed is as following table.

10	11	12	13	14	15	16	17
Din_Speed 0	Din_Speed 1	Din_Speed 2	Din_Speed 3	Din_Speed 4	Din_Speed 5	Din_Speed 6	Din_Speed 7

When d3.28 is 20~27(AIN1 for “Din_Speed (X-10)”),the corresponding speed is as following table.

20	21	22	23	24	25	26	27
Din_Speed 0	Din_Speed 1	Din_Speed 2	Din_Speed 3	Din_Speed 4	Din_Speed 5	Din_Speed 6	Din_Speed 7

7.2.3 Analog Signal Processing

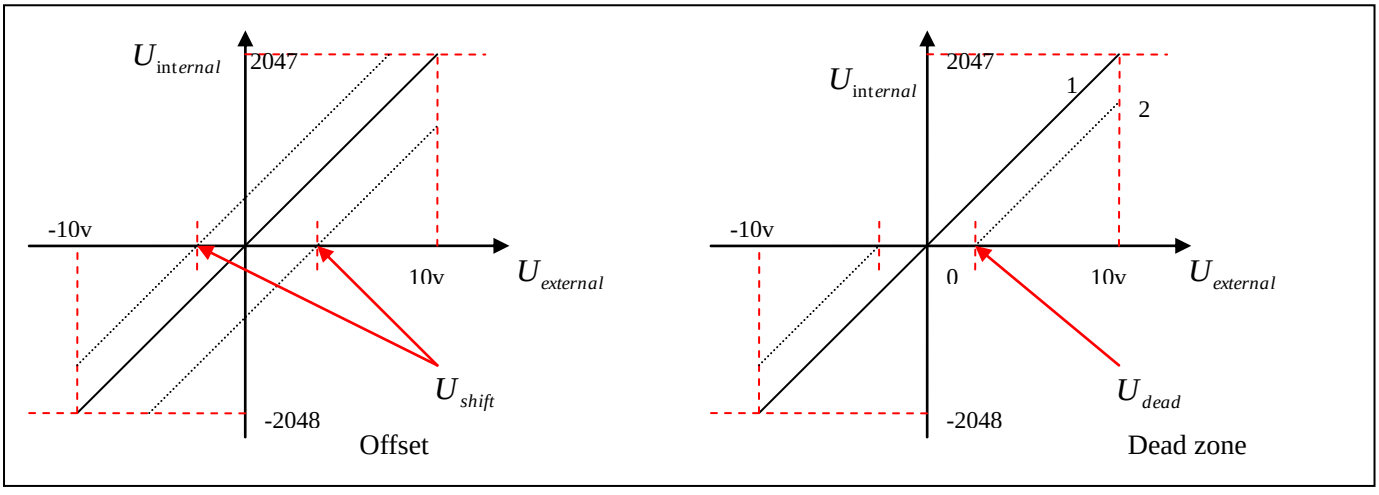


Fig. 7-8 Analog signal processing

Electrical control on internal variables is available only after ADC conversion and offset of external analog signals, and judgment of dead zone signals.
For offset processing, see the left part in Fig. 7-6; for dead zone processing, see the right part in Fig. 7-6.

Mathematical equation for offset processing: $U_{internal} = U_{external} - U_{shift}$

Mathematical equation for dead zone processing: $\begin{cases} U_{internal} = 0 \cdots\cdots\cdots\cdots\cdots\cdots -U_{dead} \le U_{external} \le U_{dead} \\ U_{internal} = U_{external} - U_{dead} \cdots\cdots\cdots \begin{cases} -U_{dead} > U_{external} \\ U_{dead} < U_{external} \end{cases} \end{cases}$

Mathematical equation for integrated processing (offset and dead zone) $\begin{cases} U_{internal} = 0 \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots -U_{dead} \le U_{external} - U_{shift} \le U_{dead} \\ U_{internal} = U_{external} - U_{shift} - U_{dead} \cdots\cdots\cdots \begin{cases} -U_{dead} > U_{external} - U_{shift} \\ U_{dead} < U_{external} - U_{shift} \end{cases} \end{cases}$

Table 7-10 Analog signal variables

Variable	Meaning	Range
$U_{internal}$	Internal data corresponding to the external voltage	-10 V – 10 V corresponds to -2048 – 2047 when no offset or dead zone voltage exists
$U_{external}$	External input voltage	-10V – 10V
U_{shift}	Offset voltage	0 – 10 V corresponds to $Analog\_Offset$ 0~8191
U_{dead}	Dead zone voltage	0 – 10 V corresponds to $Analog\_Dead$ 0~8191

The obtained analog signal $U_{internal}$ obtains U_{filter} after passing through a first-order low-pass filter, and is applied by the internal programs again.

In the analog – speed mode, if the analog signal U_{filter} that passes through the filter is multiplied by a factor, this signal will be regarded as the internal target speed V_{demand}.

Mathematical formula: $V_{demand} = Factor * U_{filter} \cdots\cdots -2048 \le U_{filter} \le 2047$

V_{demand} Formula for V_{rpm} conversion: $V_{rpm} = \dfrac{1875 * V_{demand}}{512 * \text{Encoder\_R}}$

Note: The resolution unit of an encoder is inc/r.

7.2.4 Calculation Procedure for Analog – speed Mode

Table 7-11 Calculation procedure for analog – speed mode

Procedure	**Method**	**Formula**
Step 1	Calculate U_{filter} according to the offset voltage and dead zone voltage that require	$\dfrac{2047}{10v} = \dfrac{U_{filter}}{10v - U_{shift} - U_{dead}}$

	settings	
Step 2	Calculate V_{demand} according to the required speed V_{rpm}	$V_{rpm} = \frac{1875 * V_{demand}}{512 * \text{Encoder\_R}}$
Step 3	Calculate $Factor$ according to U_{filter} and V_{demand}	$V_{demand} = Factor * U_{filter}$
Step 5	Calculate $Ana\log\_Dead$ according to the required dead zone voltage	$8191/10v = Ana\log\_Dead / U_{dead}$
Step 5	Calculate $Ana\log\_Offset$ according to the required offset voltage	$8191/10v = Ana\log\_Offset / U_{shift}$

7.2.5 Examples of Analog – Speed Mode

In the analog – speed mode, follow the steps below to set a driver:
Step 1: Confirm whether it is necessary to enable the driver through external digital input ports. To enable the driver through external digital input ports, see Table 6-12 in Example 6-3 for settings. If the driver does not require enabling through external digital input ports, you can disable the enabling function of external digital input ports by referring to Table 6-13 of Example 6-3, and enable the auto power-on function of the driver by setting its internal parameters.
Step 2: Confirm whether limit switches are required. By default, the driver operates in the limit status after being powered on. In this case, the numeric display has limit status display. If limit switches are unavailable, please disable the function of limit switches by referring to Example 6-4.
Step 3: Confirm the mode switching positions and operation modes by referring to the settings in Example 6-5. The factory default settings are as follows: When no signal is inputted to DIN3, the driver operates in the “-4” mode (d3.16 = -4); when signal is inputted to DIN3, the driver operates in the “-3” mode (d3.17 = -3). If the driver is required to operate in the speed mode after being powered on, set d3.16 to -3 or 3.
Step 4: After configuring functions on digital input ports, select the analog – speed channel, and set parameters such as analog – speed factors, dead zone, offset and filtering.
Step 5: Save parameters.

Example 7-3: Analog – speed mode (without setting the dead zone voltage and offset voltage)

Requirement: DIN1 is used for enabling the driver, DIN2 is used for error resetting, and DIN3 controls the operation modes of the driver (the mode is “-3” when no signal is inputted, and is “3” when signal is inputted). Limit switches are unavailable. The voltage 10V corresponds to the rated rotation speed of 3000 rpm, and -10V corresponds to the rated rotation speed of -3000 rpm. Select analog channel 1 (AIN1) to control the speed.

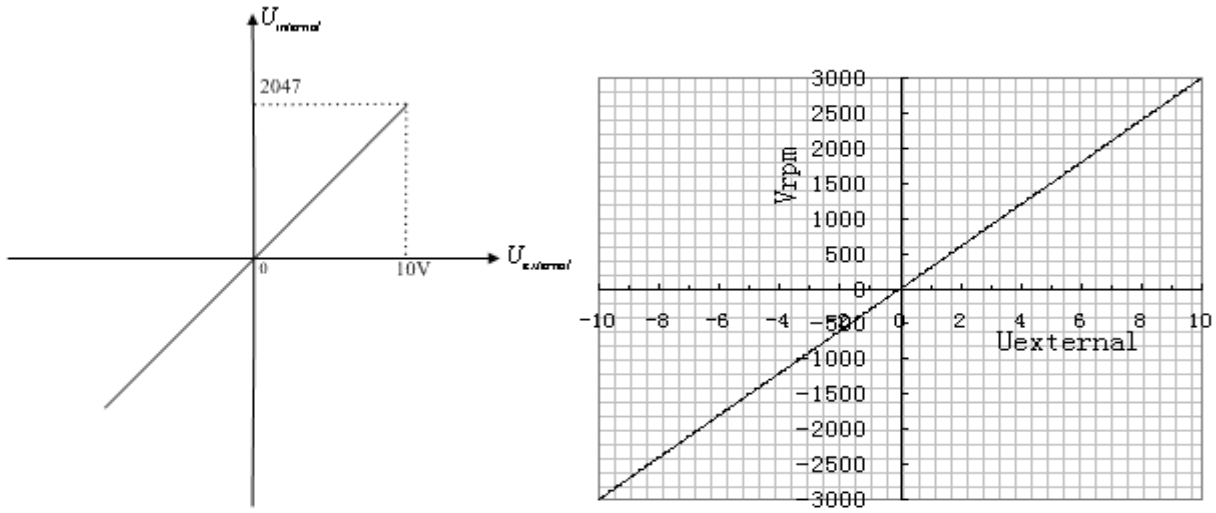


Fig. 7-9 Schematic diagram of Example 7-3

Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings:

$$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$$ (In this example, $U_{dead} = 0$, and $U_{shift} = 0$)

Result: U_{filter} =2047

Calculate V_{demand} according to the required speed V_{rpm}:

$$V_{rpm} = \frac{1875 * V_{demand}}{512 * \text{Encoder\_R}} = 3000RPM$$ (Encoder_R is 10000 inc/r)

Result: $V_{demand} = 8192000$

Calculate $Factor$ according to U_{filter} and V_{demand}:

$V_{demand} = Factor * U_{filter}$

Result: $Factor = 4000$

Table 7-12 Parameter settings in Example 7-3

Numeric Display	**Variable Name**	**Meaning**	**Parameter Settings**
d3.01	Din1_Function	Define the functions of digital input port 1	000.1 (Driver enable)
d3.02	Din2_Function	Define the functions of digital input port 2	000.2 (Error resetting)
d3.03	Din3_Function	Define the functions of digital input port 3	000.4 (Control over operation modes of drivers)
d3.05	Din5_Function	Define the functions of digital input port 5	The default value 001.0 changes to 000.0 (position positive limits are disabled)

d3.06	Din6_Function	Define the functions of digital input port 6	The default value 002.0 changes to 000.0 (position negative limits are disabled)
d3.16	Din _Mode0	Select this operation mode when input signals are invalid	Set to 0.003 (-3) mode (instantaneous speed mode)
d3.17	Din _Mode1	Select this operation mode when input signals are valid	Set to 0.003 (3) mode (speed mode with acceleration/deceleration)
d3.22	Analog1_Filter	Used to smooth the input analog signals. Filter frequency: f=4000/(2π* Analog1_Filter) Time Constant (T) = Analog1_Filter/4000 (S)	
d3.23	Analog1_Dead	Set dead zone data for external analog signal 1	Set to 0
d3.24	Analog1_Offset	Set offset data for external analog signal 1	Set to 0
d3.28	Analog_Speed_Con	Chooses analog-speed channels 0: Invalid analog channel 1: Valid analog channel 1 (AIN1) 2: Valid analog channel 2 (AIN2) 10 ～ 17： AIN1 for “Din_Speed (X-10)” 20 ～ 27： AIN2 for “Din_Speed (X-20)” Valid in mode -3, 3 and 1.	Set to 1
d3.29	Analog_Speed_Factor	Set the proportion between analog signals and output speed	Set to 4000
d2.10	Profile_Acce_16	Set the acceleration in operation mode 3 and 1.(rps/s)	610 by defaut
d2.11	Profile_Dece_16	Set the deceleration in operation mode 3 and 1.(rps/s)	610 by defaut
d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

Example 7-4 Analog – speed mode (setting the dead zone voltage)

Requirement: The dead zone voltage ranges from - 0.5 V to 0.5 V, that is, the speed is 0 when the voltage ranges from - 0.5 V to 0.5 V. The voltage 10 V corresponds to 3000 rpm, and -10 V corresponds to -3000 rpm. Select analog channel 1 (AIN1) to control the speed.

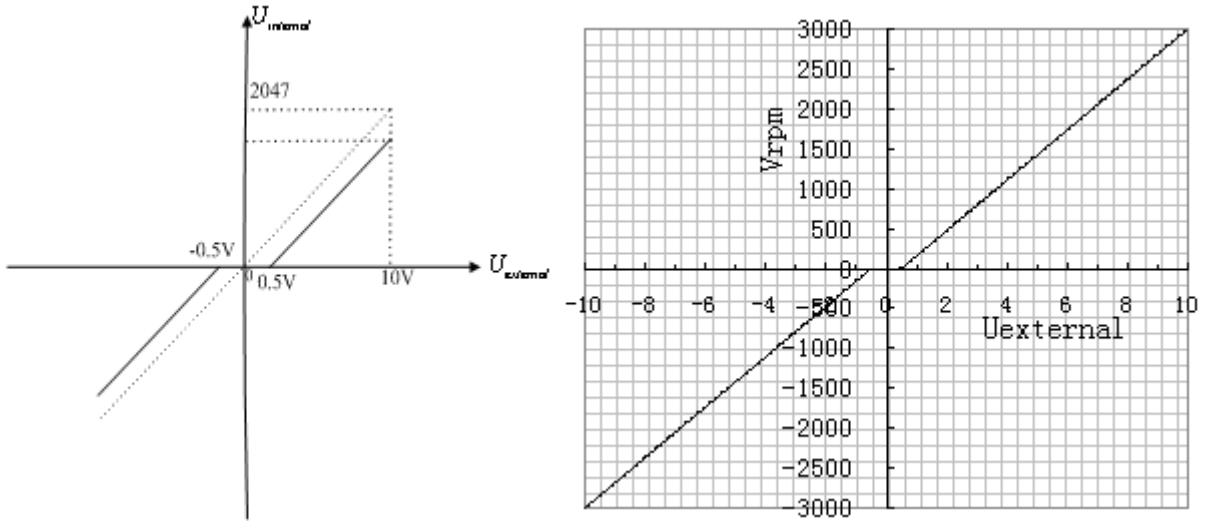


Fig. 7-10 Schematic diagram of Example 7-4

Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings:

$$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$$ (In this example, $U_{dead} = 0.5$, and $U_{shift} = 0$)

Result: U_{filter} =1944

Calculate V_{demand} according to the required speed : V_{rpm}

$$V_{rpm} = \frac{1875 * V_{demand}}{512 * \text{Encoder\_R}} = 3000RPM$$, (Encoder_R:10000 inc/r)

Result: $V_{demand} = 8192000$

Calculate U_{filter} according to V_{demand} and $Factor$:

$$V_{demand} = Factor * U_{filter}$$

Result: $Factor$ =4213

Calculate $Ana\log 1\_Dead$ according to the required dead zone voltage:

$$8191/10v = Ana\log 1\_Dead / U_{dead}$$

Result: $Ana\log 1\_Dead$ =410

The following changes are required on the basis of Example 7-3.

Table 7-13 Parameter settings in Example 7-4

d3.23	Analog1_Dead	Sets dead zone data for external analog signal 1	Set to 410
d3.29	Analog_Speed_Factor	Sets the proportion between analog signals and output speed	Set to 4213

d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

Example 7-5 Analog – speed mode (setting the offset voltage)

Requirement: The offset voltage is 1 V, that is, the speed is positive when the voltage is greater than 1 V, and is negative when the voltage is less than 1 V. In this case, the voltage 10 V corresponds to 3000 rpm, and -9 V corresponds to -3000 rpm (in case of -10 V, the corresponding speed is less than -3000 rpm). Select analog channel 1 (AIN1) to control the speed.

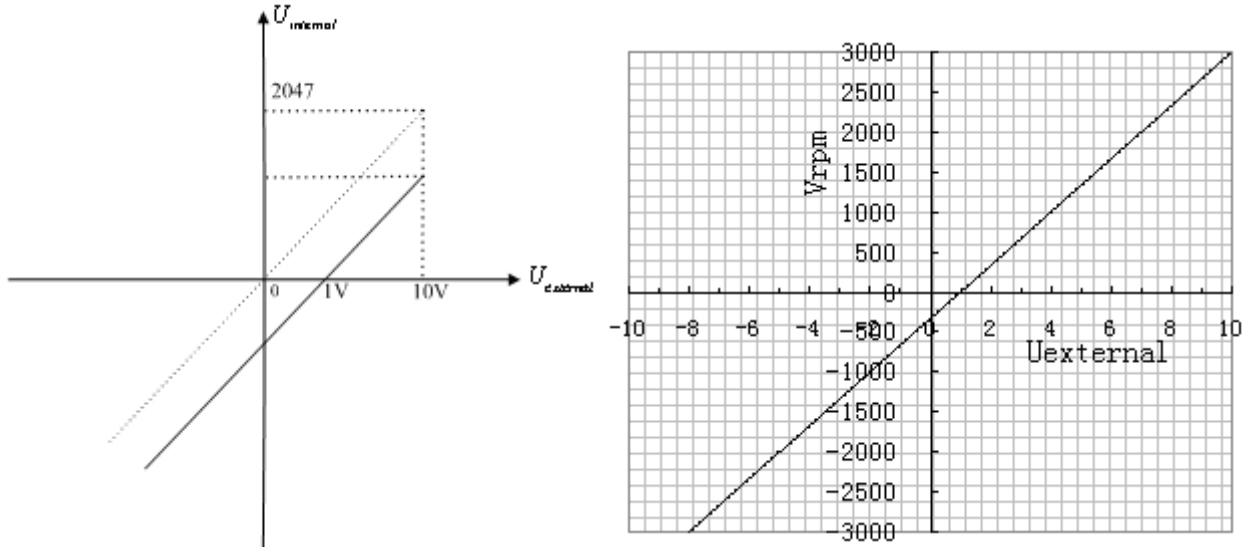


Fig. 7-11 Schematic diagram of Example 7-5

Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings:

$$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$$ (In this example, $U_{dead} = 0$, and $U_{shift} = 1$)

Result: $U_{filter} = 1842$

Calculate V_{demand} according to the required speed : V_{rpm}

$$V_{rpm} = \frac{1875 * V_{demand}}{512 * \text{Encoder\_R}} = 3000RPM$$, (Encoder_R:10000 inc/r)

Result: $V_{demand} = 8192000$

Calculate U_{filter} according to V_{demand} and $Factor$:

$$V_{demand} = Factor * U_{filter}$$

Result: $Factor$=4447

Calculate $Ana\log 1\_Offset$ according to the required offset voltage:

$$8191/10v = Ana\log 1\_Offset / U_{shift}$$

Result: $Ana\log 1\_Offset$=819

The following changes are required on the basis of Example 7-3.

Table 7-14 Parameter settings in Example 7-5

d3.24	Analog1_Offset	Sets offset data for external analog signal 1	Set to 819
d3.29	Analog_Speed_Factor	Sets the proportion between analog signals and output speed	Set to 4447
d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

Example 7-6: Analog – speed mode (setting the dead zone voltage and offset voltage)

Requirement: Set the offset voltage to 1V, the dead zone voltage to 0.5V to 1.5V, and the max speed corresponding to 10V to 3000 rpm. Select analog channel 1 (AIN1) to control the speed.

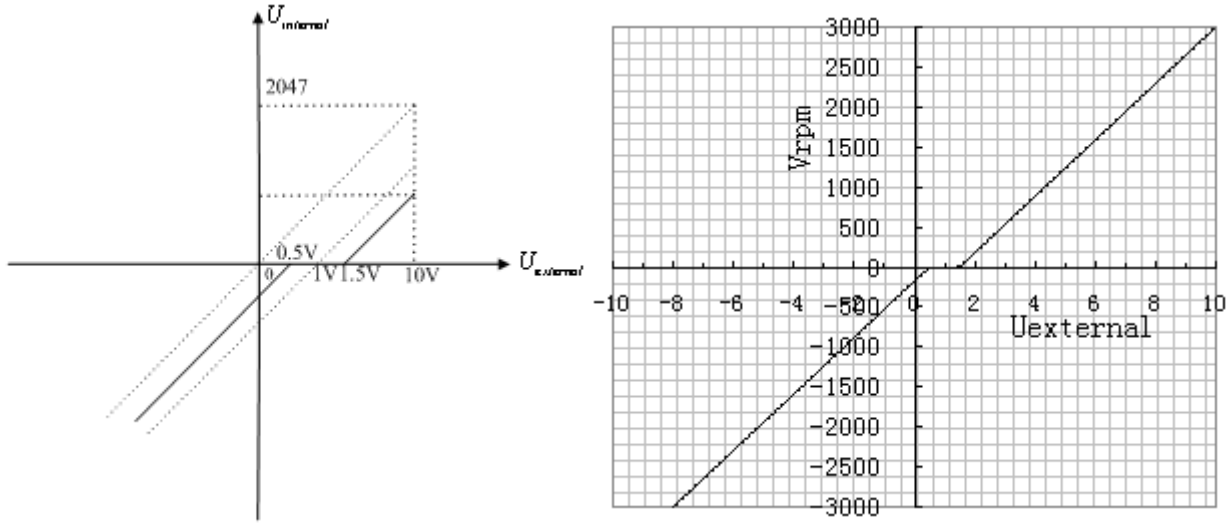


Fig. 7-12 Schematic diagram of Example 7-6

Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings:

$$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$$ (In this example, $U_{dead} = 0.5$, and $U_{shift} = 1$)

Result: U_{filter} =1740

Calculate V_{demand} according to the required speed : V_{rpm}

$V_{rpm} = \frac{1875 * V_{demand}}{512 * \text{Encoder\_R}} = 3000RPM$, (Encoder_R:10000 inc/r)

Result: $V_{demand} = 8192000$

Calculate $Factor$ according to U_{filter} and V_{demand} :

$V_{demand} = Factor * U_{filter}$

Result: $Factor$ =4708

Calculate $Ana\log 1\_Dead$ according to the required dead zone voltage:

$8191/10v = Ana\log 1\_Dead / U_{dead}$

Result: $Ana\log 1\_Dead$ =409

Calculate $Ana\log 1\_Offset$ according to the required offset voltage:

$8191/10v = Ana\log 1\_Offset / U_{shift}$

Result: $Ana\log 1\_Offset$ =819

The following changes are required on the basis of Example 7-3.

Table 7-15 Parameter settings in Example 7-6

d3.23	Analog1_Dead	Sets dead zone data for external analog signal 1	Set to 409
d3.24	Analog1_Offset	Sets offset data for external analog signal 1	Set to 819
d3.29	Analog_Speed_Factor	Sets the proportion between analog signals and output speed	Set to 4708
d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

7.3 Torque Mode (“4” Mode)

7.3.1 Wiring in Analog – Torque Mode

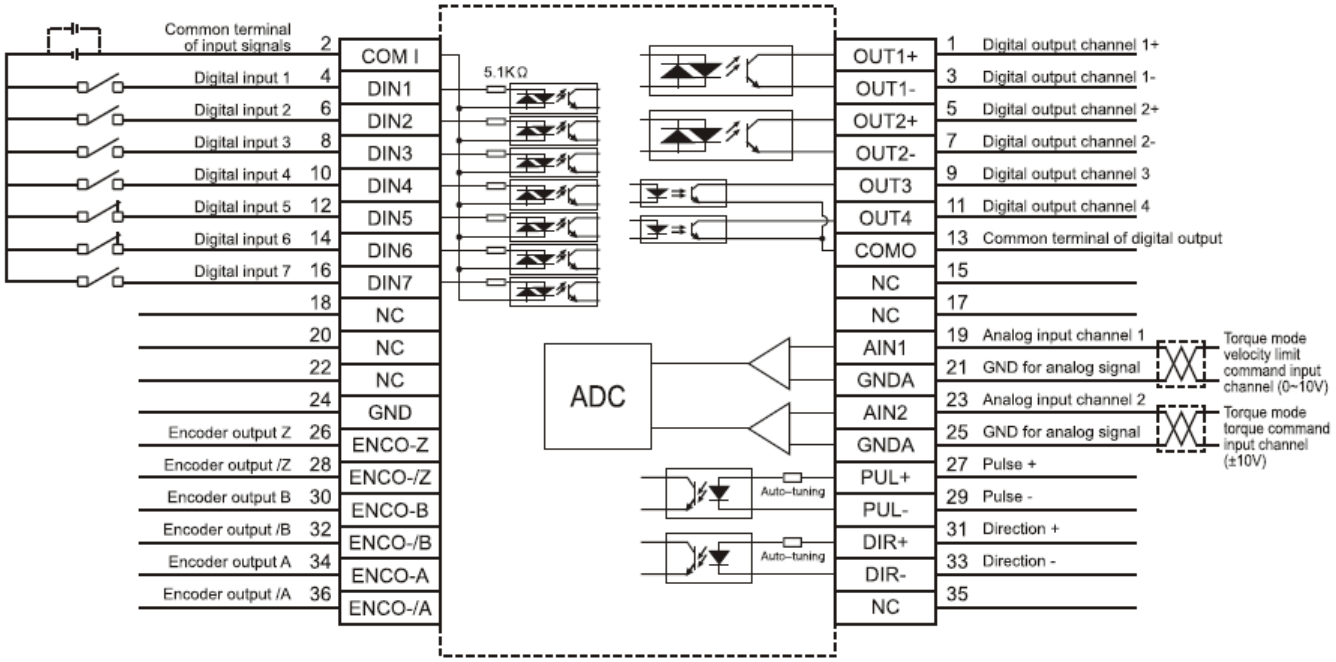


Fig. 7-13 Wiring diagram of CD2 Servo in analog – torque mode

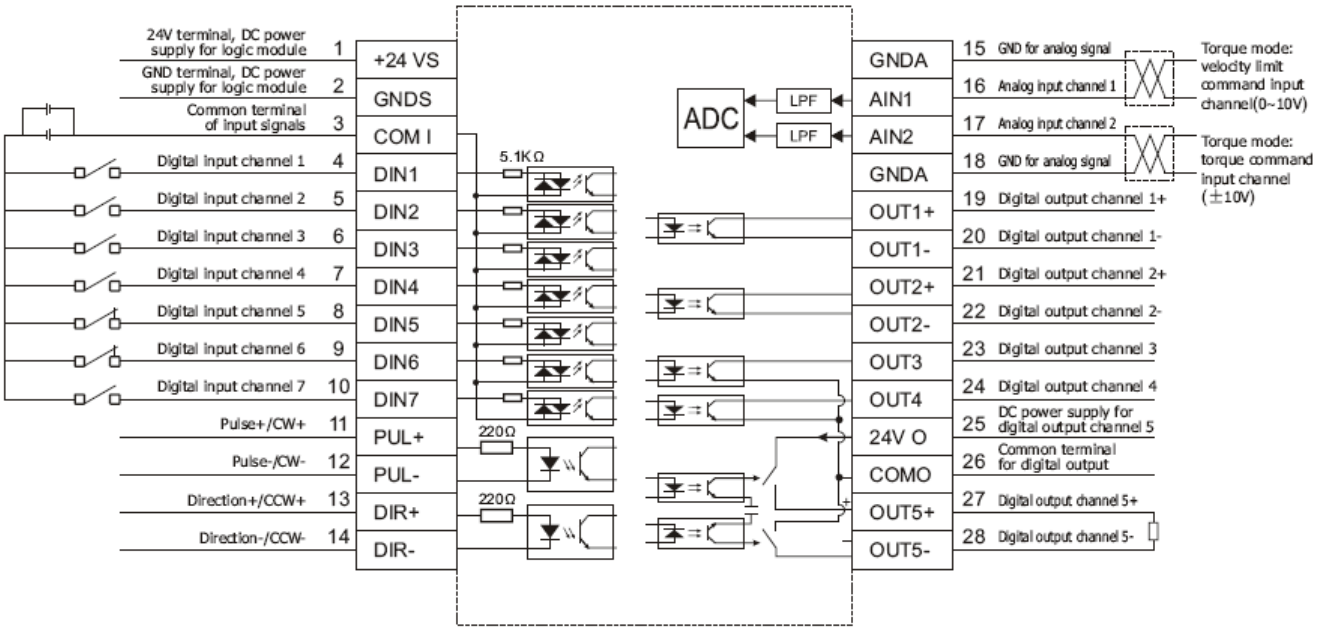


Fig. 7-14 Wiring diagram of CD Servo in analog – torque mode

7.3.2 Parameters for Analog – Torque Mode

Table 7-16 Parameters for analog – torque mode

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.22	Analog1_Filter	Used to smooth the input analog signals. Filter frequency: f=4000/(2π* Analog1_Filter) Time Constant: τ = Analog1_Filter/4000 (S)	5	1~127
d3.23	Analog1_Dead	Sets dead zone data for external analog signal 1	0	0~8192
d3.24	Analog1_Offset	Sets offset data for external analog signal 1	0	-8192 ~8192
d3.25	Analog2_Filter	Used to smooth the input analog signals. Filter frequency: f=4000/(2π* Analog1_Filter) Time Constant (T) = Analog2_Filter/4000 (S)	5	1~127
d3.26	Analog2_Dead	Sets dead zone data for external analog signal 2	0	0~8192
d3.27	Analog2_Offset	Sets offset data for external analog signal 2	0	-8192 ~8192
d3.30	Analog_Torque_Con	Selects analog - torque channels 0: Invalid analog channel 1: Valid analog channel 1 (AIN1) 2: Valid analog channel 2 (AIN2) Valid mode 4	0	N/A
d3.31	Analog_Torque_Factor	Sets the proportion between analog signals and output torque (current)	1000	N/A
d2.15	Speed_Limit_Factor	The factor that limits the maximum speed in the torque mode $\begin{cases} F_{Actual\_torque} = F_{Demand\_torque} & \cdots\cdots (1) \\ F_{Actual\_torque} = F_{Demand\_torque} - N * (V_{Actual\_speed} - V_{Max\_speed}) & \cdots\cdots (2) \end{cases}$ V_{max_speed} complies with d2.24 Max_Speed_RPM parameter settings.	10	0~1000
d2.24	Max_Speed_RPM	Limits the max rotation speed of the motor	5000	0~6000

7.3.3 Analog Signal Processing

In the analog – torque mode, external analog command signals are directly inputted to the current loops in the driver, thus directly controlling target current through the internal current loop. Analog signal is processed in the same way as that in the analog – speed mode.

In the analog – torque mode, I_{demand} is calculated according to the specified T_{demand} with the formula of $T_{demand} = K_t * \frac{I_{demand}}{\sqrt{2}}$ (K_t is a torque constant).

$Factor$ is calculated according to I_{demand} and U_{filter} with the formula of $I_{demand} = \frac{Factor * U_{filter}}{2048 * 2048} * Ipeak$ ($Ipeak$ indicates the peak current of a driver).

Table 7-17 K_t and $Ipeak$ parameters

Motor Model	K_t (Nm/A)	Driver Model	$Ipeak$ (A)
SMH60S-0020-30AXK-3LKX	0.48	CD420-AA-000	15
SMH60S-0040-30AXK-3LKX	0.48		
SMH80S-0075-30AXK-3LKX	0.662		
SMH80S-0100-30AXK-3LKX	0.562	CD430-AA-000	27.5
SMH110D-0105-20AXK-4LKX	0.992		
SMH110D-0126-20AXK-4LKX	1.058		
SMH130D-0105-20AXK-4HKX	1.1578		
SMH130D-0157-20AXK-4HKX	1.191		
SMH110D-0126-30AXK-4HKX	1.058	CD620-AA-000	25
SMH110D-0157-30AXK-4HKX	0.992		
SMH110D-0188-30AXK-4HKX	1.058		
SMH130D-0105-20AXK-4HKX	1.1578		
SMH130D-0157-20AXK-4HKX	1.191		
SMH130D-0210-20AXK-4HKX	1.3232		
SMH150D-0230-20AXK-4HKX	1.65		

7.3.4 Calculation Procedure for Analog – Torque Mode

Table 7-17 Calculation procedure for analog – torque mode

Procedure	Method	Formula

Step 1	Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings	$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$
Step 2	Calculate I_{demand} according to the required torque T_{demand}	$T_{demand} = K_t * \frac{I_{demand}}{\sqrt{2}}$
Step 3	Calculate $Factor$ according to U_{filter} and I_{demand}	$I_{demand} = \frac{Factor * U_{filter}}{2048 * 2048} * Ipeak$
Step 4	Calculate $Ana\log\_Dead$ according to the required dead zone voltage	$8191/10v = Ana\log\_Dead / U_{dead}$
Step 5	Calculate $Ana\log\_Offset$ according to the required offset voltage	$8191/10v = Ana\log\_Offset / U_{shift}$

7.3.5 Examples of Analog – Torque Mode

In the analog – torque mode, follow the steps below to configure a driver:
Step 1: Confirm whether it is necessary to enable the driver through external digital input ports. To enable the driver through external digital input ports, see Table 6-12 in Example 6-3 for settings. If the driver does not require enabling through external digital input ports, you can disable the enabling function of external digital input ports by referring to Table 6-13 of Example 7-3, and enable the auto power-on function of the driver by setting its internal parameters.
Step 3: Confirm mode switching positions and operation modes by referring to the settings in Example 6-5. The factory default settings for the driver are as follows: When no signal is inputted to DIN3, the driver operates in the “-4” mode (d3.16 = -4); when signal is inputted to DIN3, the driver operates in the “-3” mode (d3.17 = -3). If the driver is required to operate in the torque mode (“4” mode), please set d3.16 or d3.17 to 4. In case d3.16 = 4, if DIN3 has no input signals when the driver is powered on, the driver operates in the “4” mode. In case d3.17 = 4, if DIN3 has input signals, the driver operates in the “4” mode.
Step 3: After configuring functions on digital input ports, select the analog – torque channel, and set parameters such as analog – torque factors, dead zone, offset, filtering, speed limit factors, and max speed limits.
Step 4: Save parameters.

Example 7-7: Analog – torque mode (without setting the dead zone voltage and offset voltage)

Requirement: DIN1 is used for enabling the driver, DIN2 is used for error resetting, and DIN3 controls the operation modes of the driver (the mode is “4” when no signal is inputted, and is “3” when signal is inputted). The motor Kt is 0.48 Nm/A, and the peak current of drivers is 15 A. The analog input voltage -10 V corresponds to -0.64 Nm, and 10 V corresponds to 0.64 Nm. Select analog channel 2 (AIN1) to control the torque.

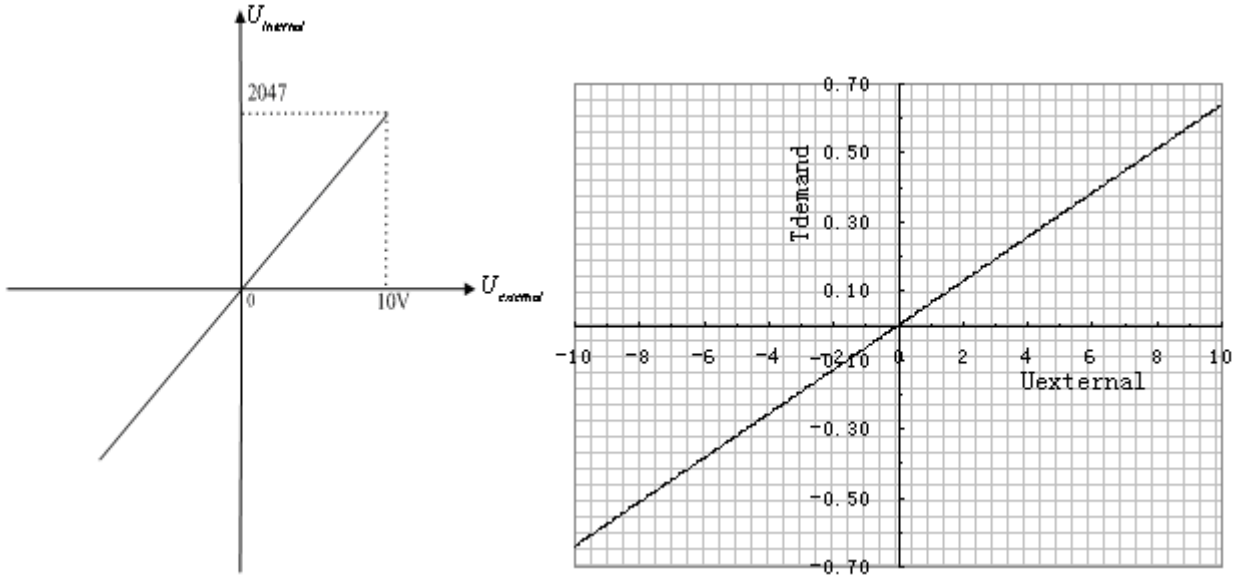


Fig. 7-15 Schematic diagram of Example 7-7

Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings:

$$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$$ (In this example, $U_{dead} = 0$, and $U_{shift} = 0$)

Result: U_{filter} =2047

Calculate I_{demand} according to the required torque T_{demand}:

$$I_{demand} = \frac{T_{demand}}{K_t} * \sqrt{2}$$

Result: I_{demand} =1.89

Calculate $Factor$ according to U_{filter} and I_{demand}:

$$Factor = \frac{I_{demand}}{U_{filter} * Ipeak} * 2048 * 4096$$

Result: $Factor = \frac{1.89}{2047*15} * 2048 * 4096 = 515$

Table 7-18 Parameter settings in Example 7-7

Numeric Display	**Variable Name**	**Meaning**	**Parameter Settings**
d3.01	Din1_Function	Defines the functions of digital input port 1	000.1 (Driver enable)
d3.02	Din2_Function	Defines the functions of digital input port 2	000.2 (Error resetting)
d3.03	Din3_Function	Defines the functions of digital input port 3	000.4 (Control over operation modes of drivers)
d3.16	Din _Mode0	Select this operation mode when input signals are invalid	Set to 0004 (4) mode (torque mode)
d3.17	Din _Mode 1	Select this operation mode when input signals are valid	Set to 0.003 (3) mode (speed mode with acceleration/deceleration)
d3.25	Analog2_Filter	Used to smooth the input analog signals. Filter frequency: f=4000/(2π* Analog1_Filter) Time Constant: T = Analog2_Filter/4000 (S)	
d3.26	Analog2_Dead	Sets dead zone data for external analog signal 2	Set to 0
d3.27	Analog2_Offset	Sets offset data for external analog signal 2	Set to 0
d3.31	Analog_Torque_Factor	Sets the proportion between analog signals and output torque (current)	Set to 515
d3.30	Analog_Torque_Con	Selects analog - torque channels 0: Invalid analog channel 1: Valid analog channel 1 (AIN1) 2: Valid analog channel 2 (AIN2) Valid mode 4	Set to 2
d3.00	Store_Loop_Data	1: Storing all configured	Set to 1

		parameters for the control loop 10: Initializing all parameters for the control loop	

Example 7-8: Analog – torque mode (setting the dead zone voltage and offset voltage)

Requirement: The offset voltage is 1V, and the dead zone voltage is 0.5V. The motor Kt is 0.48 Nm/A, and the peak current of the driver is 15A. The analog input voltage 10V corresponds to 0.64Nm. Select analog channel 2 (AIN2) to control the torque.

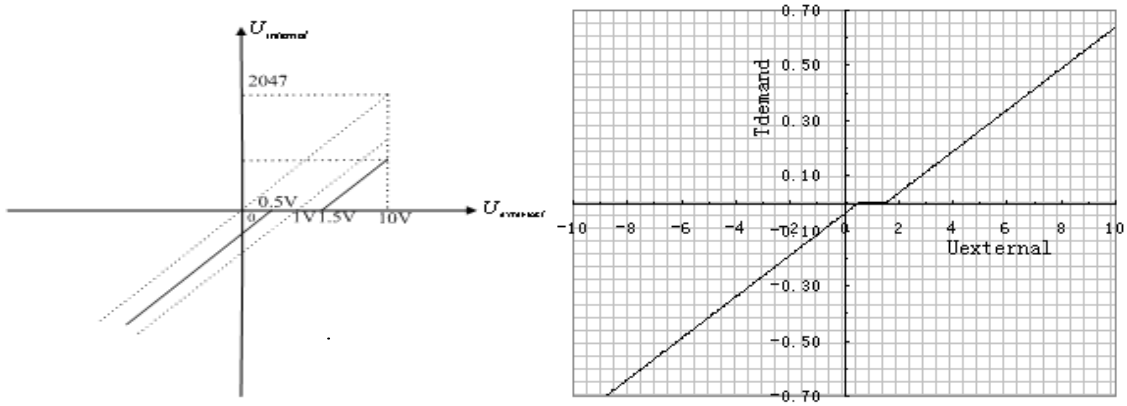


Fig. 7-16 Schematic diagram of Example 7-8

Calculate U_{filter} according to the offset voltage and dead zone voltage that require settings:

$$\frac{2047}{10v} = \frac{U_{filter}}{10v - U_{shift} - U_{dead}}$$ (In this example, $U_{dead} = 0.5$, and $U_{shift} = 1$)

Result: U_{filter} =1740

Calculate I_{demand} according to the required torque T_{demand} :

$$I_{demand} = \frac{T_{demand}}{K_t} * \sqrt{2}$$

Result: I_{demand} = 1.89

Calculate $Factor$ according to U_{filter} and I_{demand} :

$$Factor = \frac{I_{demand}}{U_{filter} * Ipeak} * 2048 * 4096$$

Result: $Factor = \frac{1.89}{1740 * 15} * 2048 * 4096 = 606$

Calculate $Ana\log 2\_Dead$ according to the required dead zone voltage:

$$Analog2\_Dead = \frac{8191}{10v} * U_{dead}$$

Result: $Ana\log 2\_Dead$ = 410

Calculate $Ana\log 2\_Offset$ according to the required offset voltage:

$$Analog2\_Offset = \frac{8191}{10v} * U_{shift}$$

Result: $Ana\log 2\_Offset$ =819

The following changes are required on the basis of Example 7-7.

Table 7-19 Parameter settings in Example 7-8

d3.26	Analog2_Dead	Sets dead zone data for external analog signal 2	Set to 410
d3.27	Analog2_Offset	Sets offset data for external analog signal 2	Set to 819
d3.31	Analog_Torque_Factor	Sets the proportion between analog signals and output torque (current)	Set to 2362
d3.00	Store_Loop_Data	1: Storing all configured parameters for the control loop 10: Initializing all parameters for the control loop	Set to 1

7.4 Internal Multi-position Control Modes (“1” Mode)

In Internal multi-position control mode, we can activate internal set target position though an external signal to control motors. The activation has two preconditions:

1, multi-position control mode can only be activated in Mode 1, it can’t be activated in other modes.

2, At least one of the external input signal is defined as “Internal position control 0”, “Internal position control 1 “ or “Internal position control 2 “, which means at least one address of digital tubes-d3.01 ~ d3.07 is set to “040.0”’, “080.0” or “800.2.

“Internal position control 0” , “Internal position control 1” and “Internal position control 2 “, these three signals will be combined into binary codes used to select a target position between “Position 0~7”.

Internal position 0	Internal position 1	Internal position 2	Corresponding position	Position section numberic display	Corresponding speed	numberic display
0	0	0	Din_Pos0	d3.40select position section sequence	Din_Speed0_RPM	d3.18

0	0	1	Din_Pos1	number d3.41select position section high bit d3.42select position section low bit	Din_Speed1_RPM	d3.19
0	1	0	Din_Pos2		Din_Speed2_RPM	d3.20
0	1	1	Din_Pos3		Din_Speed3_RPM	d3.21
1	0	0	Din_Pos4		Din_Speed4_RPM	d3.44
1	0	1	Din_Pos5		Din_Speed5_RPM	d3.45
1	1	0	Din_Pos6		Din_Speed6_RPM	d3.46
1	1	1	Din_Pos7		Din_Speed7_RPM	d3.47

Table 7-20 Internal Multi-position Control Mode Parameter Table

Note: In this control mode, “position section X” can be positive or negative, it can be flexibly set; while the corresponding speed must be positive. Other parameters such as acceleration, deceleration, etc, can use the default value; also can be changed through digital tube.

Example7-9: Internal multi-position control mode

A motor needs to go eight position sections. In position section 0, it should reach the 5000 pulse location at the speed of 100RPM.In position section 1, it should reach the 15000 pulse location at the speed of 150RPM.In position section 2, it should reach the 28500 pulse location at the speed of 175RPM.In position section 3, it should reach the -105000 pulse location at the speed of 200RPM. In position section 4, it should reach the -20680 pulse location at the speed of 300RPM. In position section 5, it should reach the -30550 pulse location at the speed of 325RPM. In position section 6, it should reach the 850 pulse location at the speed of 275RPM. In position section 7, it should reach the 15000 pulse location at the speed of 460RPM.

Table 7-21 Internal Multi-position Control Mode Demand

DIN1	The driver is enabled, the motor shaft is locked
DIN3	Driver working mode（invalid 1，valid-3）
DIN4	Internal position 0
DIN5	Internal position 1
DIN6	Internal position 2
DIN6:DIN5:DIN4=0:0:0	Select position and speed in section 0
DIN6:DIN5:DIN4=0:0:1	Select position and speed in section 1
DIN6:DIN5:DIN4=0:1:0	Select position and speed in section 2
DIN6:DIN5:DIN4=0:1:1	Select position and speed in section 3
DIN6:DIN5:DIN4=1:0:0	Select position and speed in section 4
DIN6:DIN5:DIN4=1:0:1	Select position and speed in section 5

DIN6:DIN5:DIN4=1:1:0	Select position and speed in section 6
DIN6:DIN5:DIN4=1:1:1	Select position and speed in section 7
DIN6	Activate command（execute the selected position section）

1. Define the meanings of the input points:

Table 7-22 Internal Multi-position Control Mode Configuration

Numberic display	Variable name	Configuration way
d3.01	Din1_Function	000.1（Driver enabled）
d3.03	Din3_Function	000.4（Set driver mode）
d3.04	Din4_Function	040.0（Internal position control 0）
d3.05	Din5_Function	080.0（Internal position control 1）
d3.06	Din6_Function	800.2 (Internal position control 2)
d3.07	Din7_Function	400.0（Activate command）
d3.16	Din_mode 0	Set 0001（1）Mode Internal multi-position control mode
d3.17	Din_mode 1	Set 0.004 (-4) Mode Pulse-control mode
d3.00	Storage parameters	1(Storage configuration parameters)

2. Set position and speed:

Table 7-23 Internal Multi-position and Speed Configuration

Numberic display	Variable Name	Parameters Settings
d3.43	Relative / Absolute position selection	Set to 2F(absolute location)
d3.40	Set the position section number to 0	Set to 0（select position section 0）
d3.41	Set the high bit of position section（N*10000）	Set to 0
d3.42	Set the low bit of position section	Set to 5000（set the position of section 0 t0 5000）
d3.18	Set the speed of section 0	Set to 100（set the speed of section 0 to 100）
d3.40	Set the position section number to 1	Set to 1（select position section 1）
d3.41	Set the high bit of position section（N*10000）	Set to 1
d3.42	Set the low bit of position section	Set to 15000（set the position of section 1 t0 15000））
d3.19	Set the speed of position section 1	Set to 150（set the speed of section 1 to 150）
d3.40	Set the position section number to2	Set to 2（select position section

		2）
d3.41	Set the high bit of position section（N*10000）	Set to 2
d3.42	Set the low bit of position section	Set to 28500（set the position of section 2 t0 28500）
d3.20	Set the speed of position section 1	Set to 175（set the speed of section 2 to 175）
d3.40	Set the position section number to 3	Set to 3（select position section 3）
d3.41	Set the high bit of position section（N*10000）	Set to 3
d3.42	Set the low bit of position section	Set to 10500（set the position of section 3 t0 10500）
d3.20	Set the speed of position section 3	Set to 200（set the speed of section 3 to 200）
d2.10	Acceleration	Default 610 rps/s
d2.11	Deceleration	Default 610 rps/s
d3.00	Storage parameter	1（storage configuration parameters）

Set all these parameters, then：

1. Enable the driver, which means to make the digital input DIN1 high-level.
2. Select the position section, which means to change the electrical level of DIN4,DIN5 and DIN6.
3. Activate instructions and execute the program, which means to make the digital input DIN7 high-level.

Notice:

In multi-position control mode, select location method by setting the different value of the digital tube d3.43.If you choose absolute positioning mode, set it to “F”; if the instructions require immediate updating, set it to “2F”; if you choose relative positioning method, set it to “4F”.To change these parameters successfully, you have to save the value of d3.00,and then restart.

7.5 Internal Multi-speed Control Modes (“-3” or “3” Mode)

In this control mode, external input signals are used to activate the internally configured target speed to control the motor. There are two prerequisites for activation:

1. Multi-speed control is available in the “-3” or “3” mode, and is unavailable in other modes.
2. Set d3.28 to 0. In this case, the analog – speed channel is invalid.
3. At least one external input signal DinX_Function defines Bit8 or Bit9.

For example, define Din2_Function corresponding to Din2 as 010.0, and Din3_Function corresponding to Din3 as 020.0. In this way, the combination of the two above signals is used to choose any one of Din_Speed0_RPM, Din_Speed1_RPM, Din_Speed2_RPM or Din_Speed3_RPM as the target speed.

Table 7-24 Parameters for internal multi-speed control modes

Internal Speed Control 0 (Din_Sys.Bit8)	Internal Speed Control 1 (Din_Sys.Bit9)	Meaning	Numeric Display	Valid Object (numeric display operation)
0	0	Multi-speed control: 0 [rpm]	d3.18	Din_Speed0_RPM

1	0	Multi-speed control 1 [rpm]	d3.19	Din_Speed1_RPM
0	1	Multi-speed control 2 [rpm]	d3.20	Din_Speed2_RPM
1	1	Multi-speed control 3 [rpm]	d3.21	Din_Speed3_RPM

Note: If you need to set the target speed precisely, it is required to set Din_Speed0, Din_Speed1, Din_Speed2 and Din_Speed3 with a host computer. The four data units are internal units and are suitable for users who are familiar with drivers. Din_SpeedX_RPM indicates the data after converting Din_SpeedX into the unit of rpm to facilitate users. Conversion involves both the reading and writing processes, and does not require calculation by users.

Example 7-10: Internal multi-speed control

Requirement: You need to define the digital input ports DIN6 and DIN7 as internal speed control, DIN1 as driver enabling and DIN2 as operation mode control of the driver (the mode is “3” when the driver is valid, and is “-3” when the driver is invalid). For detailed requirements, see Table 7-25. For the setting method, see Table 7-26.

Table 7-25 Requirements on internal multi-speed control

DIN6:DIN7=0:0	To execute the multi-step 1 speed (100 rpm)
DIN6:DIN7=1:0	To execute the multi-step 2 speed (200 rpm)
DIN6:DIN7=0:1	To execute the multi-step 3 speed (300 rpm)
DIN6:DIN7=1:1	To execute the multi-step 3 speed (400 rpm)
DIN1	To enable the driver, and lock the motor shaft
DIN2	To control operation modes of the driver (the mode is “3” when the driver is valid, and is “-3” when the driver is invalid)

Table 7-26 Setting methods for internal multi-speed control

Numeric Display	Variable Name	Setting Method
d3.01	Din1_Function	Set to 000.1 (Driver enable)
d3.02	Din2_Function	Set to 000.4 (control over operation modes of drivers)
d3.06	Din6_Function	Set to 010.0 (internal speed control 0)
d3.07	Din7_Function	Set to 020.0 (internal speed control 1)
d3.16	Din_Mode0	Set to 0.003 (3) mode (speed mode with acceleration/deceleration)
d3.17	Din_Mode1	Set to 0.003 (-3) mode (instantaneous speed mode)
d3.18	Din_Speed0_RPM	Set to 100 [rpm]
d3.19	Din_Speed1_RPM	Set to 200 [rpm]
d3.20	Din_Speed2_RPM	Set to 300 [rpm]
d3.21	Din_Speed3_RPM	Set to 400 [rpm]

d3.00	Store_Loop_Data	Set to 1

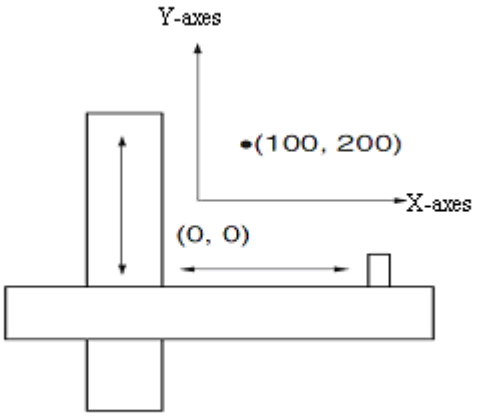
7.6 Internal Torque Control Mode (“4” Mode)

In the internal torque mode, only the current loop of the driver operates. Set d0.03 (CMD_q target current) parameter directly to obtain the desired target torque. The prerequisite is that d3.30 must be set to 0. In this case, the analog–torque channel is invalid.

7.7 Homing Mode (“6” Mode)

1, Summary

To make a system execute positioning in accordance with its absolute positioning, the first step is to define the origin. For instance, as shown in the following XY plane, to navigate to (X, Y) = (100mm, 200mm), you must define the origin of the machine firstly. It’s necessary to define the origin.



2, Procedure of homing

Use the following steps to homing:

1. Set the external I / O parameters, and then save.
2. Set the data for homing, and then save.
3. Execute homing.

3, Configuration of the data for homing

Here are simple descriptions of the data for executing homing.

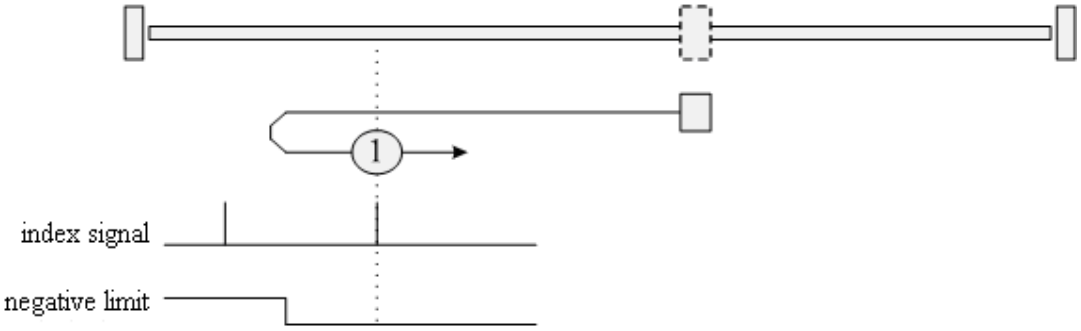
0x607C0020	Home_Offset	Home offset	In Homing mode, set the offset relative to the zero point.
0x60980008	Homing_Method	Homing method	Select the homing method
0x60990120	Homing_Speed_Switch	Speed for searching the limit switch	Set the speed for searching the limit switch which defined as homing signal.
0x60990220	Homing_Speed_Zero	Speed for searching the Zero point.	Only valid when find Index signal.
0x60990308	Homing_Power_On	Homing when power	Every time after power on,it will start

		on	homing once.
0x609A0020	Homing_Accelaration	Homing acceleration	Control the acceleration of homing

CD has 27 methods for homing, referring the CANopen's definition of DSP402.
1st-14th methods use Z signal as homing signal.
17th-30th methods use external signal as homing signal.

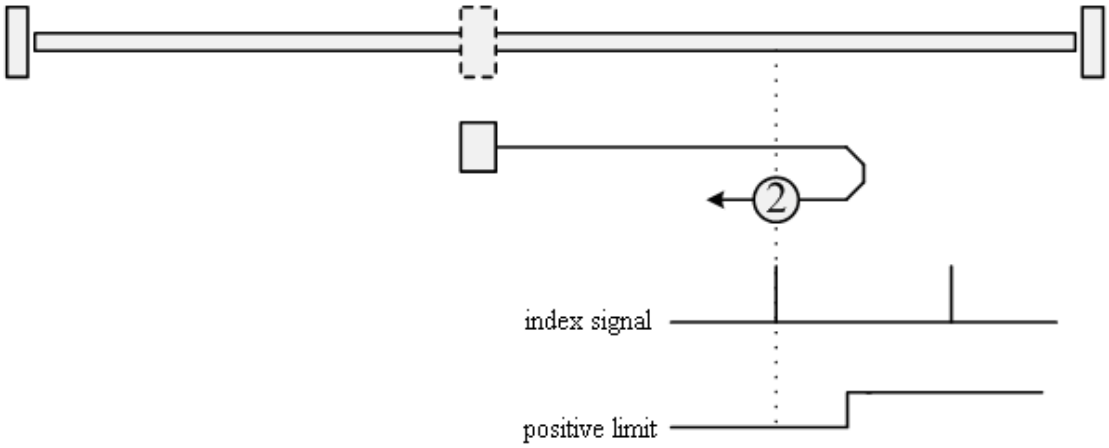
Method 1: Homing on the negative limit switch and index pulse

Using this method, the initial direction of movement is leftward if the negative limit switch is inactive (here shown as low). The home position is at the first index pulse to the right of the position where the negative limit switch becomes inactive.



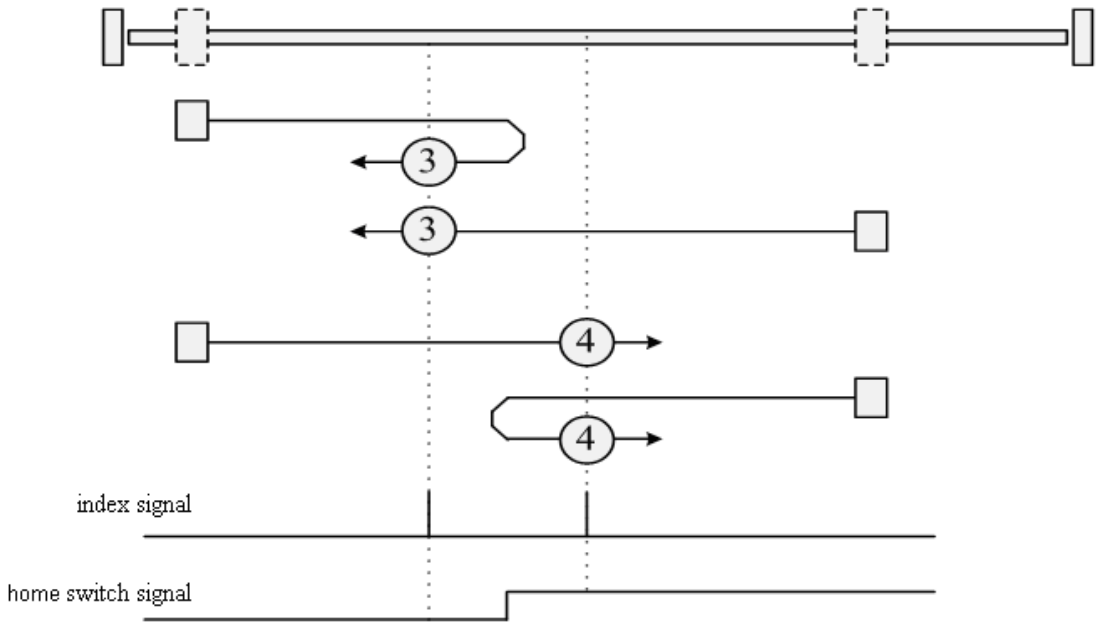
Method 2: Homing on the positive limit switch and index pulse

Using this method, the initial direction of movement is rightward if the positive limit switch is inactive (here shown as low). The position of home is at the first index pulse to the left of the position where the positive limit switch becomes inactive.



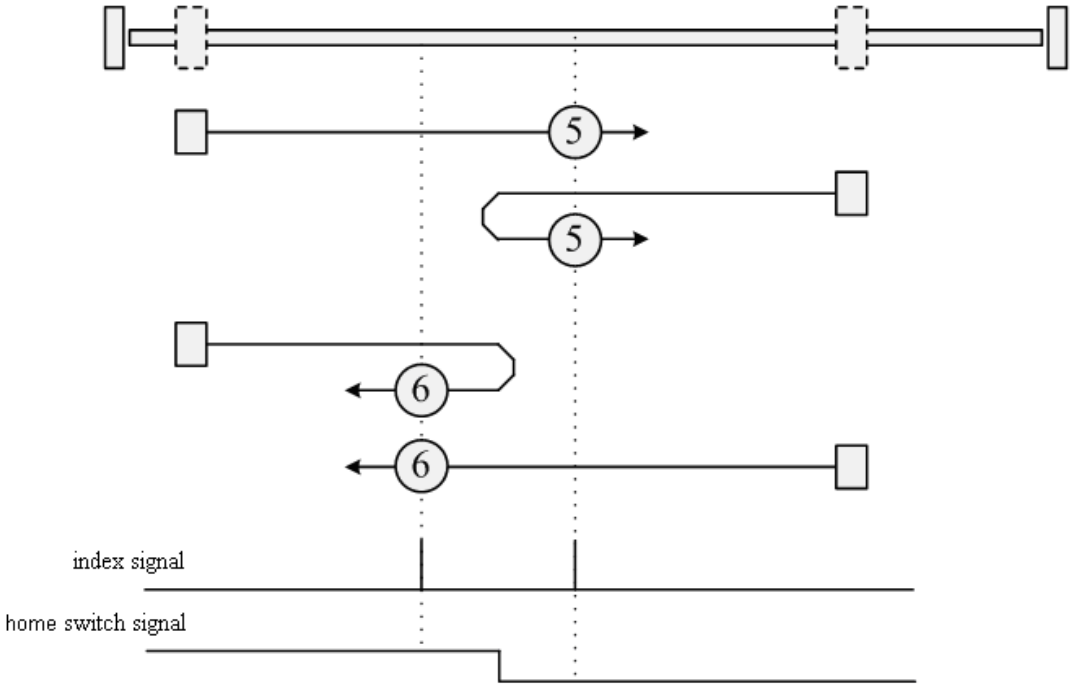
Methods 3 and 4: Homing on the positive home switch and index pulse

Using methods 3 or 4, the initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either the left or right of the pint where the home switch changes state. If the initial position is sited so that the direction of movement must reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.



Methods 5 and 6: Homing on the negative home switch and index pulse

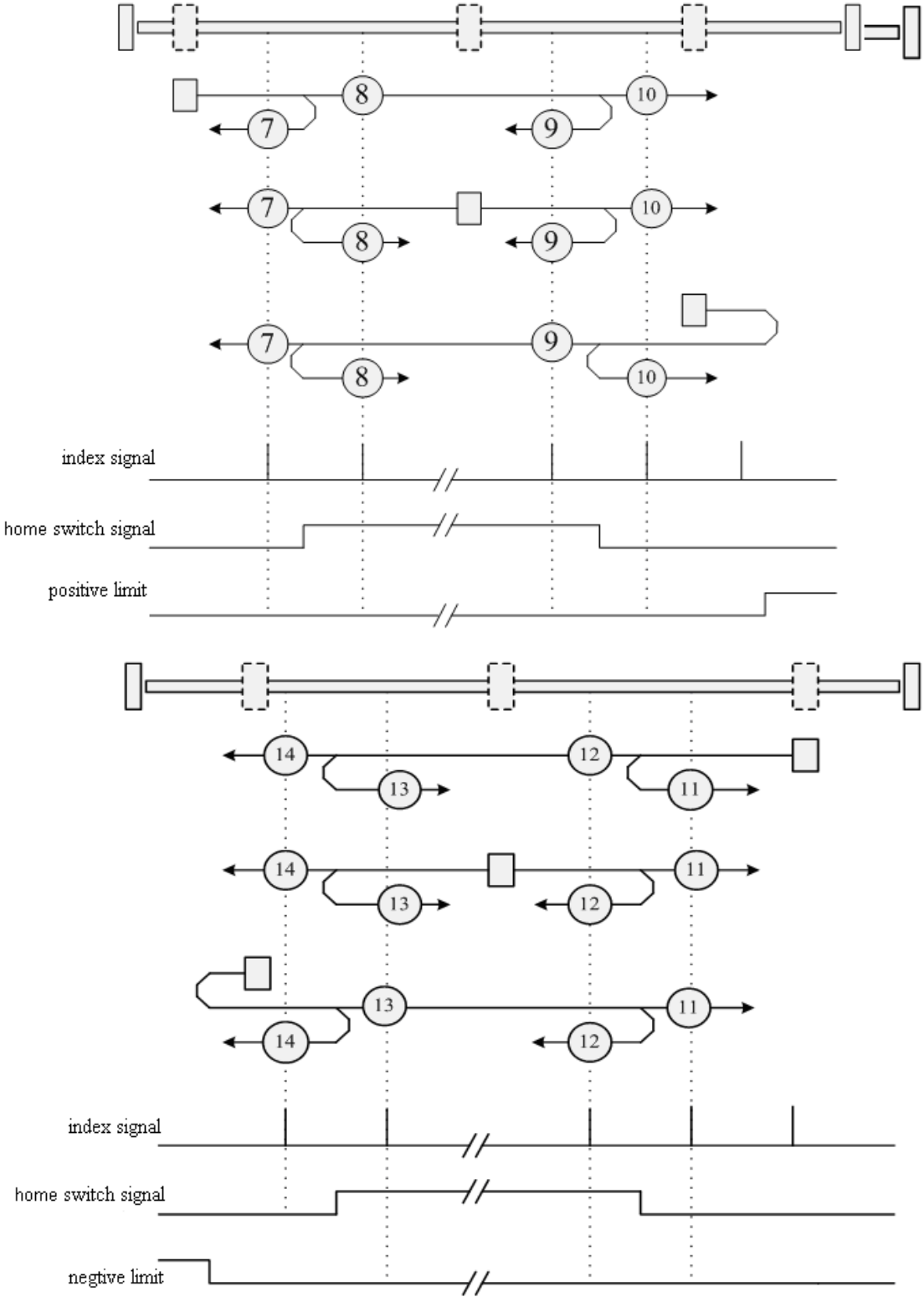
Using methods 5 or 6, the initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either the left or the right of the point where the home switch changes state. If the initial position is sited so that the direction of movement must reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.



Methods 7 to 14: Homing on the home switch and index pulse

These methods use a home switch that is active over only a portion of the travel; in effect the switch has a “momentary” action as the axle position sweeps past the switch.
Using methods 7 to 10, the initial direction of movement is to the right, and using methods 11 to 14, the initial direction of movement is to the left, except if the home

switch is active at the start of motion. In this case, the initial direction of motion is dependent on the edge being sought. The home position is at the index pulse on either side of the rising or falling edges of the home switch, as shown in the following two diagrams. If the initial direction of movement leads away from the home switch, the drive must reverse on encountering the relevant limit switch.

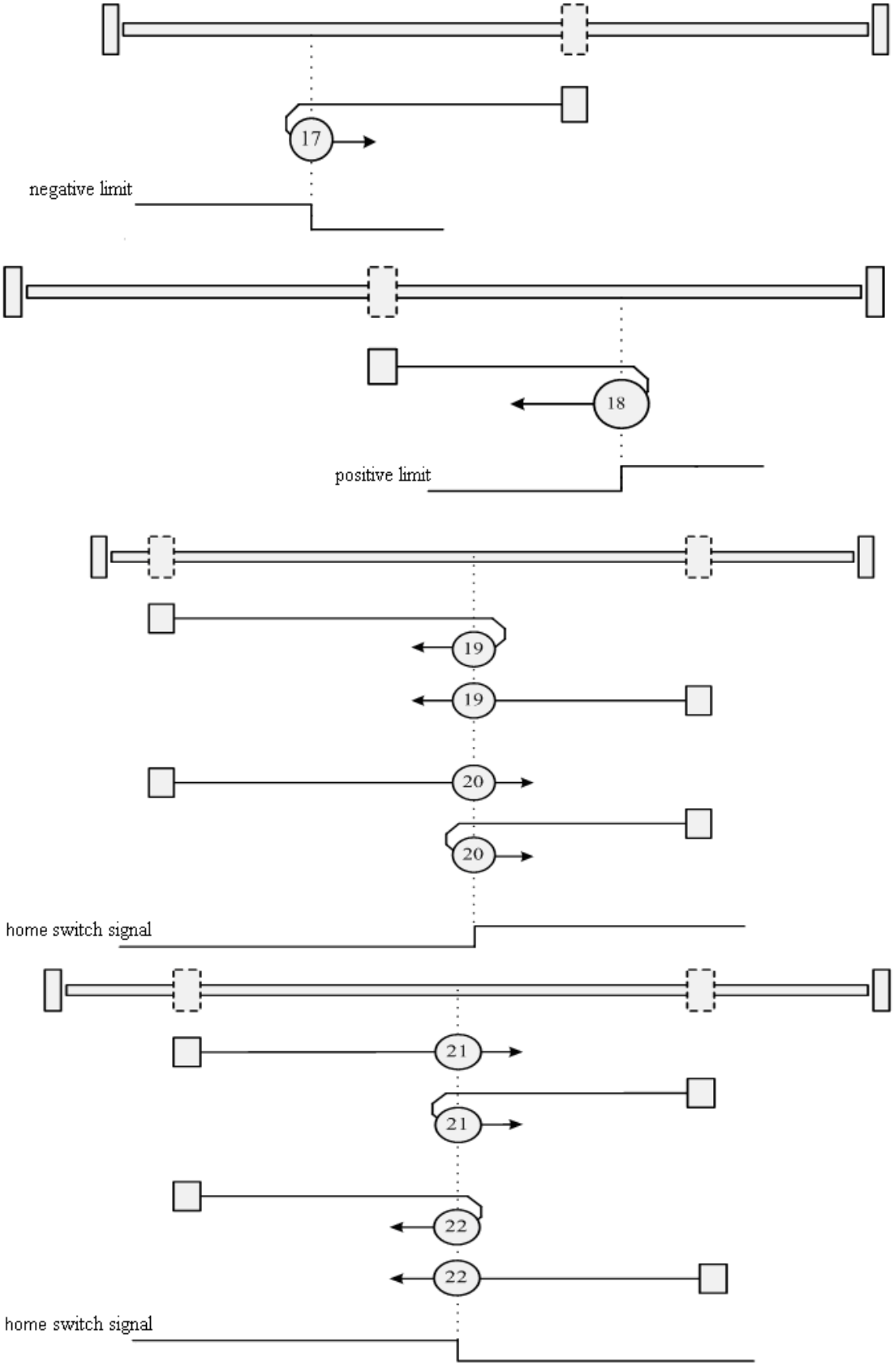


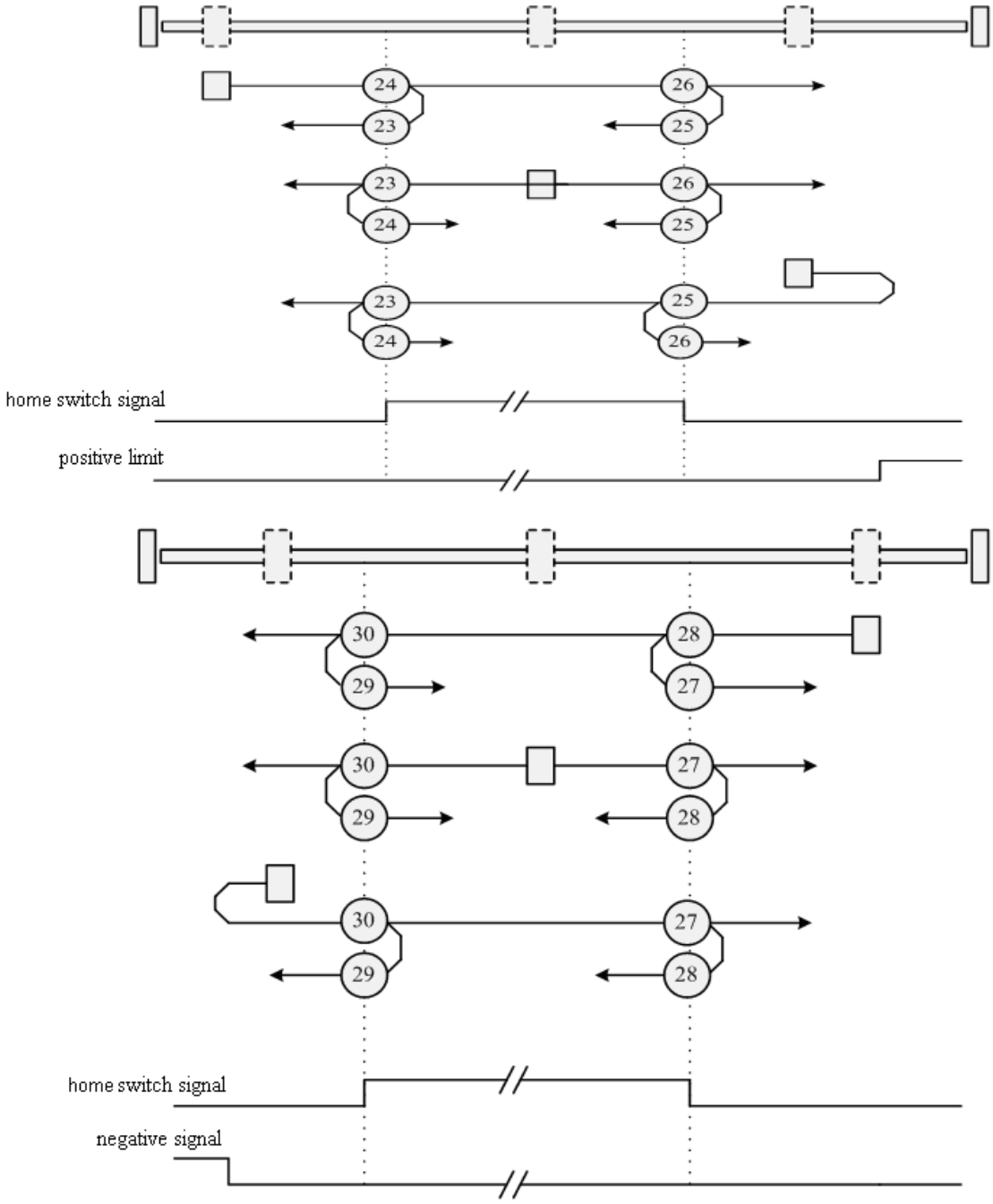
Methods 15 and 16: Reserved

These methods are reserved for future expansion of the homing mode.

Methods 17 to 30: Homing without an index pulse

These methods are similar to methods 1 to 14, except that the home position is not dependent on the index pulse; it is dependent only on the relevant home or limit switch transitions. For example, methods 19 and 20 are similar to methods 3 and 4, as shown in the following diagram:

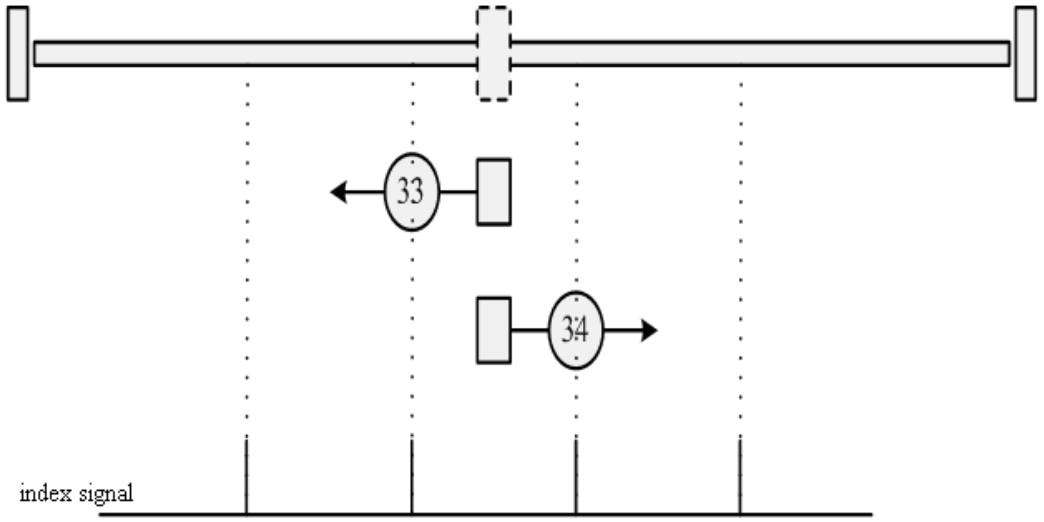




Methods 31 and 32: Reserved

These methods are reserved for future expansion of the homing mode.

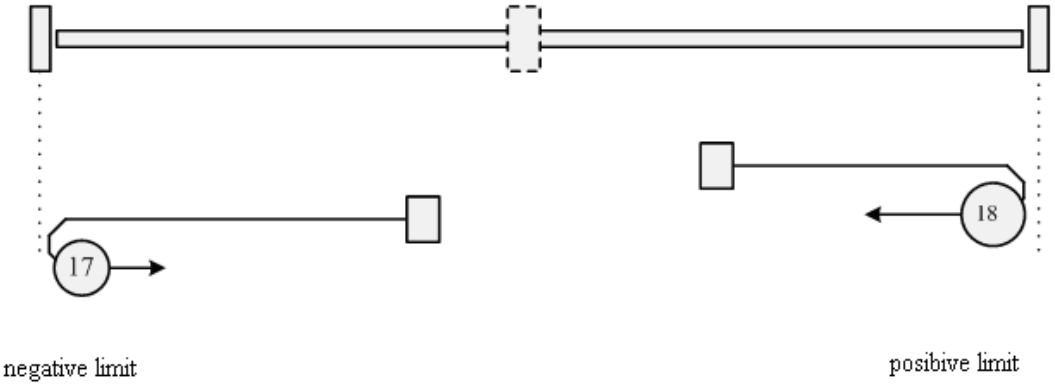
Methods 33 and 34: Homing on the index



Method 35: Homing on the current position

In this method, the current position is taken to be the home position.

Methods -17 and -18: Use the mechanical terminal as reference point



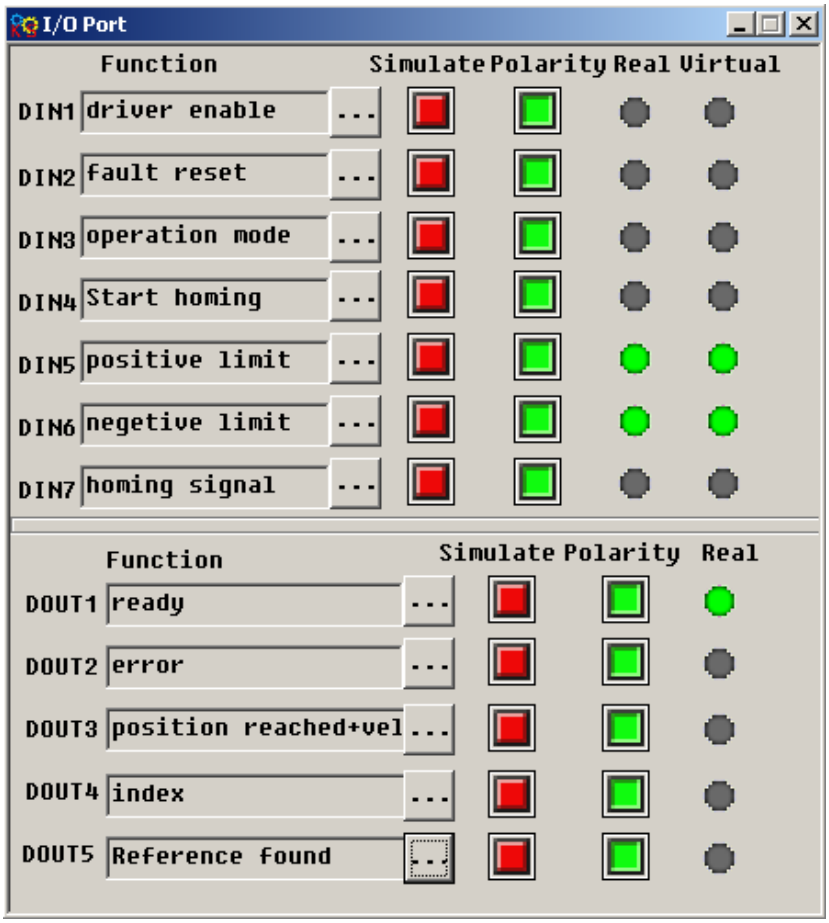
Example 7-11：Using method 7 for homing.

1. Set parameters.

Numberic display	Parameter Name	meaning	Setting Value
d3.01	Din1_Function	000.1: Driver enabled 000.2: Driver error reset 000.4: Operation mode 001.0:Positive limit 002.0:Negative limit 004.0:Origin signal	000.1 （Driver enabled）
d3.02	Din2_Function		000.2 （Driver error reset）
d3.03	Din3_Function		000.4 （Driver model control）

d3.04	Din4_Function	200.0:Start homing	200.0 （Start homing）
d3.05	Din5_Function		001.0 （Positive limit）
d3.06	Din6_Function		002.0 （Negative limit）
d3.07	Din7_Function		004.0 （Home signal）
d3.14	Dout4_Function	004.0:Index signal appears	004.0 (Index signal appears)
d3.15	Dout4_Function	040.0:Origin found	040.4 (origin found)
d3.16	Din_Mode0	Select this mode when the input signal is invalid	0.004 (-4)
d3.17	Din_Mode1	Select this mode when the input signal is valid	0.003 (-3)
d3.00	Store_Loop_Data	1： Storage all the setting parameters except those of motor 10： Initialize all the setting parameters except those of motor	0001 (1)

At this time, computer software shows:



Notice: The positive and negative limits are default to normally closed point. Otherwise, the Panel will alarm

and display P.L (positive limit) and N.L (No limit). Only when the alarm is eliminated, the origin control mode can be normally used.

Computer monitoring status is：

Basic Operate

	name	data	unit
1*	Operation_Mode_Buff	-4	DEC
2*	Status_Word	4437	HEX
3*	Pos_Actual	0	inc
4*	Real_Speed_RPM	0	rpm
5*	I_q	0.000	Ap
6	Operation_Mode	-4	DEC
7	CMD_q	0.000	Ap
8	Pos_Target	0	inc
9	SpeedDemand_RPM	0	rpm
10	Control_Word	2f	HEX
11	Switch_On_Auto	0	DEC
12	CMD_q_Max	6.797	Ap

2. Set parameters for homing.

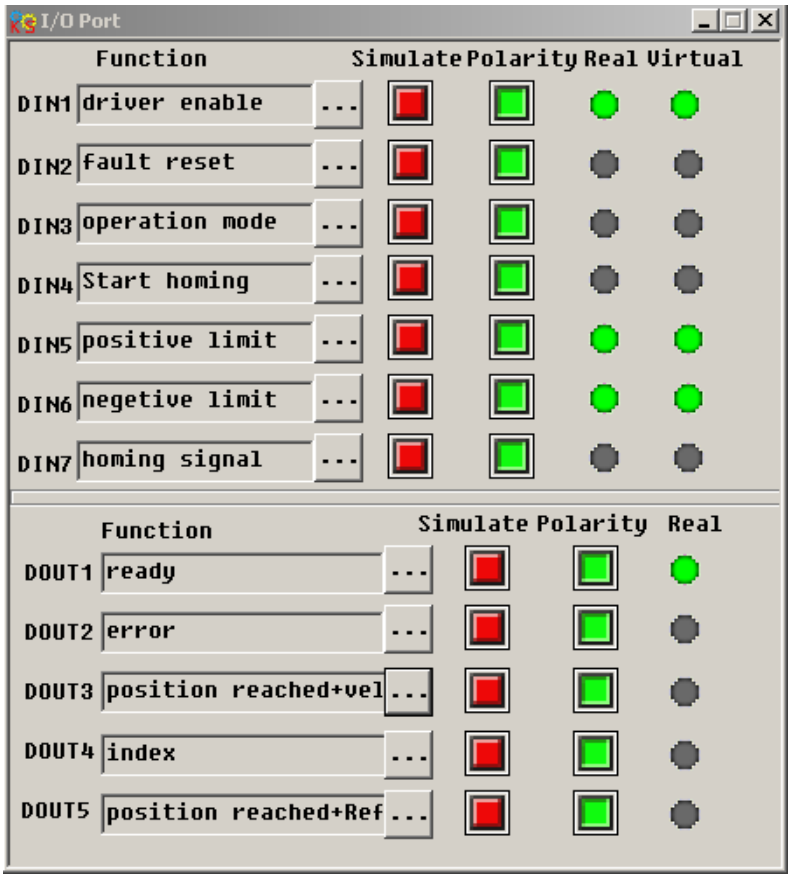
Homing Mode

	name	data	unit
1	Home_Offset	0	inc
2	Homing_Method	7	DEC
3	Homing_Speed_Switch	150.000	rpm
4	Homing_Speed_Zero	100.000	rpm
5	Homing_Power_On	0	DEC
6	Homing_Accelaration	50.000	rps/s
7	Homing_Current	1.780	Ap

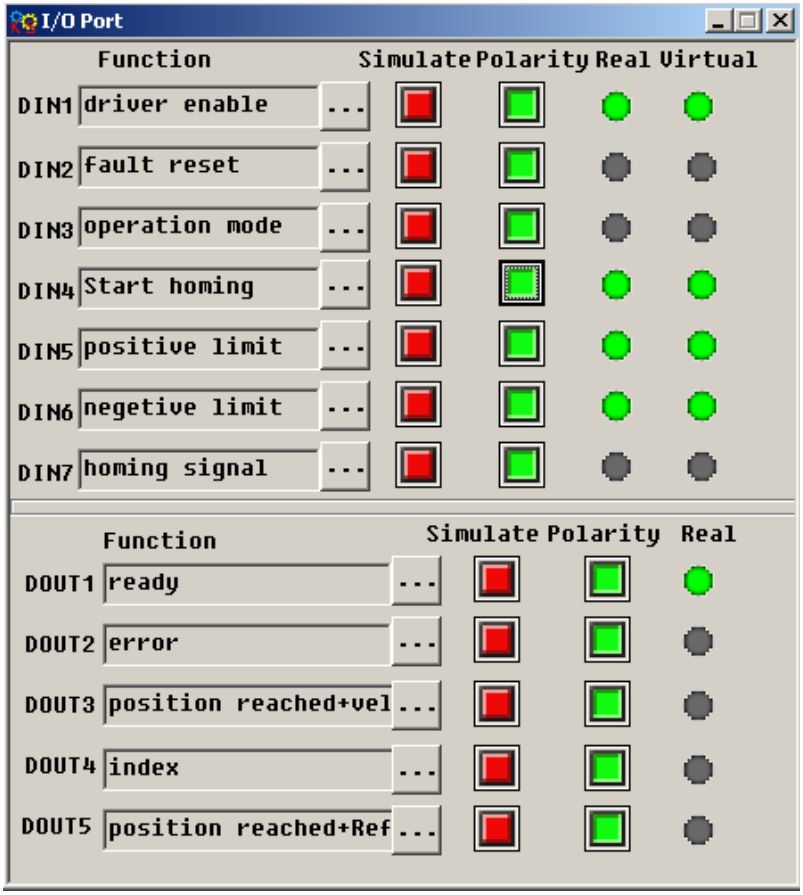
In common circumstance, only need to set up the model of origin and the rest of the parameters are default. In some case, “Electrify and then find the origin” is set to 1, at the same time the definition-- “Start finding the origin” is eliminated.

3. Start homing.

(1). Enable motor, which means the digital input point 1 is set to high-level. The computer motoring picture is shown below:



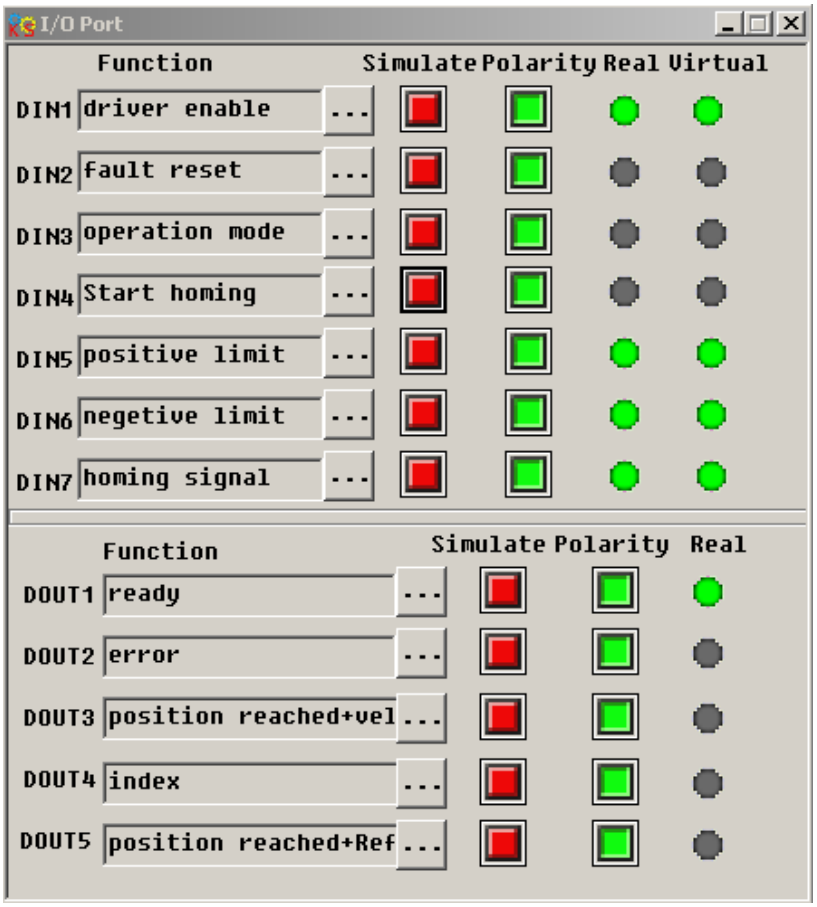
(2). Send “Start finding the origin” signal to motor, which means the digital input point 4 is set to high-level. The computer motoring picture is shown below:



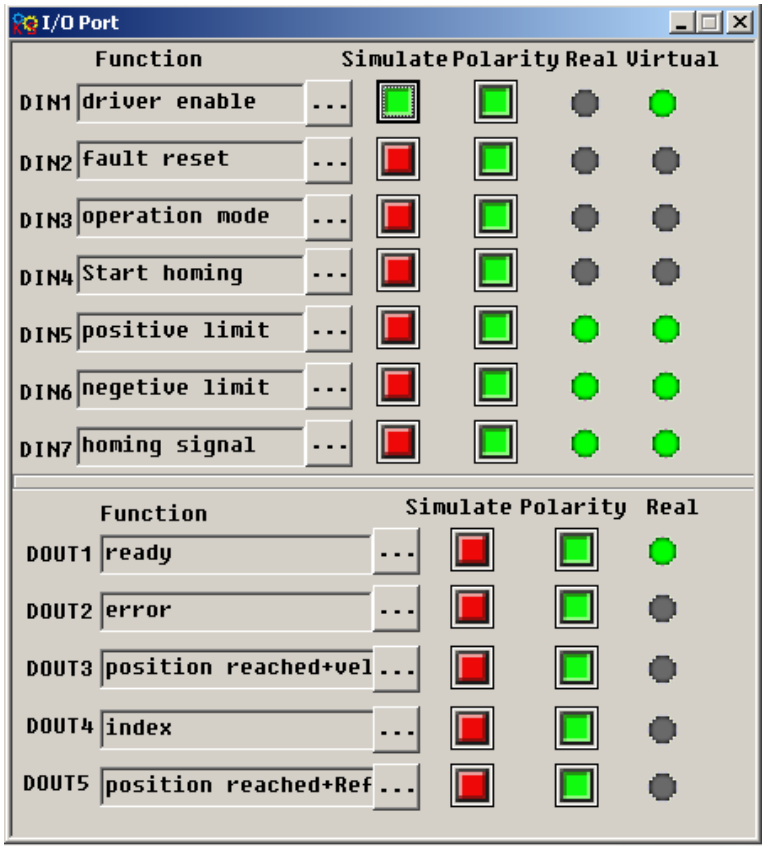
Note: “Start finding the origin” signal is a pulse signal, requires only a rise, not need to always be on. If you

want to start next time, a rise pulse is enough.

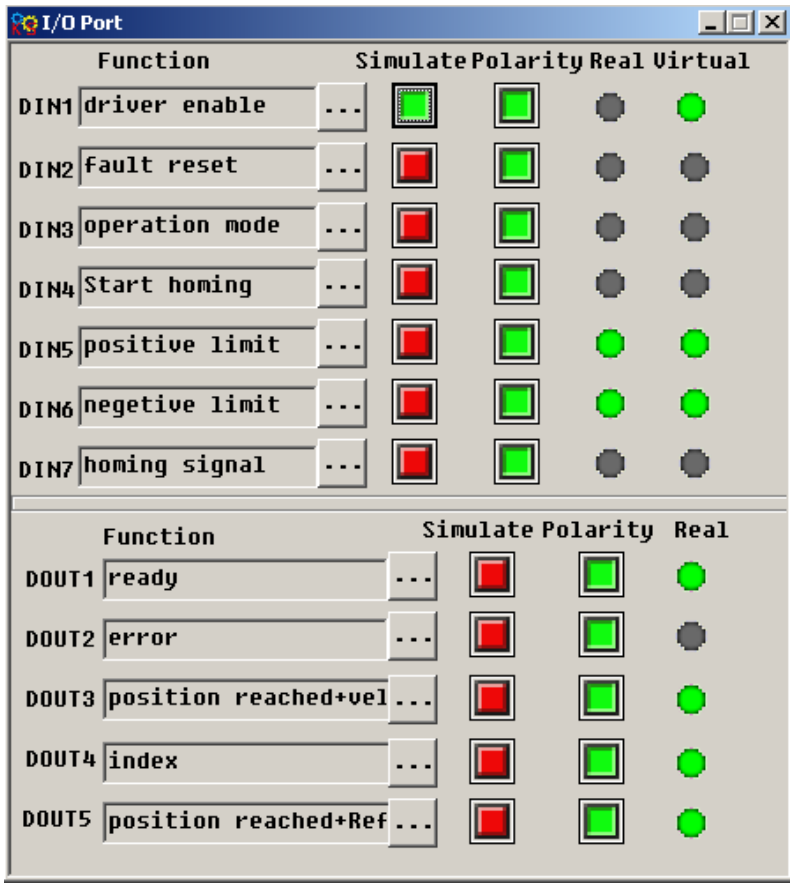
(4). After the external find the origin, computer monitoring picture is as follows:



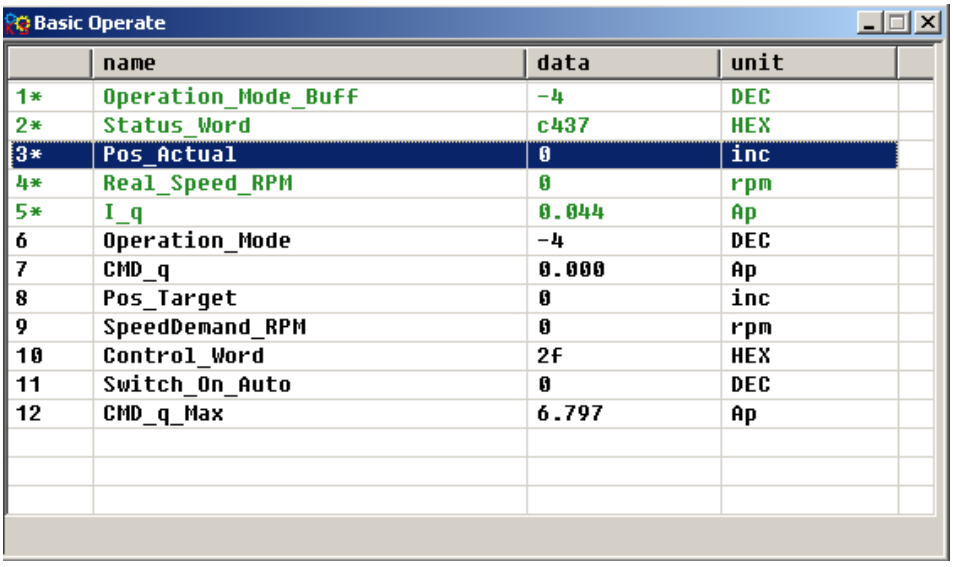
(5). Driver searches the Z phase signal in mode 7, and ultimately find the origin. Computer monitoring picture is shown as follows:



In mode 7, it is default to detect z phase signal after searching the origin decline along. Computer monitoring picture is shown as follows:



At this point, you have completed the origin search function, then the drive position is automatically set to zero, and the current position is default to origin. Computer monitoring picture is as shown:



Chapter 8 Control Performance

8.1 Driver Performance Tuning

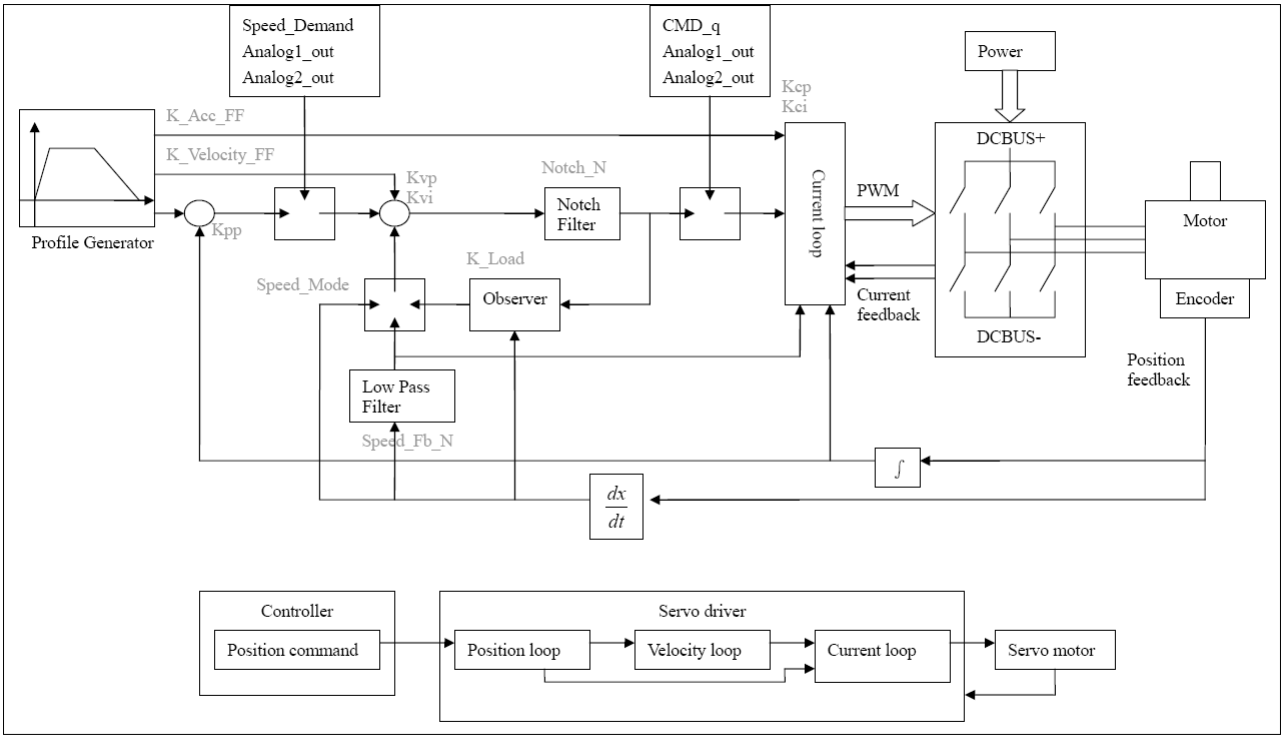


Fig. 8-1 Schematic diagram for control loop adjustment

As shown in Fig. 8-1, a typical servo system contains three control loops, namely, a position loop, a velocity loop, and a current loop.

Current loops are related to motor parameters (optimal parameters of the selected motor are default for the driver and no adjusting is required).

Parameters for velocity loops and position loops should be adjusted properly according to loading conditions.

During adjustment of the control loop, ensure that the bandwidth of the velocity loop is at least twice of that of the position loop; otherwise oscillation may occur.

8.1.1 Manual Adjustment

1. Parameters for velocity loop

Table 8-1 Parameters for velocity loop

Numeric Display	Variable Name	Meaning	Default Value	Range
d2.01	Kvp	Sets the response speed of a velocity loop	100	0~32767
d2.02	Kvi	Adjusts speed control so that the time of minor errors is compensated	2	0~16384

d2.05	Speed_Fb_N	Reduces the noise during motor operation by reducing the feedback bandwidth of velocity loops (smoothing feedback signals of encoders). When the set bandwidth becomes smaller, the motor responds slower. The formula is F=Speed_Fb_N*20+100. For example, to set the filter bandwidth to "F = 500 Hz", you need to set the parameter to 20.	45	0~45

Proportional gain of velocity loop Kvp: If the proportional gain of the velocity loop increases, the responsive bandwidth of the velocity loop also increases. The bandwidth of the velocity loop is directly proportional to the speed of response. Motor noise also increases when the velocity loop gain increases. If the gain is too great, system oscillation may occur.

Integral gain of velocity loop Kvi: If the integral gain of the velocity loop increases, the low-frequency intensity is improved, and the time for steady state adjustment is reduced; however, if the integral gain is too great, system oscillation may occur.

Adjustment steps:

Step 1: Adjust the gain of velocity loop to calculate the bandwidth of velocity loop

Convert the load inertia of the motor into the inertia Jl of the motor shaft, and then add the inertia Jr of the motor itself to obtain Jt = Jr + Jl. Put the result into the formula:

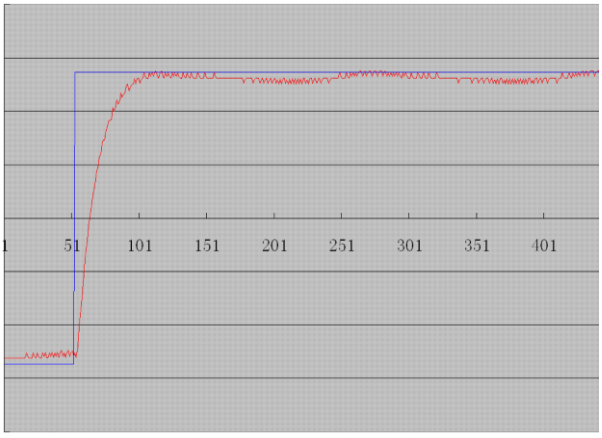
$$\mathrm{Vc\_Loop\_BW} = \mathrm{Kvp} * \frac{I_p * K_t * Encoder\_R}{J_t * 204800000 * \sqrt{2} * 2\pi}$$ To calculate the bandwidth of the velocity loop

$\mathrm{Vc\_Loop\_BW}$ according to the adjusted the gain of velocity loop Kvp, only adjust Kvi according to actual requirements.

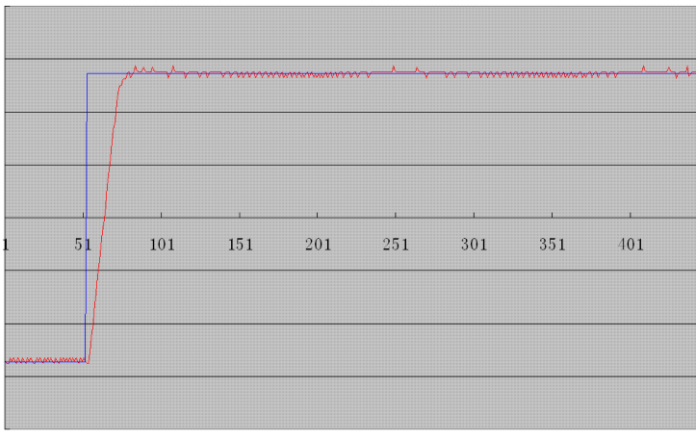
Adjust the impact of Kvp and Kvi, as shown in Fig. 8-2.

For the effect of Kvp adjustment, see the first to the fourth from left of Fig. 8-2. Kvp gradually increases from the first to the fourth from left. The value of Kvi is 0.

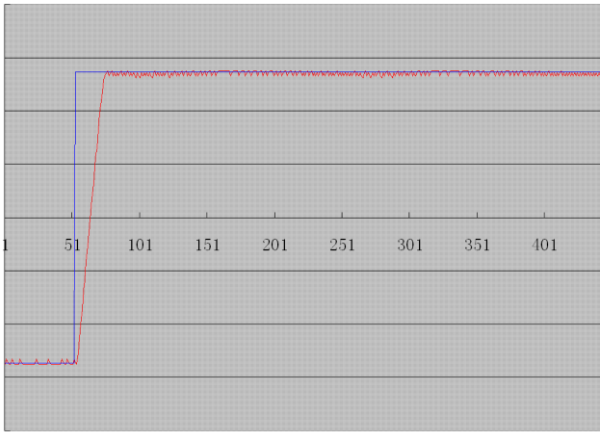
For the effect of Kvi adjustment, see the first to the fourth from right of Fig. 8-2. Kvi gradually increases from the first to the fourth from right. The value of Kvp remains unchanged.



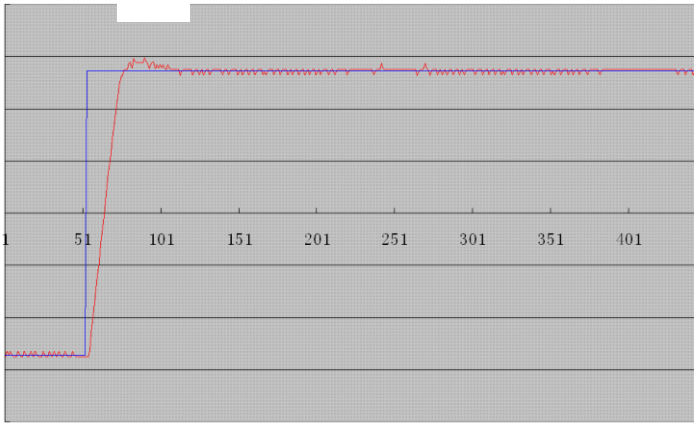
Left 1



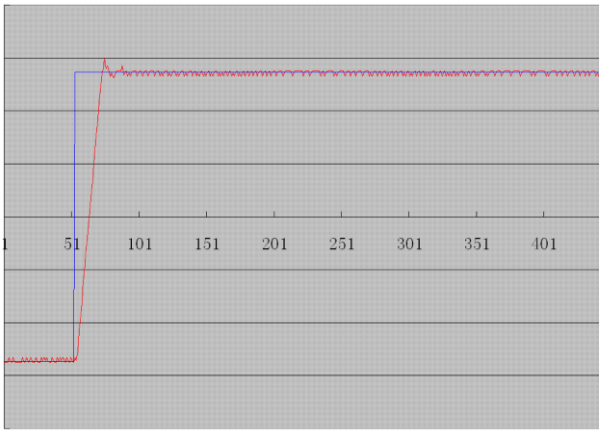
Right 1



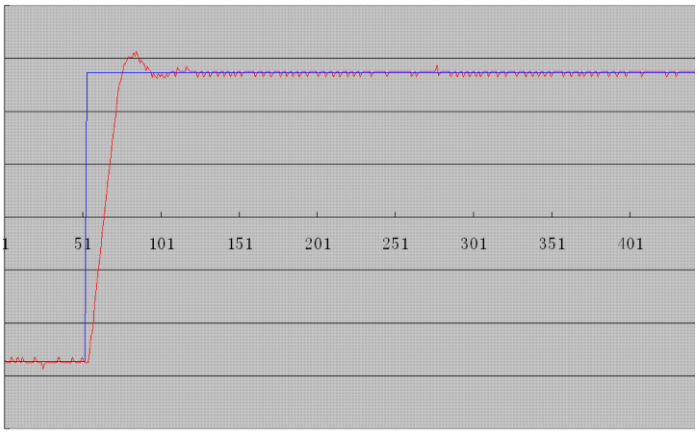
Left 2



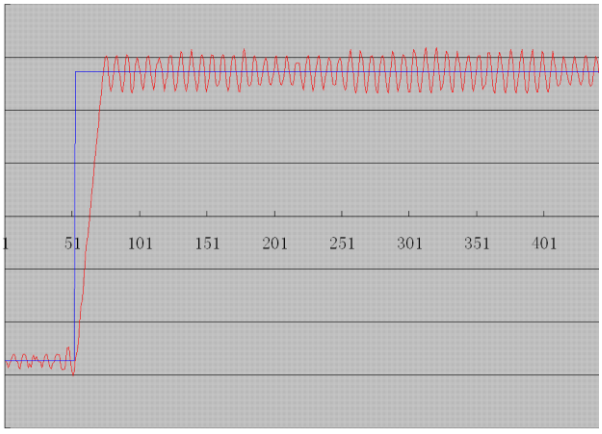
Right 2



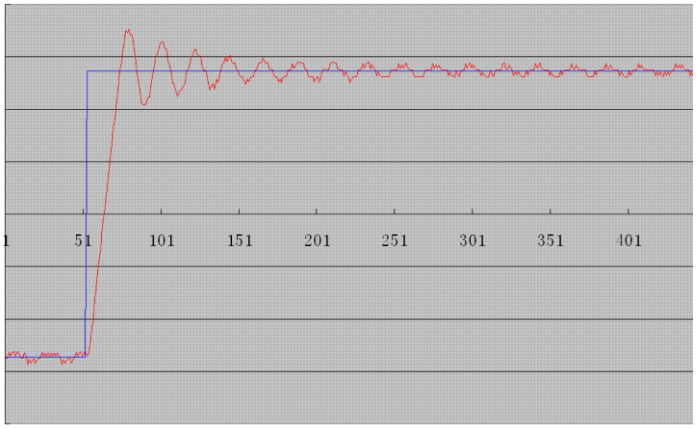
Left 3



Right 3



Left 4



Right 4

Fig. 8-2 Schematic diagram of gain adjustment of velocity loop

Step 2: Adjust parameters for feedback filter of velocity loop

During gain adjustment of a velocity loop, if the motor noise is too great, you can properly reduce the parameter Speed_Fb_N for feedback filter of the velocity loop;

however, the bandwidth F of the feedback filter of velocity loop must be at least three times of the bandwidth

of velocity loop; otherwise oscillation may occur. The formula for calculating the bandwidth of feedback filter of velocity loop is F = Speed_Fb_N*20+100 (Hz).

2. Parameters for position loop

Table 8-2 Parameters for position loop

Numeric Display	Variable Name	Meaning	Default Value	Range
d2.07	Kpp	Indicates the proportional gain of the position loop Kpp	1000	0~16384
d2.08	K_Velocity_FF	0 indicates no feedforward, and 256 indicates 100% feedforward	256	0~256
d2.09	K_Acc_FF	The value is inversely proportional to the feedforward	7FF.F	32767~10
d0.05	Pc_Loop_BW	Sets the bandwidth of the position loops in Hz	0	N/A

Proportional gain of the position loop Kpp: If the proportional gain of the position loop increases, the bandwidth of the position loop is improved, thus reducing both the positioning time and following errors. However, too great bandwidth may cause noise or even oscillation. Therefore, this parameter must be set properly according to loading conditions. In the formula Kpp=103* Pc_Loop_BW, Pc_Loop_BW indicates the bandwidth of the position loop. The bandwidth of a position loop is less than or equal to that of a velocity loop. It is recommended that Pc_Loop_BW be less than Vc_Loop_BW /4 (Vc_Loop_BW indicates the bandwidth of a velocity loop).

Velocity feedforward of the position loop K_Velocity_FF: the velocity feedforward of a position loop can be increased to reduce position following errors. When position signals are not smooth, if the velocity feedforward of a position loop is reduced, motor oscillation during running can be reduced.

Acceleration feedback of the position loop K_Acc_FF (adjustment is not recommended for this parameter): If great gains of position rings are required, the acceleration feedback K_Acc_FF can be properly adjusted to improve performance. $\mathrm{K\_Acc\_FF} = \frac{I_p * K_t * Encoder\_R}{250000 * \sqrt{2} * J_t * \pi}$ Note: K_Acc_FF is inversely proportional to the acceleration feedforward.

Adjustment steps:

Step 1: Adjust the proportional gain of a position loop.

After adjusting the bandwidth of the velocity loop, it is recommended to adjust Kpp according to actual requirements (or directly fill in the required bandwidth in Pc_Loop_BW, and the driver will automatically calculate the corresponding Kpp). In the formula Kpp = 103*Pc_Loop_BW, the bandwidth of the position loop is less than or equal to that of the velocity loop. For a common system, Pc_Loop_BW is less than Vc_Loop_BW /2; for the CNC system, it is recommended that Pc_Loop_BW is less than Vc_Loop_BW /4.

Step 2: Adjust velocity feedforward parameters of the position loop.

Velocity feedforward parameters (such as K_Velocity_FF) of the position loop are adjusted according to position errors and coupling intensities accepted by the machine. The number 0 represents 0% feedforward, and 256 represents 100% feedforward.

3. Parameters for pulse filtering coefficient

Table 8-3 Parameters for pulse filtering coefficient

Numeric Display	Variable Name	Meaning	Default Value	Range
d3.37	PD_Filter	Used to smooth the input pulses. Filter frequency: f = 1000/(2π* PD_Filter) Time constant: T = PD_Filter/1000 Unit: S Note: If you adjust this filter parameter during the operation, some pulses may be lost.	3	1~32767

When a driver operates in the pulse control mode, if the electronic gear ratio is set too high, this parameter must be adjusted to reduce motor oscillation; however, if the parameter adjustment is too great, motor running instructions will become slower.

8.1.2 Auto Adjustment (Only for Velocity Loops)

Auto adjustment is only available for velocity loops (see Section 8.11 for manual adjustment of position loops) when both forward rotation and reverse rotation of a motor are allowable, and the loadings do not change much during the operation. You can determine the total inertia of motor loadings through gain auto tuning, and then manually enter the desired bandwidth. The driver will automatically calculate appropriate Kvp and Kvi values. The motion curve is in the shape of a sine curve, as shown in Fig. 8-3.

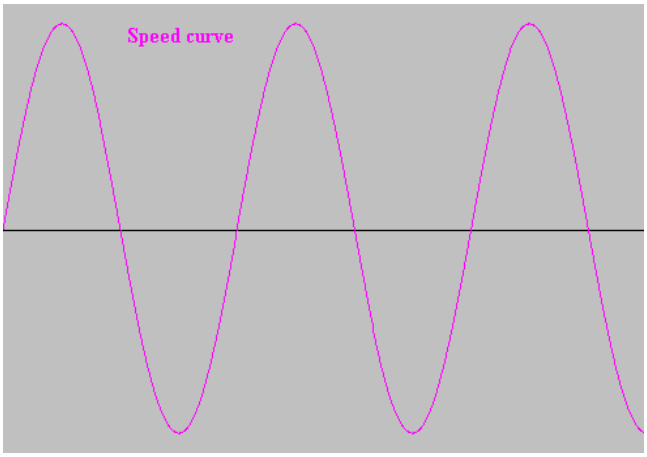


Fig. 8-3 Speed curve

K_Load represents the internal data that displays the actual inertia of the system.

$$K\_Load = \frac{I_p * K_t * Encoder\_R * 16}{62500 * \sqrt{2}\pi * J_t}$$

In the above formula:

Ip represents the maximum peak output current in units of “A”;

Kt represents the torque constant of the motor in units of “Nm/Arms”;

Encoder_R represents the resolution of a motor encoder in units of “inc/r”; and

Jt represents the total inertia of the motor and loadings in units of “kg*m^2”.

Table 8-4 Parameters for controlling gain auto tuning

Numeric Display	Variable Name	Meaning	Default Value	Range
d0.06	Tuning_Start	Auto tuning starts after the variable is set to 11. All input signals are ignored during	0	/

		auto tuning. The variable is automatically changed to 0 after auto tuning is completed. Sets the variable to other values to end auto tuning.		
d0.04	Vc_Loop_BW	Sets the bandwidth of the velocity loop in Hz. The variable can only be set after auto tuning is performed properly; otherwise the actual bandwidth goes wrong, which causes abnormal working of the driver. If the auto tuning result is abnormal, setting this parameter may also cause abnormal working of the driver. Note: This parameter cannot be applied when auto tuning is unavailable.	0	0~600
d2.17	K_Load	Indicates loading parameters	/	20~15000
d2.21	Sine_Amplitude	Proper increase in this data will reduce the tuning error, but machine vibration will become severer. This data can be adjusted properly according to actual conditions of machines. If the data is too small, the auto tuning error becomes greater, or even causes a mistake	64	0~1000
d2.22	Tuning_Scale	It is helpful to reduce the auto tuning time by reducing the data, but the result may be unstable.	128	0~16384
d2.23	Tuning_Filter	Indicates filter parameters during auto-tuning	64	1~1000

Auto tuning is a process where the suitable and stable K_Load value is automatically calculated. In the auto tuning mode, the data of numeric display is automatically switched to the real-time display mode of K_Load data. When K_Load data gradually becomes stable, the driver automatically adjusts Kvp and Kvi data of a velocity loop, so that the actual bandwidth of the velocity loop is 50Hz. When K_Load data becomes stable, the driver automatically stops auto tuning operation; then you need to customize Vc_Loop_BW, representing the desired bandwidth of the velocity ring. Finally, run the test system in the actual environment, and save the parameters.

Precautions:

1. Auto tuning applies when both forward rotation and reverse rotation of a motor are allowable, and the loadings do not change much during the operation. When forward rotation or reverse rotation of the motor is not allowable on a device, it is recommended to adjust the parameters manually.
2. During auto tuning operation, pulse signals, digital input signals, and analog signals of the external controller are temporarily unavailable, so safety must be ensured.
3. Before auto tuning operation, it is recommended to properly adjust the Kvp, Kvi and Speed_Fb_N (a feedback filter parameter) values of the velocity loop to prevent visible oscillations when the system

works in the speed mode. If necessary, adjust the data of d2.03 notch filter to inhibit resonance.

4. The time for different load tuning varies, and generally a few seconds is required. The auto tuning time can be reduced by presetting the K_Load value to a predicted value that is close to the actual value.
5. Vc_Loop_BW can be written only after successful auto tuning, otherwise the driver may work improperly. After you write the desired bandwidth of the velocity loop in Vc_Loop_BW, the driver automatically calculates the corresponding values of Kvp, Kvi and Speed_Fb_N. If you are dissatisfied with low-speed smoothness, you can manually adjust Kvi. Note that auto tuning does not automatically adjust the data of a notch filter.

In the following circumstances, auto tuning parameters should be adjusted:

1. When the friction in a rotation circle of the motor is uneven, it is required to increase the amplitude of d2.21 sine wave to reduce the impacts caused by uneven friction. Note that d2.21 increases when the oscillation amplitude of the loadings increase.
2. If auto tuning lasts for a long time, initial evaluation of the total inertia is available. It is recommended to set K_Load to an evaluation value before auto tuning.
3. If auto tuning is unstable, the stability of auto tuning increases when d2.22 increases properly, but the time for auto tuning slightly increases.

In the following conditions, auto adjustment goes wrong. In this case, you can only set parameters manually:

1. The load inertia is featured by great fluctuation.
2. Mechanical connection rigidity is low.
3. Clearances exist in the connection between mechanical elements.
4. The load inertia is too great, while Kvp values are set too low.
5. If the load inertia is too great, K_Load data will be less than 20; if the load inertia is too little, K_Load data will be greater than 15000.

Operational steps:

1. Step 1: Press **MODE** to enter Group F002. Select the object addresses “d2.01”, “d2.02” and “d2.05” respectively for initial settings, so that no obvious oscillation occurs when the system works in the speed mode.
2. Step 2: Press **MODE** to enter Group F000. Select the object address “d0.06”, set the address to 11, and auto tuning starts.
3. Step 3: Press **MODE** to enter the parameter display status. During auto tuning, the content of numeric display is K_Load data in real time. Step 4: When K_Load data becomes stable, auto tuning is completed, and the value of “d0.06” is automatically changed to 0.
4. Step 5: You need to customize the required bandwidth of the velocity loop Vc_Loop_BW. In this case, it is recommended to increase the bandwidth gradually, until the machine works in the optimum state. Finally, run the test system in the actual environment and save the parameters.

8.2 Oscillation Inhibition

If resonance occurs during machine operation, you can adjust a notch filter to inhibit resonance. If resonance frequency is known, you can directly set Notch_N to (BW-100)/10. Note that you need to set Notch_On to 1 to enable the notch filter. If you do not know exactly the resonance frequency, you can firstly set the max value of d2.14 current instruction to a low one, so that the oscillation amplitude is within the acceptable range; then try to adjust Notch_N to check whether resonance disappears.

If machine resonance occurs, you can calculate the resonance frequency by observing the waveform of the target current with the oscilloscope function of the driver.

Table 8-5 Parameters for oscillation inhibition

Numeric Display	Variable Name	Meaning	Default Value	Range
d2.03	Notch_N	Notch/filtering frequency setting for a velocity loop, used to set the frequency of the internal notch filter, so as to eliminate the mechanical resonance produced when the motor drives the machine. The formula is F = Notch_N*10 + 100. For example, if the mechanical resonance frequency is F = 500 Hz, the parameter should be set to 40.	45	0~90
d2.04	Notch_On	Enable or disable the notch filter 0: Disable the notch filter 1: Enable the notch filter	0	/

Chapter 9 Communication

A CD servo driver has the RS232 communication interface, which directly controls the working of the servo driver with the operation software of a host computer. If the servo driver needs to communicate with a Programmable Logic Controller (PLC) or other controllers via the free RS485 communication interface, an RS232 to RS485 converter should be added on the driver side.

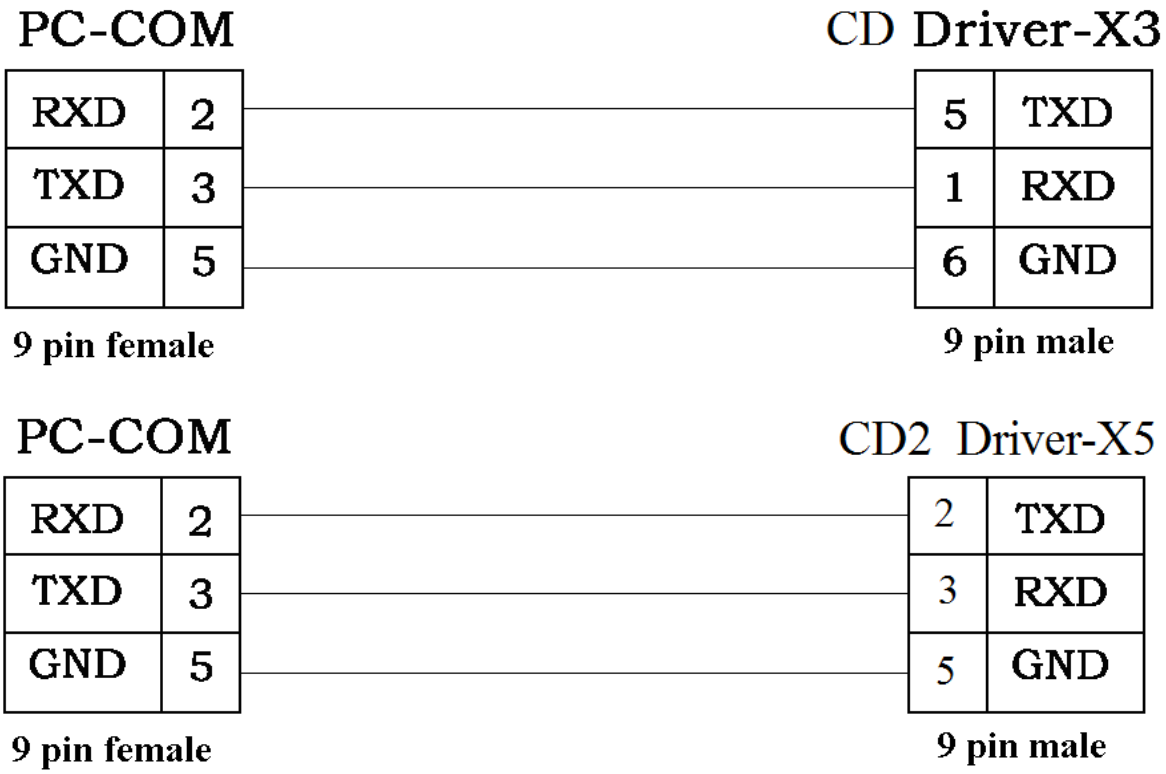


Fig. 9-1 Communication cables between a PC and a servo driver

9.1 Transport Protocol

The RS-232C communication of the CD servo driver strictly follows a master/slave protocol. The host computer can send any data to CD driver. The driver configured with ID No. will calculate such data and return a reply. Default communication settings for the CD servo driver are as follows:

Baud rate = 38400 bps

Data bits = 8

Stop bits = 1

No parity check

The baud rate can be changed by setting d5.02, after changing the value, it is necessary to set d2.00 or d3.00 to save it and reboot the system so that it will take effect.

The transport protocol used by the RS-232 uses a data packet with fixed length of 10 bytes.

byte 0		byte 9
ID	8 byte data	CHKS

ID is the ID No. of the slave

CHKS =-SUM(byte0,…,byte8), CHKS is the last two digits of the calculation result.
The host sends:

byte 0		byte 9
ID	8 byte host data	CHKS

The slave sends/The host receives:

byte 0		byte 9
ID	8 byte slave data	CHKS

Note: Each 10-byte packet has its own CHKS.
If the host sends an ID not existed in the network to the CD servo driver, no CD servo driver will make a reply. After the host sends the data correctly, the slave will find the data packets in compliance with its own ID and check the CHKS value. If the checksum does not match, the slave will not make a response.

9.2 Data Protocol

A data protocol is different from a transport protocol. It contains 8 bytes of all 10 bytes of the above RS-232. Definition of CD servo driver internal data complies with the CANopen international standard. All parameters, values and functions are expressed by index and subindex.

9.2.1 Download(from Host to Slave)

Download refers to that the host sends a command to write values into the objects in the slave, and the host generates an error message when the value is downloaded to a non-existent object.
The host sends:

byte 0	byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7
CMD	INDEX		SUB INDEX	DATA			

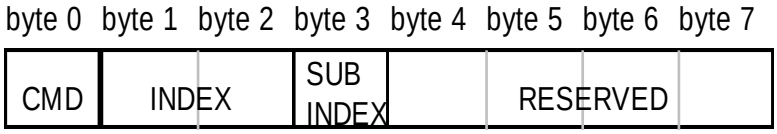
CMD Specifies the direction of data transfer and the volume of data.
23(0x16) Sends 4-byte data (bytes 4...7 contain 32 bits)
2b(0x16) Sends 2-byte data (bytes 4, 5 contain 16 bits)
2f(0x16) Sends 1-byte data (bytes 4 contains 8 bits)
INDEX Index in the object dictionary where data should be sent
SUB INDEX Subindex in object dictionary where data should be sent
In all four bytes in data, the lower-order bits are arranged before the higher-order bits. To write 600 RPM into “Target Velocity” in the slave, the unit of 2FF00910 is rpm, 600 is in decimal system, and 258 is in hexadecimal system.Since the length of the object to be written is 4 bytes and the calculation result 02 58 has only 2 bytes,zero shall be filled to the higher-order bits. Therefore, the final result = 00 00 02 58.
DATA: byte4=58,byte5=02,byte6=00,byte7=00
The slave answers:

byte 0	byte 1	byte 2	byte 3	byte 4	byte 5	byte 6	byte 7
RES	INDEX		SUB INDEX	RESERVED			

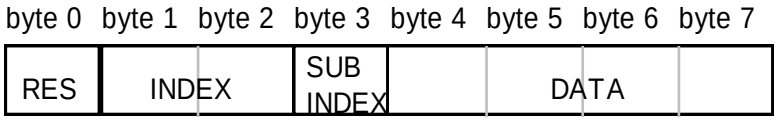
RES: Displays slave response:
60(0x16) Data successfully sent
80(0x16) Error, bytes 4…7 contain error cause
INDEX 16-bit value, same as that sent by the master
SUBINDEX 8-bit value, same as that sent by the master
RES Reserved for future use

9.2.2 Upload(From Slave to Host)

Upload refers to that the master sends a command to read object address in the slave and the master will generate an error if a non-existent target address is uploaded.
The master sends:



CMD Specifies the direction of data transfer
40(0x16)
INDEX 16-bit value
SUBINDEX 8-bit subindex
RESERVED Bytes 4…7 not used
The slave receives:



RES Displays slave response:
43(0x16) bytes 4...7 contain 32-bit data
4B(0x16) bytes 4, 5 contain 16-bit data
4F(0x16) byte 4 contains 8-bit data
80(0x16) error, bytes 4…7 contain error cause
INDEX 16-bit value, same as that sent by the master
SUBINDEX 8-bit value, same as that sent by the master
If the data contains no error, byte 4…byte 7 save the object value read from the slave, with the lower-order bits arranged before the higher-order bits. Correct value = byte7, byte6, byte5, byte4. If there is an error, data contained in these four types is no longer object values read from the slave.
For example:
The master sends a “upload” command to the slave:
01 40 F0 2F 09 58 02 00 00 3D (This command reads target velocity 2FF00910 from the slave)
The slave answers:
01 4B F0 2F 09 58 02 00 00 32
Indicates: 01—Slave index is 1. 4B – Received data contains 2 bytes, saved to byte 4…byte 5 in the 10 bytes of the response. byte4=58, byte5=02, byte6=00, byte7=00. Then, DATA= byte7 byte6 byte5 byte4 = 0258(hex)= 600 rpm

Chapter 10 Troubleshooting

10.1 Alarm Messages

Digital flickering on the display indicates that an alarm occurs indicating that the driver is faulty. For details about faults, see Table 10-1 “Fault codes”. A code of the alarm message is represented by a hexadecimal data, and four numeric displays appear. If the driver is faulty, the corresponding bits in the alarm codes are set to “1”. For example, if an encoder is not connected, the 1st and 2nd bits of the faulty code are set to “1”. As a result, “0006” is displayed.

Table 10-1 Fault codes

1st bit in numeric display (left)				2nd bit in numeric display				3rd bit in numeric display				4th bit in numeric display (right)			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
EEPROM Error	Commutation	Reserved	Over Frequency	Ilt Error	Logic Voltage	Following Error	Chop Resistor	Over Current	Low Voltage	Over Voltage	Over Temperature	Encoder Counting	Encoder UVW	Encoder ABZ	Internal

A maximum of 7 generated alarms can be stored in the driver. For details, enter the menu of Group F007. Press **Enter**. The interface of faulty codes is displayed. The errors that you first discovered are those that have occurred most recently. Press ▲ or ▼ to browse the messages of historical alarms. If the decimal point at the lower right corner in the second bit of the numeric display is on, it indicates that the earliest alarm message is just browsed; if the decimal point at the lower right corner in the third bit of the numeric display is on, it indicates that the latest alarm message is just browsed.

For details on error messages, you need to access PC software via a communication port to check the working status of the driver when an error occurs. Here are some messages of the driver for your reference:

1. Error codes;
2. Bus voltage when an error occurs;
3. Motor speed when an error occurs;
4. Motor current when an error occurs;
5. Driver temperature when an error occurs;
6. Working mode of the driver when an error occurs;
7. Accumulated working time of the driver when an error occurs;
8. Whether the current loop works when an error occurs; [0x0000 indicates that the power tube does not work, and 0x0077 indicates that the power tube is working]

10.2 Alarm Causes & Troubleshooting

Alarm code	Alarm Information	Alarm Cause	Troubleshooting
FFF.F /800.0	No motor configured	There is no motor type set in servo driver	Set the motor type in d4.01.
000.1	Internal	Internal problem	Please contact manufacturer
000.2	Encoder ABZ	The ABZ signal cable is disconnected.	Check the cable.
000.4	Encoder UVW	The UVW signal cable is disconnected.	Check the cable.
000.8	Encoder Counting	Interferences are suppressed. Encoder cable problem	Check encoder cable. Remove interference(Such as connect the motor cable to SHIELD terminal etc.)
000.6	Encoder Error	ABZ and UVW signals of the encoders incur error simultaneously.	Check the cable.
001.0	Over Temperature	The driver temperature exceeds 83℃.	Check whether the selected driver has enough power.
002.0	Over Voltage	The bus voltage of the driver exceeds the allowable range.	Check the input voltage,or determine whether a braking resistor is connected.
004.0	Low Voltage	The voltage of the driver bus is below the allowable range.	Check the input power. Power on AC first,then power DC. Reduce deceleration.
008.0	Over Current	The power tube in the driver is faulty, or short circuit occurs on the phase line of the motor.	Check motor wires. If the motor works properly, it can be judged that faults occur on the power tube in the driver.
010.0	Chop Resistor	The actual power of brake resistor is larger than rated power	Change brake resistor.
020.0	Following Error	Control loop parameters setting problem. Overload or block. Encoder signal problem.	Set VFF (d2.08) as 100%,increase kpp(d2.07) and kvp(d2.01). Choose bigger power motor or check whether the load is blocked. Check the encoder cable.
040.0	Logic Voltage	The logic voltage is lower than 18V.	Check the logic power supply 24V.
080.0	IIt Error	Control loop parameters setting problem. Overload or block.	Increase kvp(d2.01). Choose bigger power motor or check whether the load is blocked.
100.0	Over Frequency	The input pulse frequency exceeds the allowable maximum value.	Check the input pulse frequency and the maximum permissible value of the frequency.（d3.38）。

200.0	STO Error	STO Error	Check the wiring according to Chapter 3.4.
400.0	Commutation	UVW signal of encoder cable problem	Check encoder cable.
800.0	EEPROM Error	Because of updating firmware. Driver internal problem.	Initialize all control parameters and save,then restart driver. Contact manufacturer.
888.8	Driver abnormal working states	Logic power supply problem. Driver internal problem.	Check 24VDC power supply. Contact manufacturer.

Chapter 11 Specification

11.1 Servo Drivers and Motors Selection Table

Catagory	Servo Driver	Servo Motor	Description	Power/brake Cable	Encoder Cable	Rated Speed/ Rated Torgue/ Rated Current
Small Inertia 220V	CD420–AA–000 CD422–AA–000	SMH60S–0020–30AAK–3LKH	Cable connector	MOT–005–LL–KL	ENCCA–LL–KH	3000rpm/ 0.64Nm/ 1.6A
		SMH60S–0020–30ABK–3LKH	Cable connector and brake	MOT–005–LL–KL/BRA–LL–KL		
		SMH60S–0020–30AAK–3LKN	HFO standard connector	MOT–005–LL–KC0	ENCCA–LL–KC0	
		SMH60S–0020–30AAK–3LKM	Intercontec connector	MOT–005–LL–KM1	ENCCA–LL–KM1	
		SMH60S–0020–30ABK–3LKM	Intercontec connector with brake	MOT–005–LL–KM1–B		
		SMH60S–0040–30AAK–3LKH	Cable connector	MOT–005–LL–KL	ENCCA–LL–KH	3000rpm/ 1.27Nm/ 3.1A
		SMH60S–0040–30ABK–3LKH	Cable connector and brake	MOT–005–LL–KL/BRA–LL–KL		
		SMH60S–0040–30AAK–3LKN	HFO standard connector	MOT–005–LL–KC0	ENCCA–LL–KC0	
		SMH60S–0040–30AAK–3LKM	Intercontec connector	MOT–005–LL–KM1	ENCCA–LL–KM1	
		SMH60S–0040–30ABK–3LKM	Intercontec connector with brake	MOT–005–LL–KM1–B		
		SMH80S–0075–30AAK–3LKH	Cable connector	MOT–005–LL–KL	ENCCA–LL–KH	3000rpm/ 2.39Nm/ 3.9A
		SMH80S–0075–30ABK–3LKH	Cable connector and brake	MOT–005–LL–KL/BRA–LL–KL		
		SMH80S–0075–30AAK–3LKN	HFO standard connector	MOT–005–LL–KC0	ENCCA–LL–KC0	
		SMH80S–0075–30AAK–3LKM	Intercontec connector	MOT–005–LL–KM1	ENCCA–LL–KM1	
		SMH80S–0075–30ABK–3LKM	Intercontec connector with brake	MOT–005–LL–KM1–B		
		SME60S–0020–30AAK–3LKH	Cable connector	MOT–005–LL–KL	ENCCF–LL–FH	3000rpm/ 0.64Nm/ 1.6A
		SME60S–0020–30ABK–3LKH	Cable connector and brake	MOT–005–LL–KL/BRA–LL–KL		
		SME60S–0040–30AAK–3LKH	Cable connector	MOT–005–LL–KL	ENCCF–LL–FH	3000rpm/ 1.27Nm/ 3.1A
		SME60S–0040–30ABK–3LKH	Cable connector and brake	MOT–005–LL–KL/BRA–LL–KL		
		SME80S–0075–30AAK–3LKH	Cable connector	MOT–005–LL–KL	ENCCF–LL–FH	3000rpm/ 2.39Nm/ 3.9A
		SME80S–0075–30ABK–3LKH	Cable connector and brake	MOT–005–LL–KL/BRA–LL–KL		
	CD430–AA–000 CD432–AA–000	SMH80S–0100–30AAK–3LKH	Cable connector	MOT–008–LL–KL	ENCCA–LL–KH	3000rpm/ 3.18Nm/ 6.3A
		SMH80S–0100–30ABK–3LKH	Cable connector and brake	MOT–008–LL–KL/BRA–LL–KL		
		SMH80S–0100–30AAK–3LKN	HFO standard connector	MOT–008–LL–KC0	ENCCA–LL–KC0	
		SMH80S–0100–30AAK–3LKM	Intercontec connector	MOT–008–LL–KM1	ENCCA–LL–KM1	
		SMH80S–0100–30ABK–3LKM	Intercontec connector with brake	MOT–008–LL–KM1–B		
Medium Inertia 220V		SMH110D–0105–20AAK–4LKC	YL22 standard connector	MOT–008–LL–KC1	ENCCA–LL–KC1	2000rpm/ 5Nm/ 5.9A
		SMH110D–0105–20ABK–4LKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH110D–0105–20AAK–4LKD	Intercontec connector	MOT–008–LL–KM2	ENCCA–LL–KM1	
		SMH110D–0105–20ABK–4LKD	Intercontec connector with brake	MOT–008–LL–KM2–B		
		SMH110D–0126–20AAK–4LKC	YL22 standard connector	MOT–008–LL–KC1	ENCCA–LL–KC1	2000rpm/ 6Nm/ 6.2A
		SMH110D–0126–20ABK–4LKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH110D–0126–20AAK–4LKD	Intercontec connector	MOT–008–LL–KM2	ENCCA–LL–KM1	
		SMH110D–0126–20ABK–4LKD	Intercontec connector with brake	MOT–008–LL–KM2–B		
		SMH110D–0125–30AAK–4LKC	YL22 standard connector	MOT–008–LL–KC1	ENCCA–LL–KC1	3000rpm/ 4Nm/ 6.5A
		SMH110D–0125–30ABK–4LKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH110D–0125–30AAK–4LKD	Intercontec connector	MOT–008–LL–KM2	ENCCA–LL–KM1	
		SMH110D–0125–30ABK–4LKD	Intercontec connector with brake	MOT–008–LL–KM2–B		
Medium Inertia 380V	CD620–AA–000 CD622–AA–000	SMH110D–0126–30AAK–4HKC	YL22 standard connector	MOT–008–LL–KC1	ENCCA–LL–KC1	3000rpm/ 4Nm/ 4.3A
		SMH110D–0126–30ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH110D–0126–30AAK–4HKD	Intercontec connector	MOT–008–LL–KM2	ENCCA–LL–KM1	
		SMH110D–0126–30ABK–4HKD	Intercontec connector with brake	MOT–008–LL–KM2–B		
		SMH110D–0157–30AAK–4HKC	YL22 standard connector	MOT–008–LL–KC1	ENCCA–LL–KC1	3000rpm/ 5Nm/ 5.9A
		SMH110D–0157–30ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH110D–0157–30AAK–4HKD	Intercontec connector	MOT–008–LL–KM2	ENCCA–LL–KM1	
		SMH110D–0157–30ABK–4HKD	Intercontec connector with brake	MOT–008–LL–KM2–B		
		SMH110D–0188–30AAK–4HKC	YL22 standard connector	MOT–008–LL–KC1	ENCCA–LL–KC1	3000rpm/ 6Nm/ 6.2A
		SMH110D–0188–30ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH110D–0188–30AAK–4HKD	Intercontec connector	MOT–008–LL–KM2	ENCCA–LL–KM1	
		SMH110D–0188–30ABK–4HKD	Intercontec connector with brake	MOT–008–LL–KM2–B		
Medium Inertia 220V	CD430–AA–000 CD432–AA–000 CD620–AA–000 CD622–AA–000	SMH130D–0105–20AAK–4HKC	YL24 standard connector	MOT–008–LL–KC2	ENCCA–LL–KC1	2000rmp/ 5Nm/ 4.3A
		SMH130D–0105–20ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH130D–0157–20AAK–4HKC	YL24 standard connector	MOT–008–LL–KC2		2000rmp/ 7.5Nm/ 6.3A
		SMH130D–0157–20ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
Medium Inertia 380V	CD620–AA–000 CD622–AA–000	SMH130D–0210–20AAK–4HKC	YL24 standard connector	MOT–008–LL–KC2		2000rmp/ 10Nm/ 7.6A
		SMH130D–0210–20ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		
		SMH150D–0230–20AAK–4HKC	YL24 standard connector	MOT–008–LL–KC2		2000rmp/ 11.1Nm/ 7.1A
		SMH150D–0230–20ABK–4HKC	YL24 standard connector and brake	MOT–008–LL–KC2–B		

11.2 Servo Driver

11.2.1.1 Technical Specification Table for CD422/CD432/CD622 Servo Driver

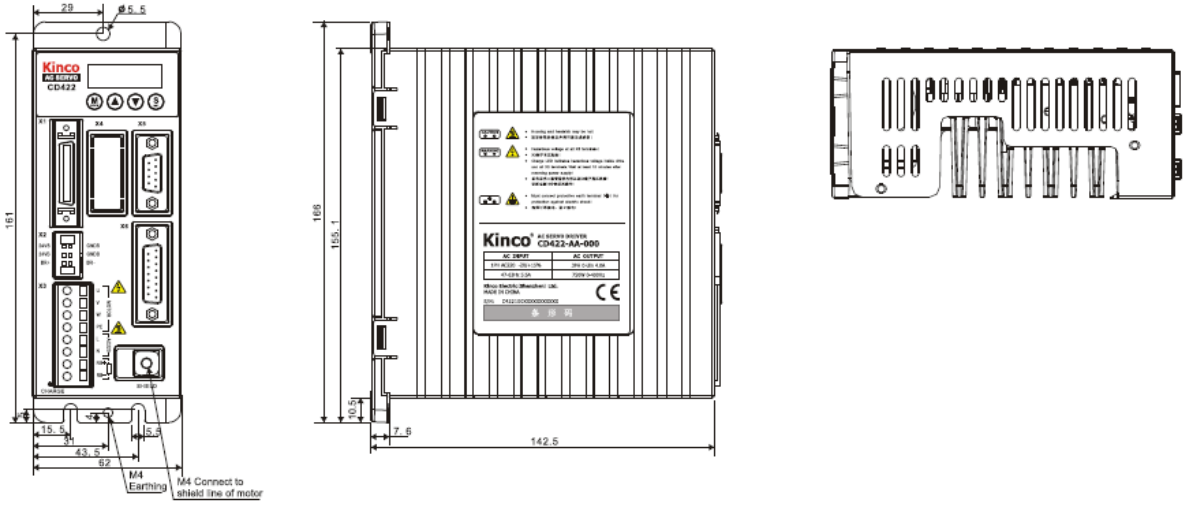
Model parameter		CD422-AA-000	CD432-AA-000	CD622-AA-000
Power	Main supply voltage	Single-phase AC220V -20/+15% 47~63Hz	Single-phase or 3-phase AC220V -20/+15% 47~63Hz	3-phase AC380V -20/+15% 47~63Hz
	Control circuit voltage	18VDC~30VDC 1A		
Current	Max. continuous current	4A	10A	7A
	Peak current(PEAK)	15A	27. 5A	25A
	Feedback signal	2500PPR (incremental encoder with 5V		
	Brake chopper	Use an external braking resistor according to application, mainly in occasion of quick stop.		
	Brake chopper threshold	DC380V±5V		DC680V±5V
	Over-voltage alarming threshold	DC400V±5V		DC700V±5V
	Under-voltage alarming threshold	DC200V±5V		DC400V±5V
	Cooling method	Natural air cooling	Fan	
	Weight	1.2kg	2.4kg	
Position Mode	Max. frequency of input pulse	Differential signal: 500KPPS, Open-collector signal: 200KPPS		
	Pulse command mode	Pulse+direction, CCW+CW, A+B phase(5V-24V)		
	Command smoothing	Low-pass filtering(Adjustable by internal parameter setting)		
	Feedforward gain	Adjustable by internal parameter setting		
	Electronic gear ratio	Setting range, Gear factor: -32768~32767, Gear divider: 1~32767, 1/50≤|Gear factor/Gear divider|≤50		
	Position loop sampling frequency	1KHz		
Speed Mode	Analog input voltage range	-10V~+10V(Resolution 12bit)		
	Input impedance	200K		
	Analog input sampling frequency	4KHz		
	Command source	External analog command / Adjustable by internal parameter setting		
	Command smoothing	Low-pass filtering(Adjustable by internal parameter setting)		
	Input voltage dead-zone setting	Adjustable by internal parameter setting		
	Input voltage offset settiong	Adjustable by internal parameter setting		
	Speed limit	Adjustable by internal parameter setting		
	Torque limit	Adjustable by internal parameter setting / External analog command control		
	Speed loop sampling frequency	4KHz		
Torque Mode	Analog voltage input range	-10V~+10V(Resolution 12bit)		
	Input impedance	200K		
	Input sampling frequency	4KHz		
	Command source	External analog command / internal command		
	Command smoothing	Low-pass filtering(Adjustable by internal parameter setting)		
	Speed limit	Adjustable by internal parameter setting / External analog command control		
	Input voltage dead-zone setting	Adjustable by internal parameter setting		
	Input voltage offset setting	Adjustable by internal parameter setting		
	Current sampling frequency	16KHz		
Digital Input	Input specification	7 digital inputs, with COMI terminal for PNP (high level valid 12.5-30V) or NPN (low level valid) connection.		
	Input function	Define freely according to requirement, supporting following functions: Driver enable,driver fault reset,driver mode control, proportional control, positive limit, negetive limit, homing signal,reverse command, internal speed section control, internal positive section control, quick stop, start homing, active command, switch electronic gear ratio, switch gain		
Digital Output	Output specification	5 digital outputs,OUT1~OUT4 current is 100mA,OUT5 current is 800mA, can drive brake device directly		
	Output function	Define freely according to requirement, supporting following functions: Driver ready, driver fault, position reached, motor at zero speed, motor brake, motor speed reached, Z signal, maximum speed obtained in torque mode, motor brake, position limiting, reference found, multi-position reached		
	Protection functions	Over-voltage protection,under-voltage protection,motor over-heat protection(I^2T),short-circuit protection,drive over-heat protection,etc.		
	Communication interface	RS232 (Connections with PC: 2-2, 3-3, 5-5)		
Operation Environment	Operating temperature	0~40℃		
	Storage temperature	-10℃~70℃		
	Humidity(non-condensing)	Below 90%RH		
	Protection class	IP20		
	Installation environment	Installed in a dust-free,dry and lockable environment(such as in a electrical cabinet)		
	Installation mode	Vertical installation		
	Altitude	No power limitation below 1000m		
	Atmospheric pressure	86kpa~106kpa		

11.2.1.2 Technical Specification Table for CD420/CD430/CD620 Servo Driver

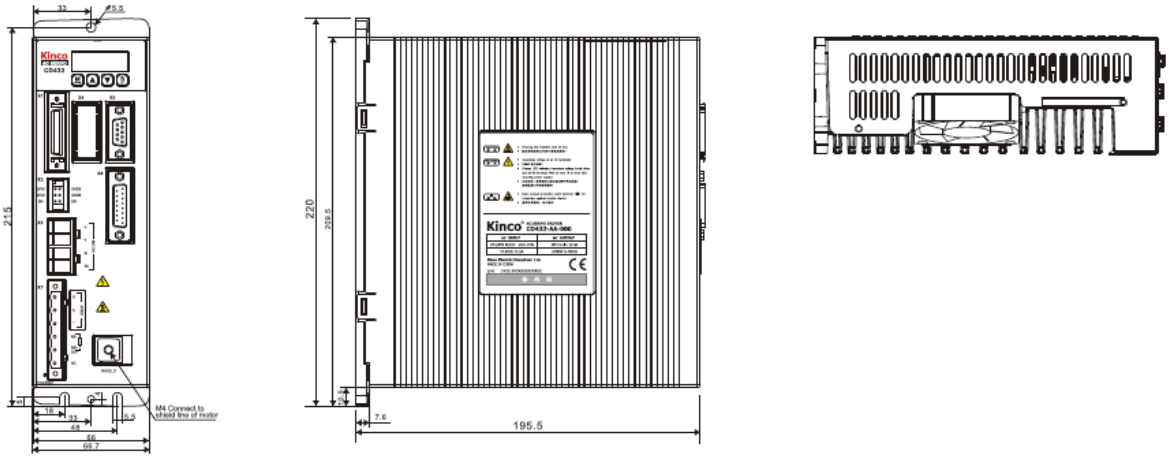
Model parameter		CD420			CD430				CD620		
		200W	400W	750W	1KW	1.05KW	1.25KW	1.26KW	1.26KW	1.57KW	1.88KW
Power	Main supply voltage	Single-phase AC220V±20% 47~63Hz			Single-phase or 3-phase AC220V±20% 47~63Hz				3-phase AC380V±20% 47~63Hz		
	Control circuit voltage	DC24V 1A									
Current	Rated current(RMS)	1.6A	3.1A	3.9A	6.3A	5.4A	6.5A	6.2A	4.3A	5.4A	6.2A
	Peak current(PEAK)	6.8A	13.2A	15A	26.7A	22.9A	27A	26.3A	18.2A	22.9A	25A
	Feedback signal	2500PPR (incremental encoder with 5V supply and RS422 signals)									
	Brake chopper	Use an external braking resistor if necessary									
	Brake chopper threshold	DC380V±5V							DC680V±5V		
	Over-voltage alarming threshold	DC400V±5V							DC700V±5V		
	Under-voltage alarming threshold	DC200V±5V							DC400V±5V		
	Cooling method	Natural air cooling			Fan						
	Weight	1.2kg			2.4kg						
Position Mode	Max. frequency of input pulse	Differential signal: 500KPPS, Open-collector signal: 200KPPS									
	Pulse command mode	Pulse+direction, CCW+CW, (higher voltages than 5V need external current limiting resistors)									
	Command smoothing	Low-pass filtering(Internal parameters)									
	Feedforward gain	Internal parameters									
	Electronic gear ratio	Setting range, Gear factor: -32768~32767, Gear divider: 1~32767, 1/50≤|Gear factor/Gear divider|≤50									
	Position loop sampling frequency	1KHz									
Speed Mode	Analog input voltage range	0 ~±10V(Resolution 12bit)									
	Input impedance	200K									
	Analog input sampling frequency	4KHz									
	Command source	External analog command/internal command									
	Command smoothing	Low-pass filtering(Internal parameters)									
	Input voltage dead-zone setting	Internal parameters									
	Input voltage offset settiong	Internal parameters									
	Speed limit	Internal parameters									
	Torque limit	Internal parameters / External analog command control									
	Speed loop sampling frequency	4KHz									
Torque Mode	Analog voltage input range	0 ~±10V (Resolution 12bit)									
	Input impedance	200K									
	Input sampling frequency	4KHz									
	Command source	External analog command/internal command									
	Command smoothing	Low-pass filtering(Internal parameters)									
	Speed limit	Internal parameters /External analog command control									
	Input voltage dead-zone setting	Internal parameters									
	Input voltage offset setting	Internal parameters									
	Current sampling frequency	16KHz									
Digital Input	Input specification	7 digital inputs, with COMI terminal for PNP or NPN connection.									
	Input function	Define freely according to requirement, supporting following functions: Driver enable,driver fault reset,driver mode control, Proportional control, forward inhibit limit, reverse inhibit limit, negative limit position,home signal, speed command reverse, internal speed or position select									
Digital Output	Output specification	5 digital outputs,OUT1 ~ OUT4 current is 100mA,OUT5 current is 800mA									
	Output function	Define freely according to requirement, supporting following functions: Driver ready, driver fault, position reached, motor at zero speed, motor brake, motor speed reached, N signal									
	Protection functions	Over-voltage protection,under-voltage protection,motor over-heat protection(I^2T),short-circuit protection,drive over-heat protection,etc.									
	Communication interface	RS232									
Operation Environment	Operating temperature	0~40℃									
	Storage temperature	-10℃~70℃									
	Humidity(non-condensing)	5~95%									
	Protection class	IP20									
	Installation environment	Installed in a dust-free,dry and lockable environment(such as in a electrical cabinet)									
	Installation mode	Vertical installation									
	Height	Below 1000m									
	Atmospheric pressure	86kpa~106kpa									

11.2.2 Mechanical Dimension Diagram for Servo Driver

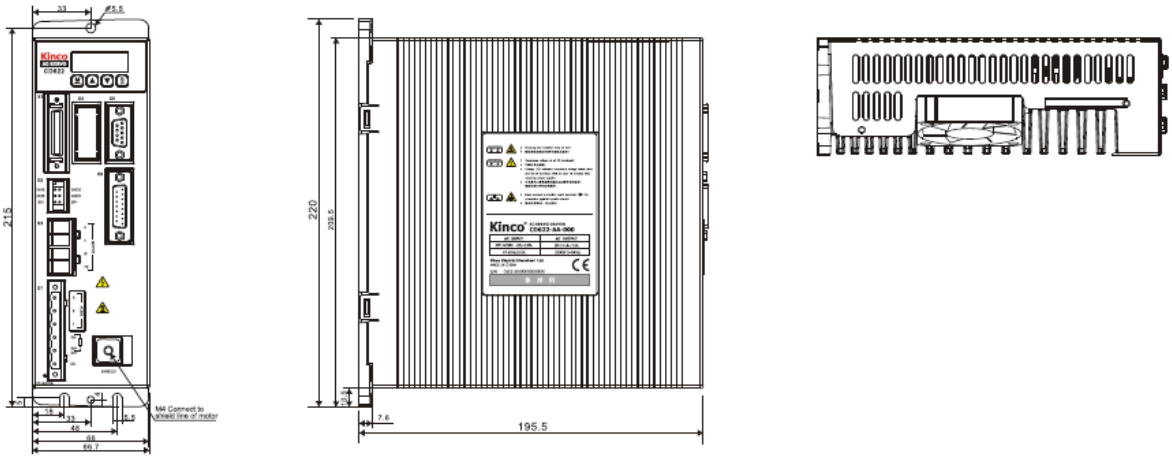
Mechanical Dimension Diagram for CD422



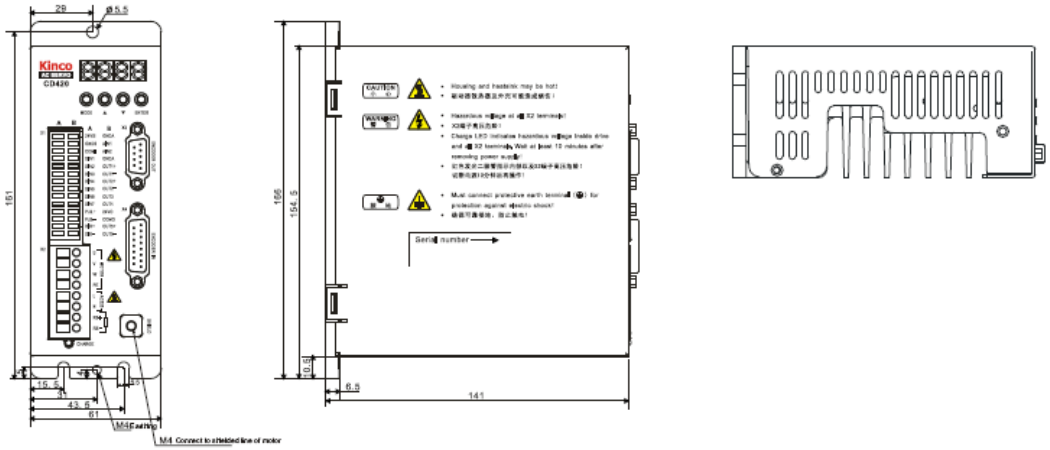
Mechanical Dimension Diagram for CD432



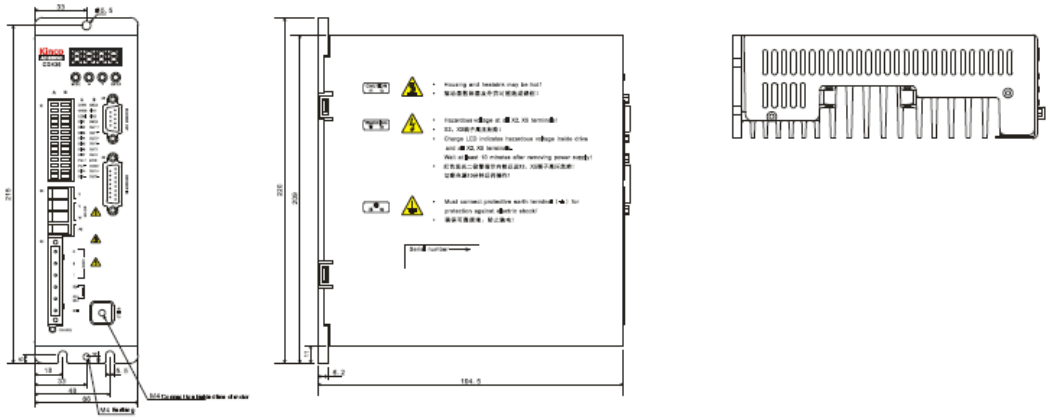
Mechanical Dimension Diagram for CD622



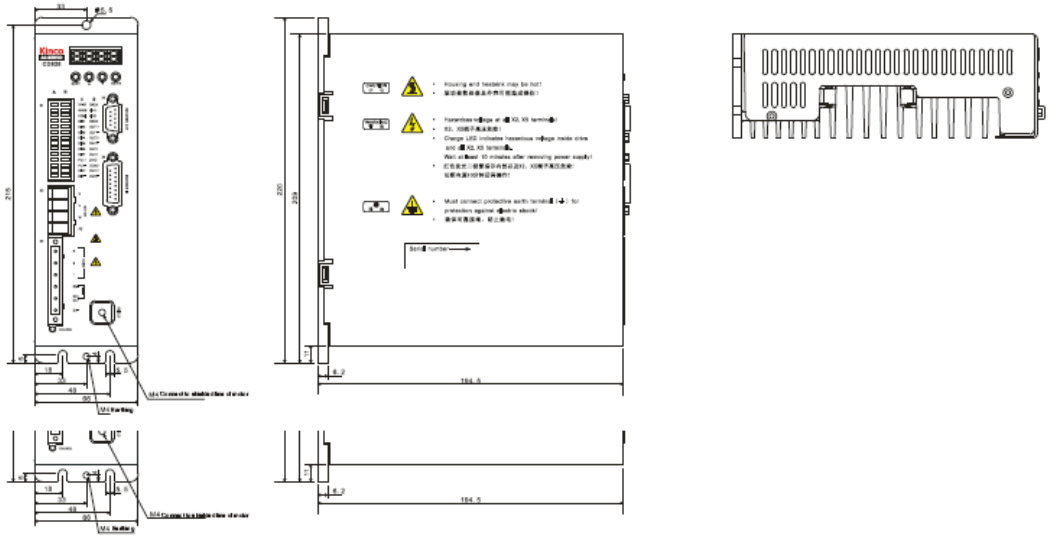
Mechanical dimension diagram for CD420 (Unit:mm)



Mechanical dimension diagram for CD430 (Unit:mm)



Mechanical dimension diagram for CD620 (Unit:mm)



11.3 Dimensions/Torque Curve/Technical Specifications of Servo Motors

11.3.1 SME/SMH60 SME/SMH80 Servo Motor

1.Technical Speifications.

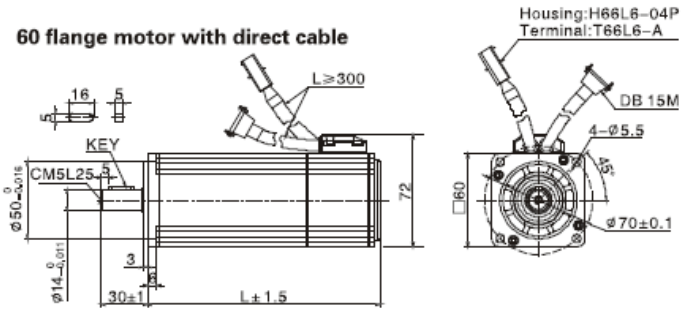
Motor series		SMH Series Motor				SME Series Motor		
		Small inertia flange size 60mm		Small inertia flange size 80mm		Small inertia flange size 60mm		Small inertia flange size 80mm
Model		SMH60S-0020-30A□K-3LK□	SMH60S-0040-30A□K-3LK□	SMH80S-0075-30A□K-3LK□	SMH80S-0100-30A□K-3LK□	SME60S-0020-30A□K-3LK□	SME60S-0040-30A□K-3LK□	SME80S-0075-30A□K-3LK□
Compatible driver		CD420-AA-000, CD422-AA-000			CD430-AA-000 CD432-AA-000	CD420-AA-000, CD422-AA-000		
DC link voltage UDC		300	300	300	300	300	300	300
Continuous performance	Rated power P_N (W)	200	400	750	1000	200	400	750
	Rated torque T_N (Nm)	0.64	1.27	2.39	3.18	0.64	1.27	2.39
	Rated speed n_N (rpm)	3000	3000	3000	3000	3000	3000	3000
	Rated current I_N (A)	1.6	3.1	3.9	6.3	1.6	3.1	3.9
Maximum torque	T_P (Nm)	1.92	3.82	7.17	9.48	1.92	3.81	7.17
Maximum current	I_P (A)	4.8	9.3	11.7	18.9	4.8	9.3	11.7
Standstill torque	T_S (Nm)	0.7	1.39	2.63	3.3	0.7	1.4	2.63
Standstill current	I_S (A)	1.79	3.38	4.4	6.93	1.76	3.41	4.29
Resistance line-line	R_L (Ω)	8.02	3.52	1.4	0.86	10.4	5.8	3
Inductance line-line	L_L (mH)	16.3	7.8	7.5	4.5	25.4	15	16.2
Electrical time constant	τe (ms)	2.03	2.22	5.35	5.23	2.44	2.59	5.4
Mechanical time constant	τm (ms)	2.26	1.35	0.75	0.89	2.93	1.93	1.49
Reverse voltage constant	K_e (V/krpm)	29	29	40	34	29	29	40
Torque constant	K_t (Nm/A)	0.48	0.48	0.662	0.562	0.48	0.48	0.662
Rotor moment of inertia	J_m (Kg · cm²)	0.375	0.51	1.36	1.9	0.375	0.443	1.255
		0.379 (with brake)	0.514 (with brake)	1.385 (with brake)	1.925 (with brake)	0.379 (with brake)	0.447 (with brake)	1.28 (with brake)
Pole pair number		3	3	3	3	3	3	3
Maximum voltage rising	du/dt (KV/μs)	8	8	8	8	8	8	8
Insulation class		F	F	F	F	F	F	F
Maximum radial force	F (N)	180	180	335	335	180	180	335
Maximum axial force	F (N)	90	90	167.5	167.5	90	90	167.5
Weight	G(Kg)	1.3	1.8	3.3	3.9	1.3	1.6	2.9
		1.8 (with brake)	2.3 (with brake)	4 (with brake)	4.6 (with brake)	1.8 (with brake)	2.1 (with brake)	3.6 (with brake)
Length of motor	L(mm)	120	150	147	167	120±1.5	135±1.5	132±1.5
		159 ± 1.5(with brake)	189 ± 1.5(with brake)	197 ± 1.5(with brake)	217 ± 1.5(with brake)	159 ± 1.5(with brake)	174 ± 1.5(with brake)	182 ± 1.5(with brake)
Position feedback device		Incremental encoder 2500ppr						
Cooling method		Totally enclosed, non-ventilated						
Protection level		IP65 for body, shaft sealing IP54						
Environmental conditions for operation	Temperature	-20℃ ~ 40℃ (Non-freezing)						
	Humidity	Below 90% RH (Non-condensing)						
	Ambient enviroment	Away from active gas, combustible gas, oil drops and dust						
	Altitude	Maximum altitude 4000m, Rated power at 1000m or below, Above 1000m: Decreasing 1.5% per 100m rise						

Note: □=A: no brake □=B: brake

□=H: Cable connector
□=N: HFO series standard connector
□=M: Intercontec connector

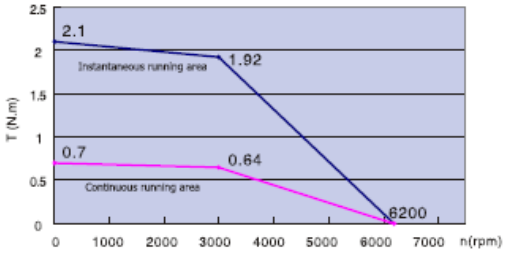
2.Dimensions and Torque Curve

60 flange motor with direct cable

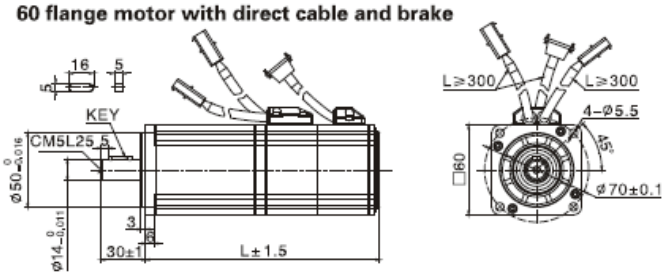


Note: DB15(2-row plastic shell 15 pin or 3-row metal shell 15 pin are selectable)

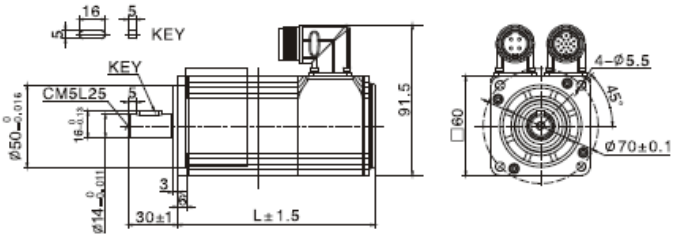
SMH/SME60S-0020-30A□K-3LK□ 200W



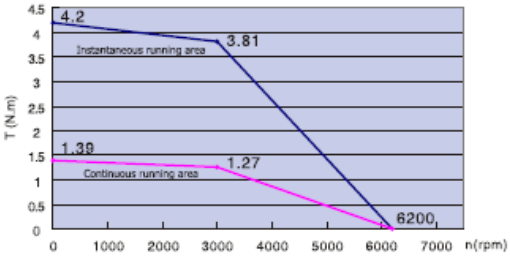
60 flange motor with direct cable and brake



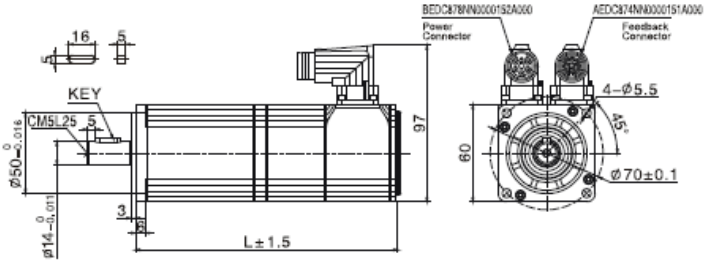
60 flange motor with HFO series standard connector



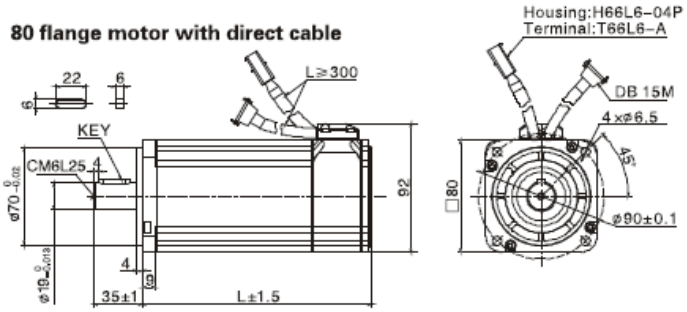
SMH/SME60S-0040-30A□K-3LK□ 400W



60 flange motor with Intercontec connector

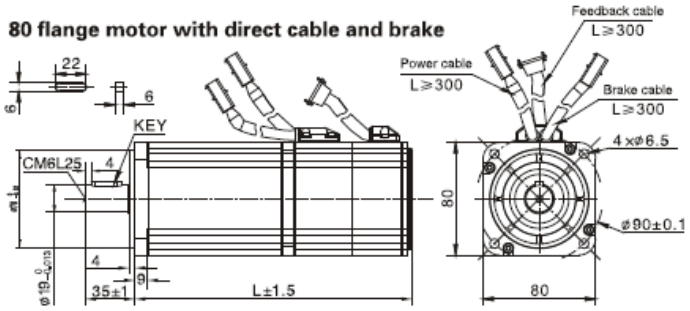


80 flange motor with direct cable

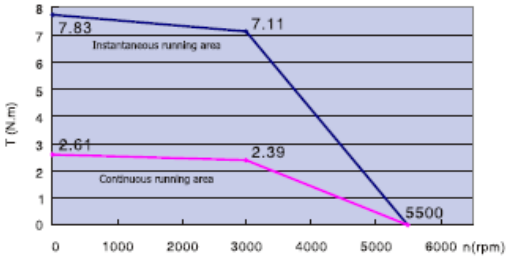


Note: DB15(2-row plastic shell 15 pin or 3-row metal shell 15 pin are selectable)

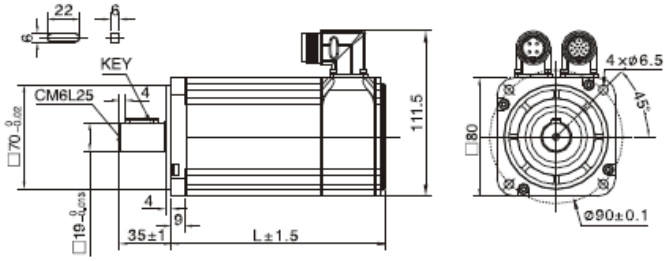
80 flange motor with direct cable and brake



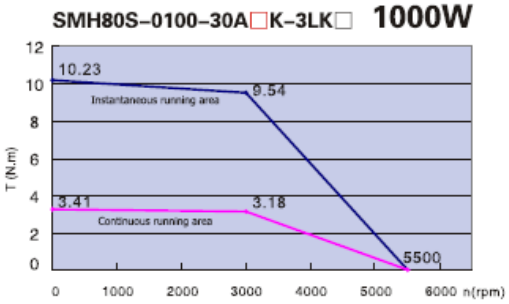
SMH/SME80S-0075-30A□K-3LK□ 750W



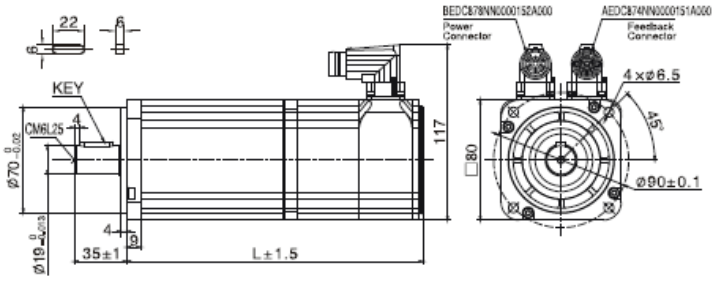
80 flange motor with HFO series standard connector



SMH80S-0100-30A□K-3LK□ 1000W



80 flange motor with Intercontec connector



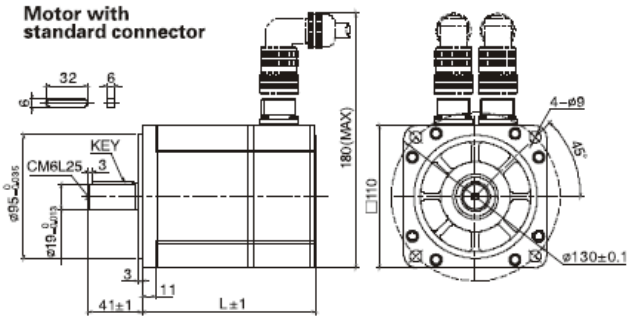
11.3.2 SMH110 Servo Motor

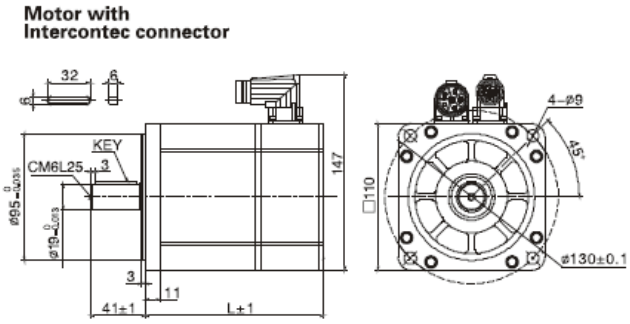
1.Technical Specification

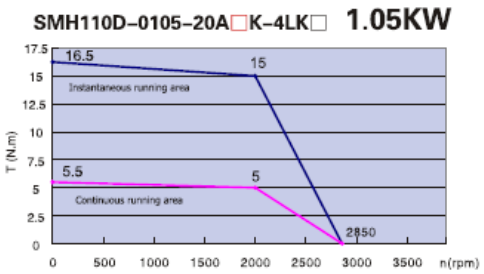
Motor series		Medium inertia,flange size 110mm					
Model		SMH110D-0125-30A□K-4LK□	SMH110D-0126-30A□K-4HK□	SMH110D-0105-20A□K-4LK□	SMH110D-0157-30A□K-4HK□	SMH110D-0126-20A□K-4LK□	SMH110D-0188-30A□K-4HK□
Compatible driver		CD430-AA-000 CD432-AA-000	CD620-AA-000 CD622-AA-000	CD430-AA-000 CD432-AA-000	CD620-AA-000 CD622-AA-000	CD430-AA-000 CD432-AA-000	CD620-AA-000 CD622-AA-000
DC link voltage UDC		300	560	300	560	300	560
Continuous performance	Rated power P_N (W)	1250	1260	1050	1570	1260	1880
	Rated torque T_N (Nm)	4.0	4.0	5.0	5.0	6.0	6.0
	Rated speed n_N (rpm)	3000	3000	2000	3000	2000	3000
	Rated current I_N (A)	6.5	4.3	5.9	5.9	6.2	6.2
Maximum torque	T_m (Nm)	12	12	15.0	15.0	18.0	18.0
Maximum current	I_m (A)	19.5	12.9	17.7	17.7	18.6	18.6
Standstill torque	T_s (Nm)	4.4	4.4	5.5	5.5	6.6	6.6
Standstill current	I_s (A)	6.82	4.73	6.49	6.49	6.765	6.765
Resistance line-line	R_L (Ω)	0.8	1.83	1.03	1.03	1.258	1.258
Inductance line-line	L_L (mH)	6.4	13.5	7.8	7.8	9.62	9.62
Electrical time constant	τ e (ms)	7.9	7.37	7.57	7.57	7.64	7.64
Mechanical time constant	τ m (ms)	1.4	1.63	1.55	1.55	1.65	1.65
Reverse voltage constant	K_e (V/krpm)	45	64	55	55	64	64
Torque constant	K_t (Nm/A)	0.744	1.058	0.910	0.910	1.058	1.058
Rotor moment of inertia	J_m (Kg · cm²)	5.8	5.8	7.2	7.2	8.5	8.5
		5.85 (with brake)	5.85 (with brake)	7.25 (with brake)	7.25 (with brake)	8.55 (with brake)	8.55 (with brake)
Pole pair number		4	4	4	4	4	4
Maximum voltage rising	du/dt (KV/μs)	8	8	8	8	8	8
Insulation class		F	F	F	F	F	F
Maximum radial force	F (N)	630	630	630	630	630	630
Maximum axial force	F (N)	315	315	315	315	315	315
Weight	G(Kg)	6.2	6.2	7.2	7.2	8.2	8.2
		8.2(with brake)	8.2(with brake)	9.2(with brake)	9.2(with brake)	10.2(with brake)	10.2(with brake)
Length of motor	L(mm)	168	168	185	185	202	202
		228 ± 1(with brake)	228 ± 1(with brake)	245 ± 1(with brake)	245 ± 1(with brake)	262 ± 1(with brake)	262 ± 1(with brake)
Position feedback device		Incremental encoder 2500ppr					
Cooling method		Totally enclosed, non-ventilated					
Protection level		IP65 for body, shaft sealing IP54					
Environmental conditions for operation	Temperature	-20℃ ~ 40℃ (Non-freezing)					
	Humidity	Below 90% RH (Non-condensing)					
	Ambient enviroment	Away from active gas, combustible gas, oil drops and dust					
	Altitude	Maximum altitude 4000m, Rated power at 1000m or below, Above 1000m: Decreasing 1.5% per 100m rise					

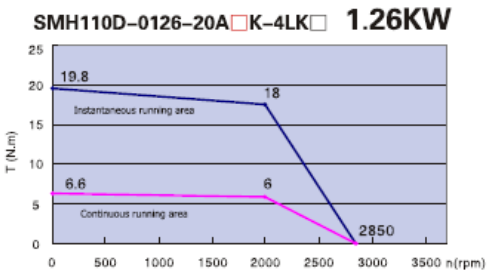
Note: □=A: no brake □=C: Standard connector
□=B: brake □=D: Intercontec connector

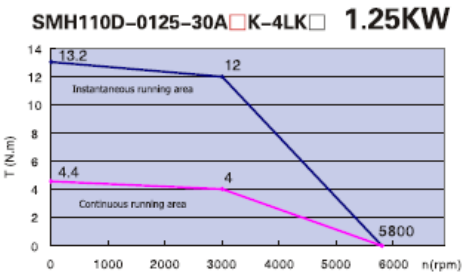
2.Dimensions and Torque Curve

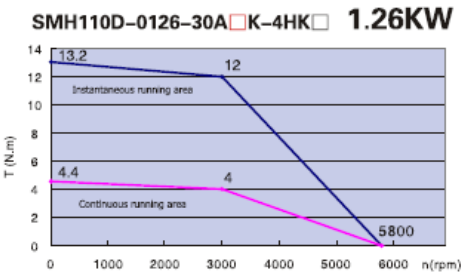


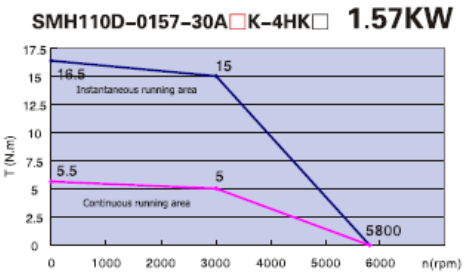


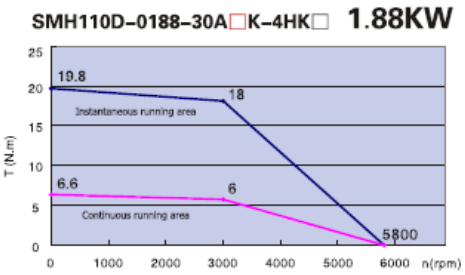












11.3.3 SMH130/150 Servo Motor

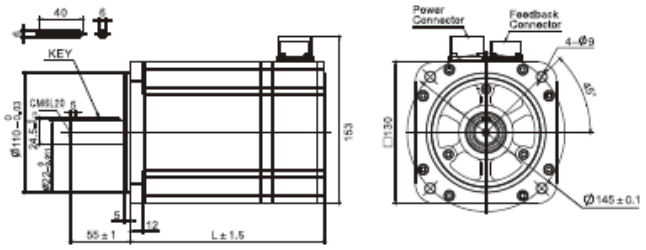
1.Technical Specifications

Motor series		Medium inertia, flange size 130mm			Medium inertia, flange size 150mm
Model		SMH130D-0105-20A□K-4HK□	SMH130D-0157-20A□K-4HK□	SMH130D-0210-20A□K-4HK□	SMH150D-0230-20A□K-4HK□
Compatible driver		CD430-AA-000、CD620-AA-000 CD432-AA-000、CD622-AA-000		CD620-AA-000、CD622-AA-000	
DC link voltage UDC		560	560	560	560
Continuous performance	Rated power P_N (W)	1050	1570	2100	2300
	Rated torque T_N (Nm)	5	7.5	10	11.1
	Rated speed n_N (rpm)	2000	2000	2000	2000
	Rated current I_N (A)	4.3	6.3	7.6	7.1
Maximum torque	T_m (Nm)	12.5	18.75	25	27.5
Maximum current	I_m (A)	10.75	15.75	19	17.75
Standstill torque	T_s (Nm)	5.5	8.25	11	12.1
Standstill current	I_s (A)	4.73	6.93	8.36	7.81
Resistance line-line	R_L (Ω)	1.85	1.17	0.98	2.2
Inductance line-line	L_L (mH)	23.7	16.2	14.3	14(AVG)
Electrical time constant	τ e (ms)	12.81	13.846	14.592	6.36
Mechanical time constant	τ m (ms)	2.868	2.529	2.268	4.68
Reverse voltage constant	K_e (V/krpm)	70	72	80	100
Torque constant	K_t (Nm/A)	1.1578	1.191	1.3232	1.65
Rotor moment of inertia	J_m (Kg · cm^2)	12	17.7	23.4	33.5
		12.04 (with brake)	17.74 (with brake)	23.44 (with brake)	33.6 (with brake)
Pole pair number		4	4	4	4
Maximum voltage rising	du/dt (KV/μs)	8	8	8	8
Insulation class		F	F	F	F
Maximum radial force	F (N)	900	900	900	1200
Maximum axial force	F (N)	450	450	450	600
Weight	G(Kg)	7.5	9.1	10.7	12
		9.7 (with brake)	11.3 (with brake)	12.9 (with brake)	15.5 (with brake)
Length of motor	L(mm)	159 ± 1.5	179 ± 1.5	199 ± 1.5	226 ± 1.5
		220 ± 1.5 (with brake)	240 ± 1.5 (with brake)	260 ± 1.5 (with brake)	292 ± 1.5 (with brake)
Position feedback device		Incremental encoder 2500ppr			
Cooling method		Totally enclosed, non-ventilated			
Protection level		IP65 for body, shaft sealing IP54			
Environmental conditions for operation	Temperature	-20℃ ~ 40℃ (Non-freezing)			
	Humidity	Below 90% RH (Non-condensing)			
	Ambient enviroment	Away from active gas, combustible gas, oil drops and dust			
	Altitude	Maximum altitude 4000m, Rated power at 1000m or below, Above 1000m: Decreasing 1.5% per 100m rise			

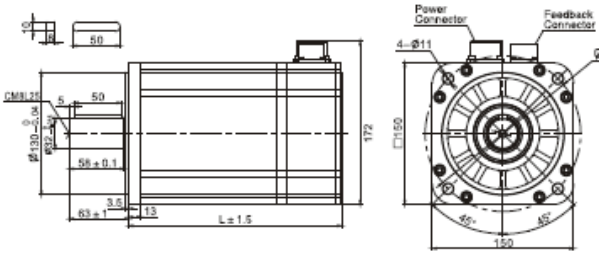
Note: □=A: no brake □=B: brake □=C: Standard connector □=D: Intercontec connector

2.Dimensions and Torque Curve

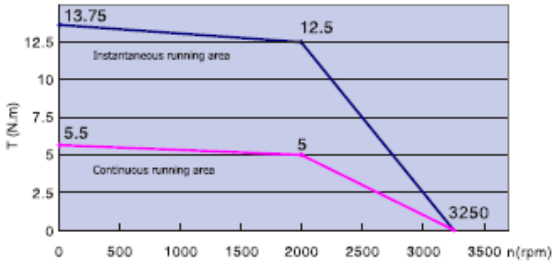
SMH Series motors, flange size 130, with standard connector



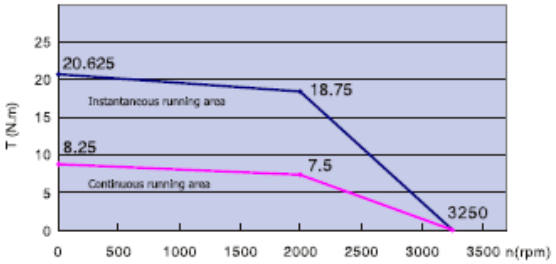
SMH Series motors, flange size 150, with intercontec connector



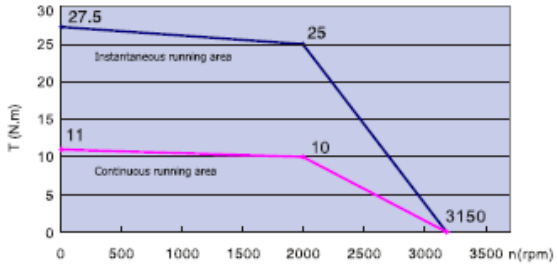
SMH130D-0105-20A□K-4HK□ 1.05KW



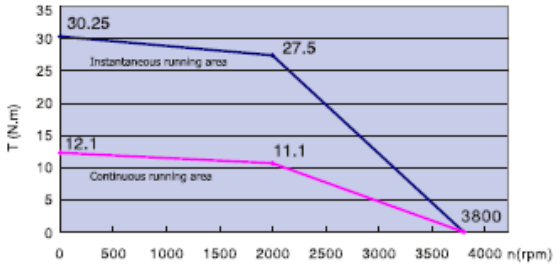
SMH130D-0157-20A□K-4HK□ 1.57KW



SMH130D-0210-20A□K-4HK□ 2.1KW



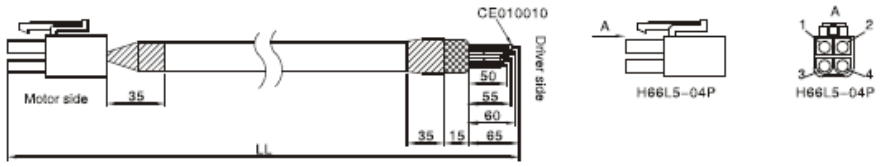
SMH150D-0230-20A□K-4HK□ 2.3KW



11.4 Wiring Diagram for Servo Motor Cable

11.4.1 Wiring Diagram for the Power Cable

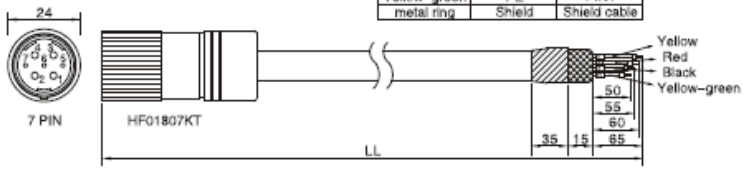
MOT-005-LL-KL
Wire spec. UI20328 4C×18AWG(41/0.16T) black



MOT-005-LL-KL		
Cable Color	Signal	PIN #
Yellow	U	PIN1
Red	V	PIN2
Black	W	PIN3
Yellow-green	PE	PIN4

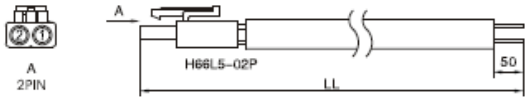
MOT-005-LL-KC0
Wire spec. 4C×18AWG(41/0.16T)

MOT-005-LL-KC0		
Cable color	Signal	Pin#
Yellow	U	PIN2
Red	V	PIN3
Black	W	PIN4
Yellow-green	PE	PIN1
metal ring	Shield	Shield cable

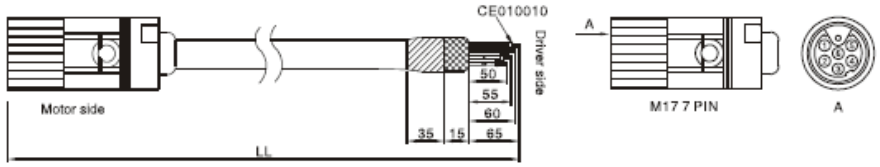


BRA-LL-KL
Wire spec. 2×20AWG

BRA-LL-KL		
Cable color	Signal	Pin#
Red	break+	PIN1
Blue	break-	PIN2

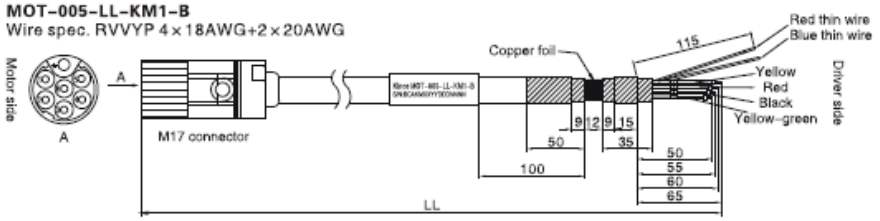


MOT-005-LL-KM1
Wire spec. UI20328 4C×18AWG(41/0.16T) black



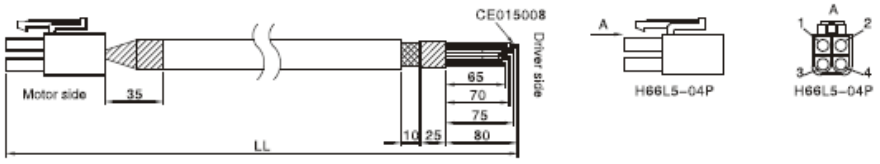
MOT-005-LL-KM1		
Cable Color	Signal	PIN #
Yellow	U	PIN1
Red	V	PIN2
Black	W	PIN3
Yellow-green	PE	⏚

MOT-005-LL-KM1-B
Wire spec. RVVYP 4×18AWG+2×20AWG



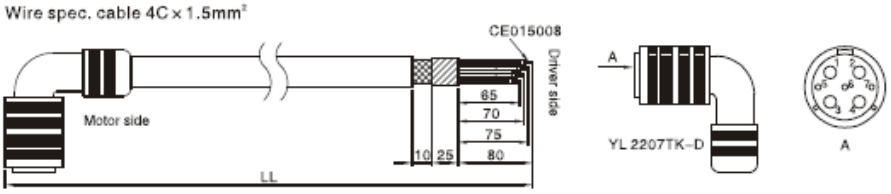
MOT-005-LL-KM1-B		
Cable Color	Signal	M17 7PIN
Yellow	U	PIN1
Red	V	PIN2
Black	W	PIN3
Yellow-green	PE	⏚
Shield terminal	shield	metal ring
Red(thin)	brake+	PIN4
Blue(thin)	brake-	PIN5

MOT-008-LL-KL
Wire spec. cable 4C×1.5mm²



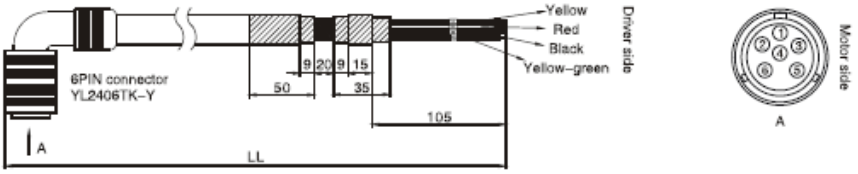
MOT-008-LL-KL		
Cable Color	Signal	PIN #
1	U	PIN1
2	V	PIN2
3	W	PIN3
Yellow-green	PE	PIN4

MOT-008-LL-KC1
Wire spec. cable 4C × 1.5mm²



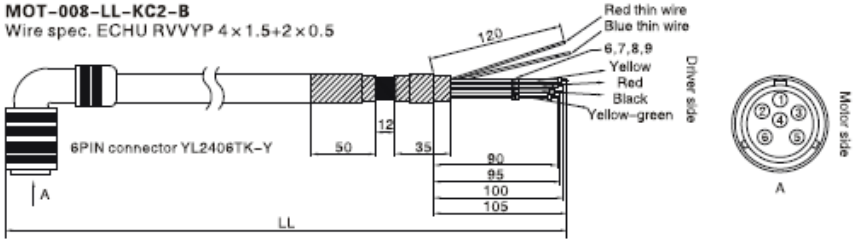
MOT-008-LL-KC1		
Cable Color	Signal	PIN #
1	U	PIN2
2	V	PIN3
3	W	PIN4
Yellow-green	PE	PIN1

MOT-008-LL-KC2
Power cable O-2395 4C × 1.5mm²(30/0.25B)



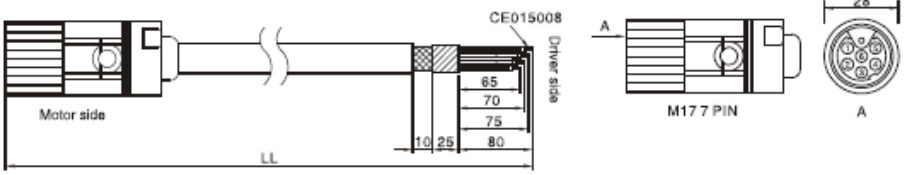
MOT-008-LL-KC2		
Cable Color	Signal	YL2406TK-Y
Yellow	U	PIN1
Red	V	PIN2
Black	W	PIN3
Yellow-green	PE	PIN4

MOT-008-LL-KC2-B
Wire spec. ECHU RVVYP 4 × 1.5+2 × 0.5



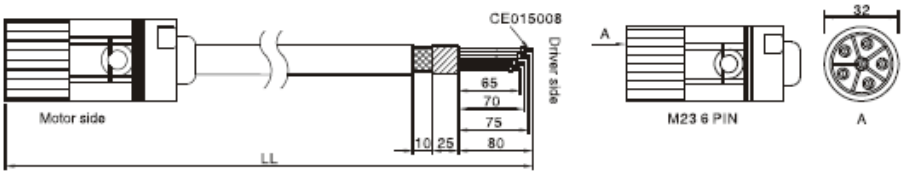
MOT-008-LL-KC2-B		
Cable Color	Signal	YL2406TK-Y
Yellow	U	PIN1
Red	V	PIN2
Black	W	PIN3
Yellow-green	PE	PIN4
Red(thin)	brake+	PIN5
Blue(thin)	brake-	PIN6
Shield terminal	Shield	metal ring

MOT-008-LL-KM1
Wire spec. cable 4C × 1.5mm²



MOT-008-LL-KM1		
Cable Color	Signal	PIN #
1	U	PIN1
2	V	PIN2
3	W	PIN3
Yellow-green	PE	⏚

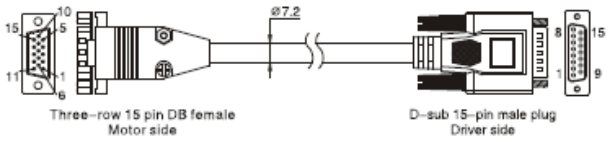
MOT-008-LL-KM2
Wire spec. cable 4C × 1.5mm²



MOT-008-LL-KM2		
Cable Color	Signal	PIN #
1	U	PIN1
2	V	PIN2
3	W	PIN4
Yellow-green	PE	PIN3

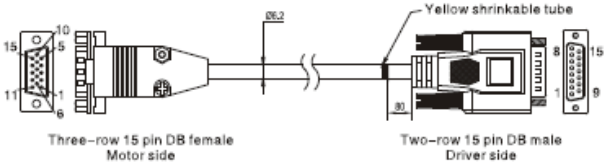
11.4.2 Wiring Diagram for the Encoder Cable

ENCCA-LL-KH
Wire spec. 1P×24AWG(7/0.20T)+7P×28AWG(7/0.127T)



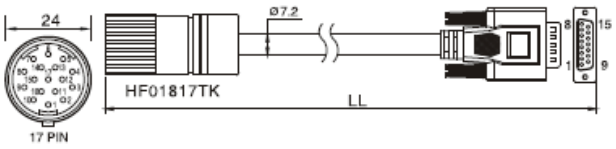
ENCCA-LL-KH				
Three-row 15 pin DB	Two-row 15 pin DB	Signal	External wire color	Motor wire color
PIN1	PIN1	+5V	Red(thick)	Red
PIN8	PIN2	A	Orange	Blue-black
PIN7	PIN3	B	Yellow	Green
PIN6	PIN4	Z	Green	Yellow
PIN4	PIN5	U	Brown	Brown-black
PIN10	PIN6	V	Purple	White-black
PIN9	PIN7	W	Blue	Gray-black
PIN2	PIN9	GND	Black(thick)	Black
PIN13	PIN10	/A	Orange-white	Blue
PIN12	PIN11	/B	Yellow-white	Green-black
PIN11	PIN12	/Z	Green-white	Yellow-black
PIN5	PIN13	/U	Brown-white	Brown
PIN15	PIN14	/V	Purple-white	White
PIN14	PIN15	/W	Blue-white	Gray
PIN3 empty	PIN8 empty			
Metal shell	DB metal shell	Shield	Shield	Metal shell

ENCCF-LL-FH
Wire spec. 1P×24AWG(7/0.20T)+3P×28AWG(7/0.127T)

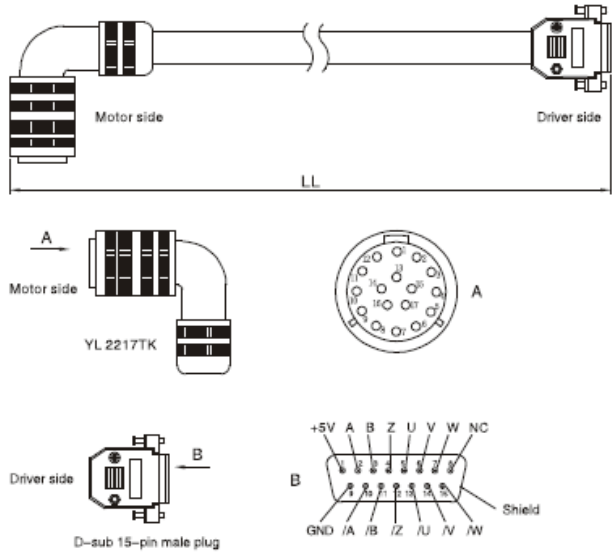


ENCCF-LL-FH				
Three-row 15 pin DB	Two-row 15 pin DB	Signal	Wire color	Motor wire color
PIN1	PIN1	+5V	Red(thick)	Red
PIN8	PIN2	A	Brown	Blue-black
PIN7	PIN3	B	Yellow	Green
PIN6	PIN4	Z	Green	Yellow
PIN2	PIN9	GND	Black(thick)	Black
PIN13	PIN10	/A	Brown-white	Blue
PIN12	PIN11	/B	Yellow-white	Green-black
PIN11	PIN12	/Z	Green-white	Yellow-black
Other pins empty	Other pins empty			
Shell	Shell	Shield	Shield	Shield

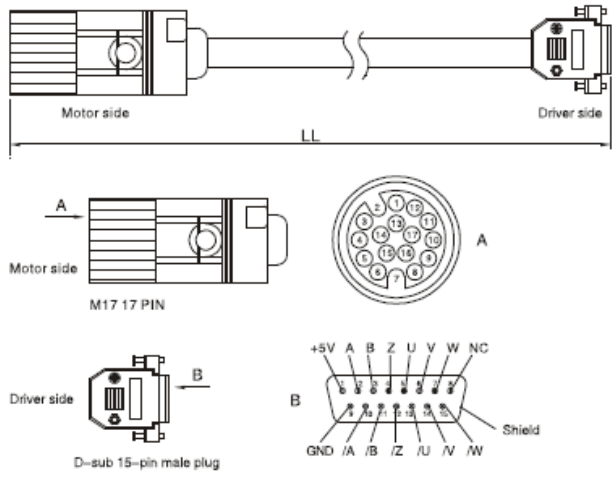
ENCCA-LL-KC0
Wire spec. 1P×24AWG(7/0.20T)+7P×28AWG(7/0.127T)



ENCCA-LL-KC1
Wire spec. 1P×24AWG(7/0.20T)+7P×28AWG(7/0.127T)



ENCCA-LL-KM1
Wire spec. 1P×24AWG(7/0.20T)+7P×28AWG(7/0.127T)



ENCCA-LL-KC0/ENCCA-LL-KC1				
17PIN	15PIN DB	Signal	External wire colour	Motor wire colour
PIN1	PIN1	+5V	Red(thick)	Red
PIN3	PIN2	A	Orange	Blue
PIN5	PIN3	B	Yellow	Green
PIN14	PIN4	Z	Green	Yellow
PIN9	PIN5	U	Brown	Brown
PIN11	PIN6	V	Purple	Gray
PIN16	PIN7	W	Blue	White
PIN2	PIN9	GND	Black(thick)	Black
PIN4	PIN10	/A	Orange-white	Blue-black
PIN6	PIN11	/B	Yellow-white	Green-black
PIN15	PIN12	/Z	Green-white	Yellow-black
PIN10	PIN13	/U	Brown-white	Brown-black
PIN12	PIN14	/V	Purple-white	Gray-black
PIN17	PIN15	/W	Blue-white	White-black
Internal metal ring	DB metal shell	Shield	Shield	Shield

ENCCA-LL-KM1				
17PIN	15PIN DB	Signal	External wire colour	Motor wire colour
PIN1	PIN1	+5V	Red(thick)	Red
PIN3	PIN2	A	Orange	Blue
PIN5	PIN3	B	Yellow	Green
PIN14	PIN4	Z	Green	Yellow
PIN9	PIN5	U	Brown	Brown
PIN11	PIN6	V	Purple	Gray
PIN16	PIN7	W	Blue	White
PIN2	PIN9	GND	Black(thick)	Black
PIN4	PIN10	/A	Orange-white	Blue-black
PIN6	PIN11	/B	Yellow-white	Green-black
PIN15	PIN12	/Z	Green-white	Yellow-black
PIN10	PIN13	/U	Brown-white	Brown-black
PIN12	PIN14	/V	Purple-white	Gray-black
PIN17	PIN15	/W	Blue-white	White-black
Internal metal ring	DB metal shell	Shield	Shield	Shield

Chapter12 Appendix

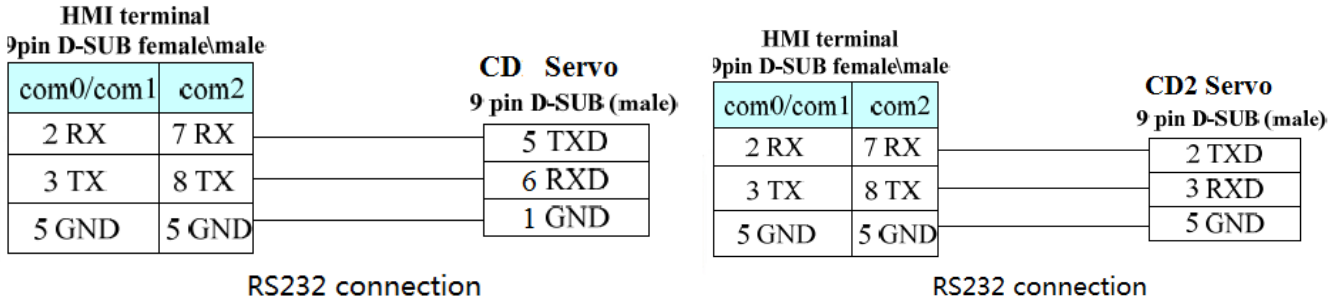
Appendix 1:Example for RS232 Communication

1.Communication between CD servo and Kinco HMI.

Kinco MT4000 and MT5000 series HMI can communicate with RS232 port of CD or CD2 servo.Users can set internal parameters of servo and display the status of servo.Kinco HMI can communicate with single servo,and also can communicate with multiple servo via RS232.

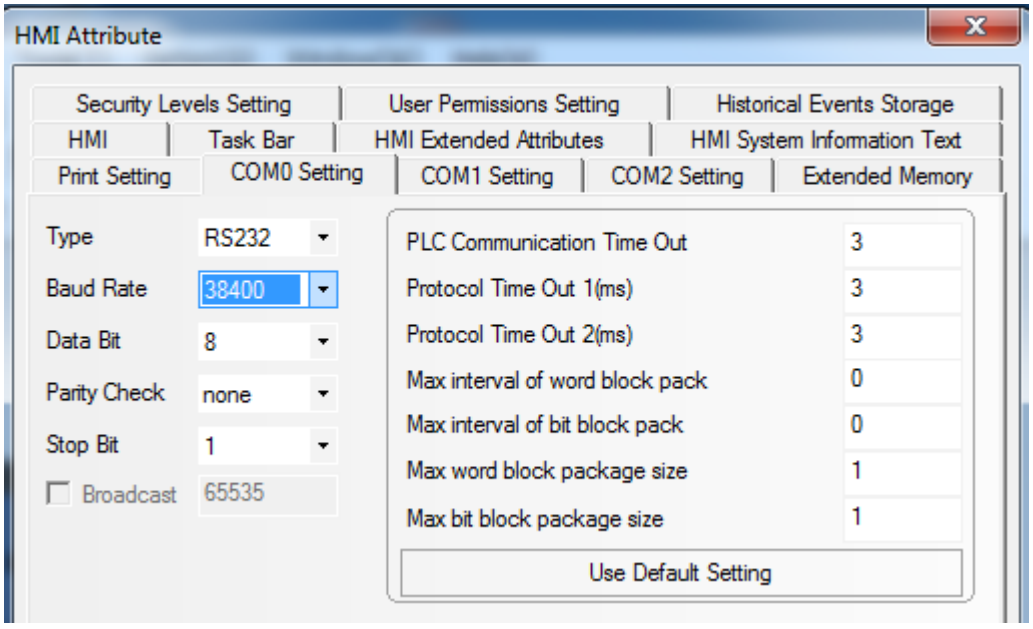
(1) HMI control single CD servo

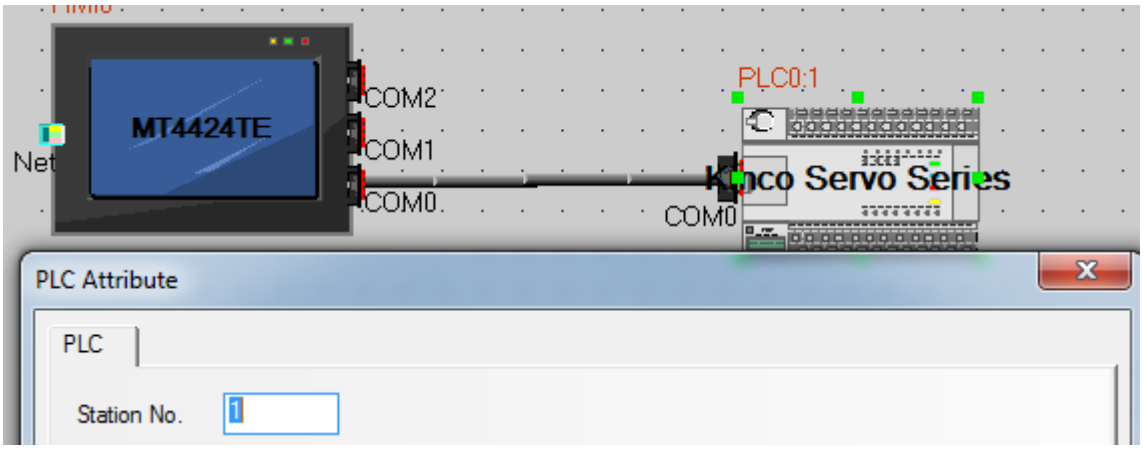
a. Wiring diagram



b. Communication parameters setting

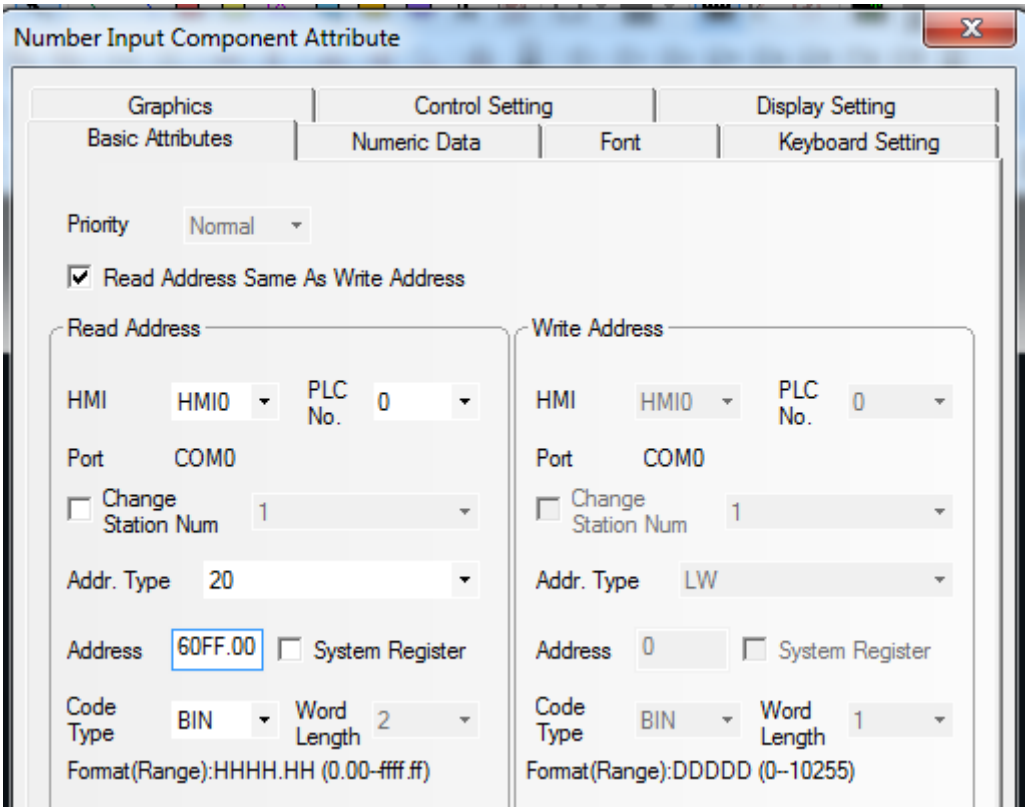
It needs to choose Kinco Servo Series driver in HMI.The parameters setting are shown in following figure.





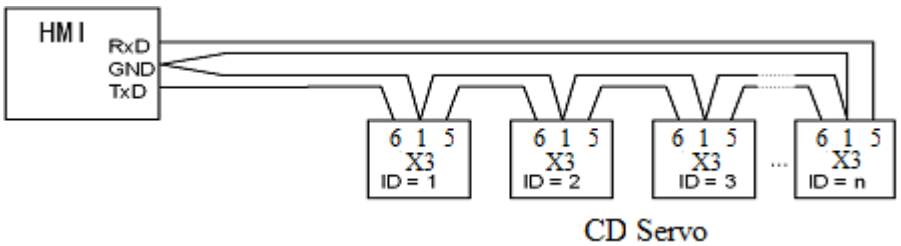
c. Address setting

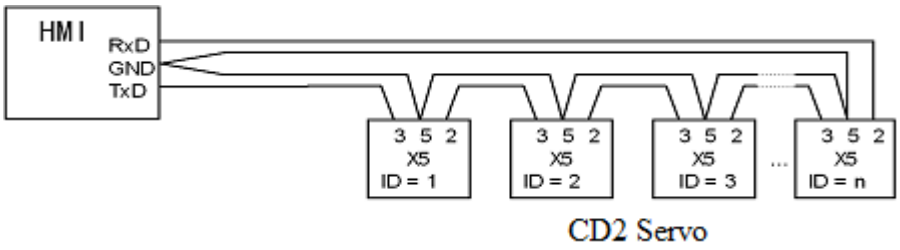
There are three address types in HMI software which are corresponding to the data length of the objects in CD servo.These address types are 08(8 bits),10(16 bits) and 20 (32 bits).The format of the address is Index.Subindex.Following figure is an example for using object 60FF0020(Target velocity)

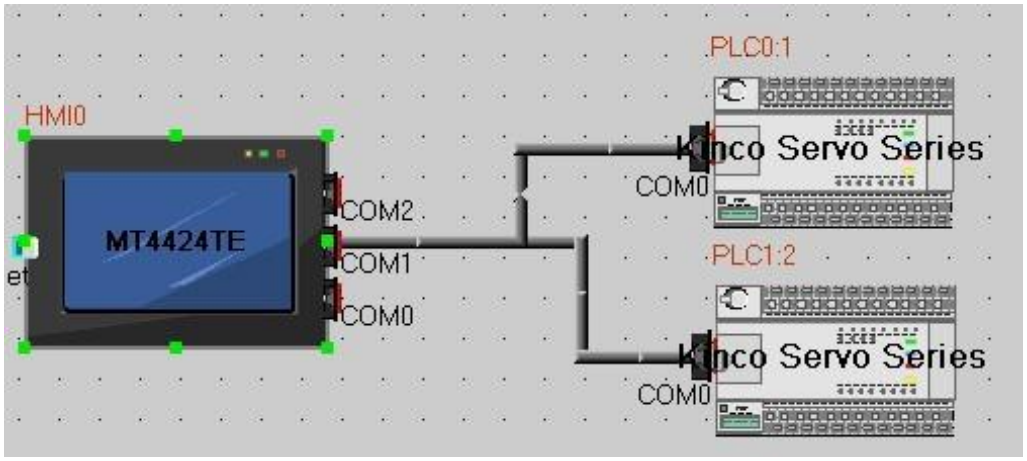


(2)HMI controls multiple CD servo (d5.15 must set as 1)

a、Wiring diagram

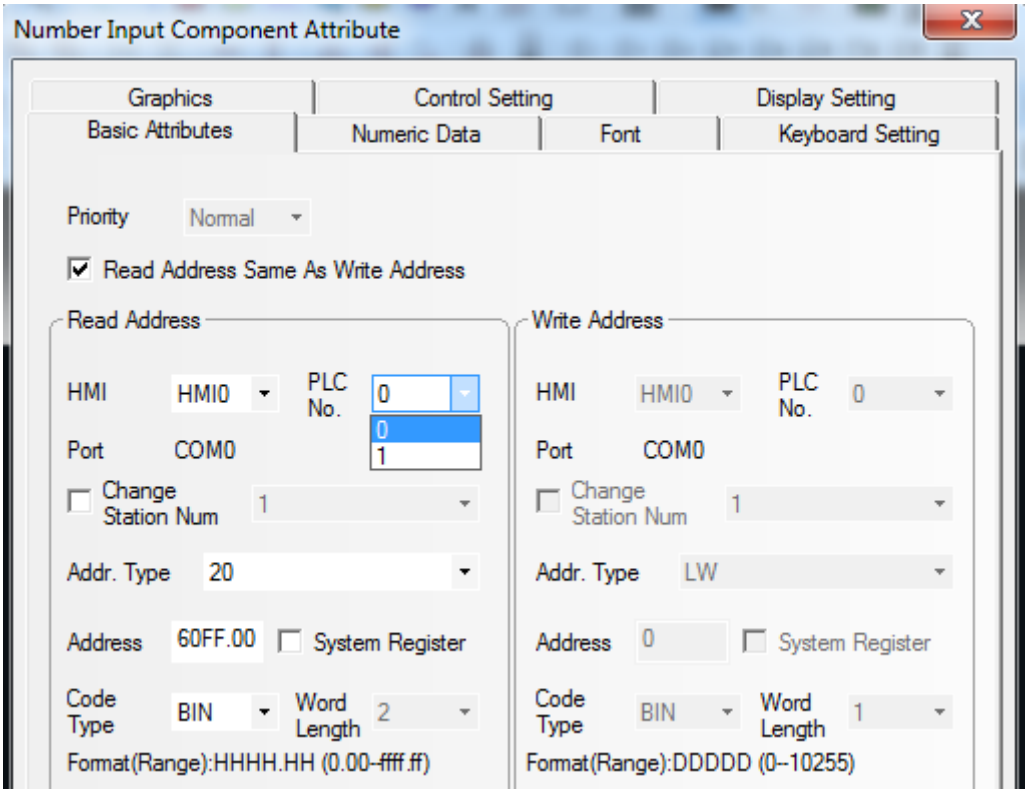






b. Parameters setting

The parameters setting in HMI is the same as above example,the difference is to set different station no. for different servo.In the attribute of components in HMI,it needs to select the PLC No. for different servo.(The PLC No. is not the servo station No.,as shown in the figure above,PLC0:1 means the PLC No. is 0,and station No. is 1)



Appendix 2:Selection Table for Brake Resistor

Driver Model	Driver Power[W]	Brake Resistor[Ω]			Brake Resistor Model(Ref.)	Brake Resistor Power[W] (Ref.)	Brake Resistor Withstand Voltage[VDC] (Min.)
		Min.	Max.	Ref.			
CD420-AA-000 CD422-AA-000	200W	39	100	75	T-75R-100	100	500
	400W						
	750W						
CD430-AA-000 CD432-AA-000	1.0KW	27	51	39	T-39R-200	200	
	1.05KW						
	1.26KW						
CD620-AA-000 CD622-AA-000	1.26KW	47	150	75	T-75R-200		800
	1.57KW						
	1.88KW						
	2.1kw						
	2.3kw						

Note:Please set brake resistor value and power in d5.04 and d5.05 when using brake resistor.
Please select brake resistor power according to real application.

Appendix 3:Selection Table for Fuse

Driver Model	Driver Power[W]	Specification
CD420-AA-000 CD422-AA-000	200W	3.5A/250VAC
	400W	7A/250VAC
	750W	15A/250VAC
CD430-AA-000 CD432-AA-000	1000W	20A/250VAC
	1.05KW	20A/250VAC
	1.26KW	25A/250VAC
CD620-AA-000 CD622-AA-000	1.26KW	15A/500VAC
	1.57KW	
	1.88KW	20A/500VAC
	2.1KW	25A/250VAC

	2.3KW	