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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 CD2S 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 wires are purchased

1.1.2 Nameplate of Servo Driver

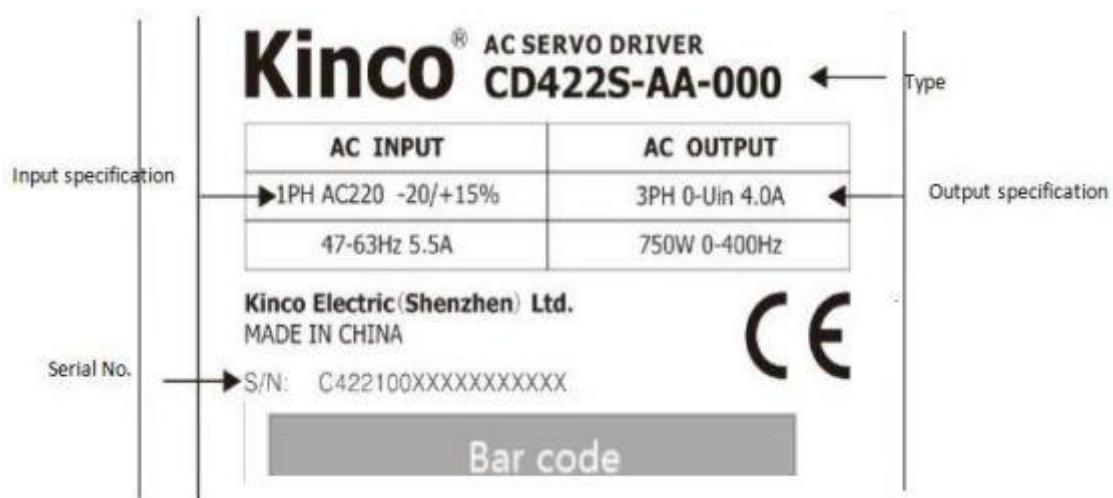


Fig. 1-1 Nameplate of a servo driver

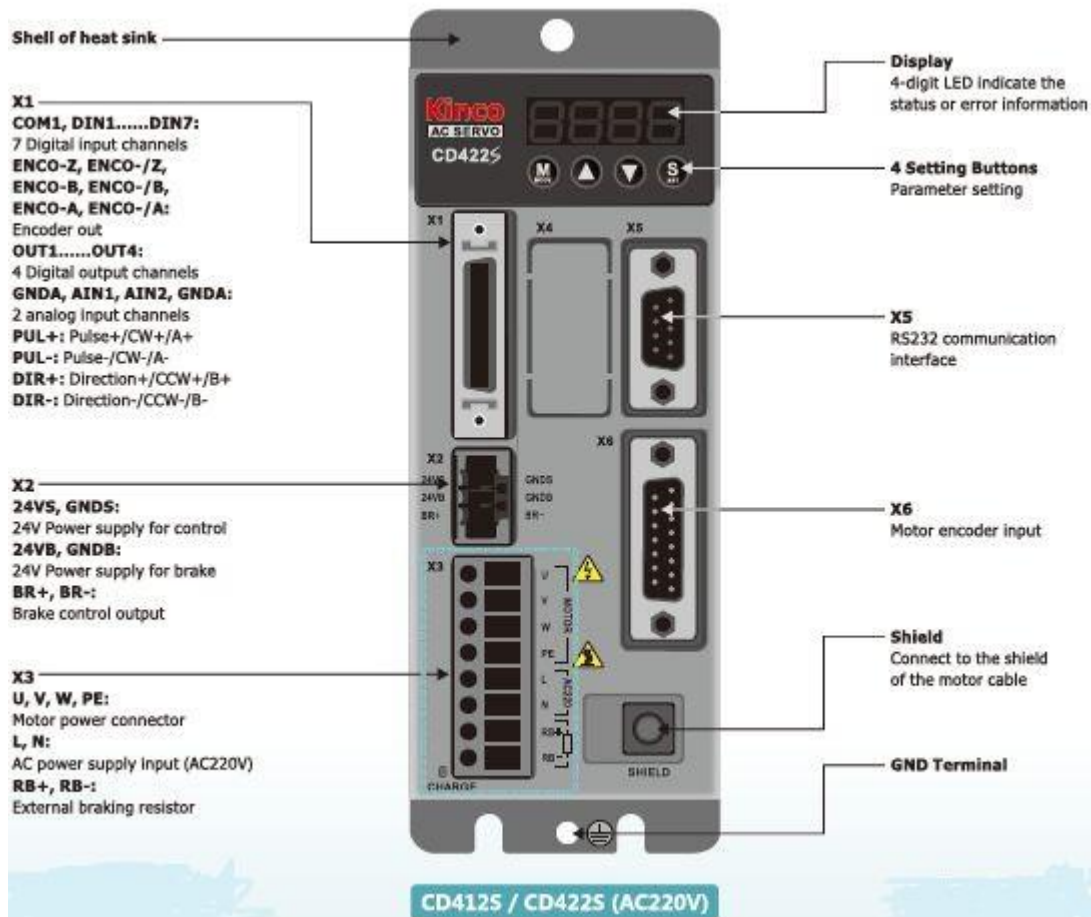
1.1.3 Nameplate of Servo Motor



Fig. 1-2 Nameplate of a servo motor

1.2 Component Names

1.2.1 Component Names of CD2S Servo Driver



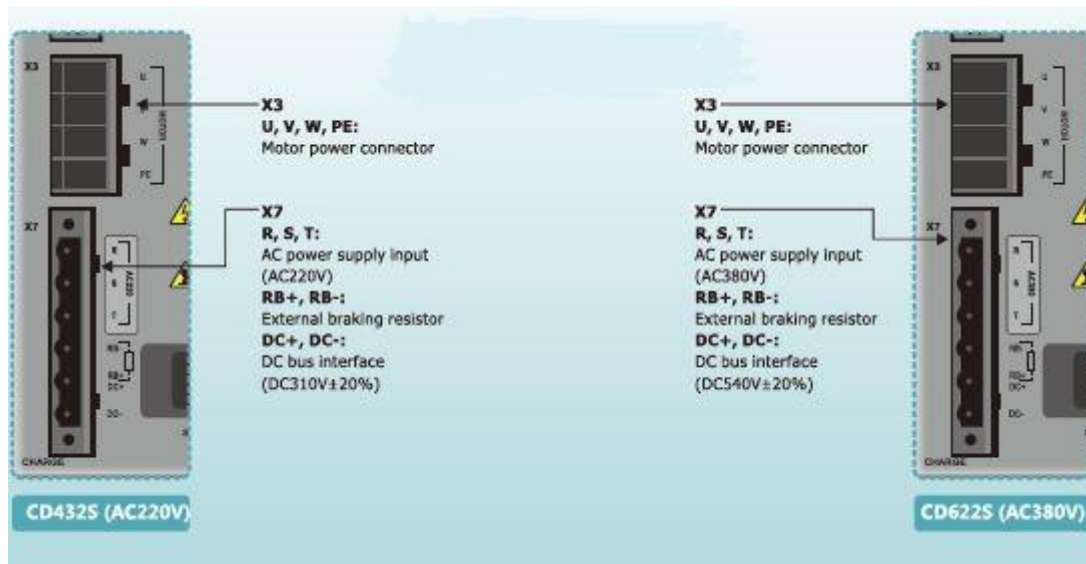


Fig. 1-3 Component Names of CD2S Servo Driver

1.2.2 Component Names of Servo Motor

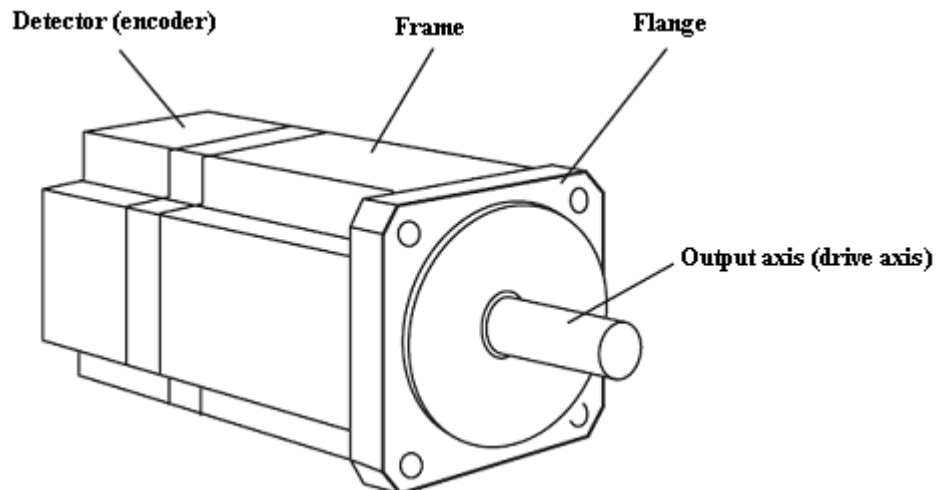
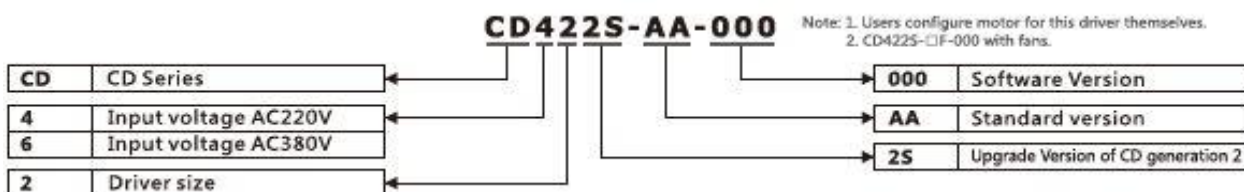


Fig. 1-4 Component names of a servo motor (brakes excluded)

1.3 Model Description of Servo Motors and Drivers

1.3.1 Servo Drivers



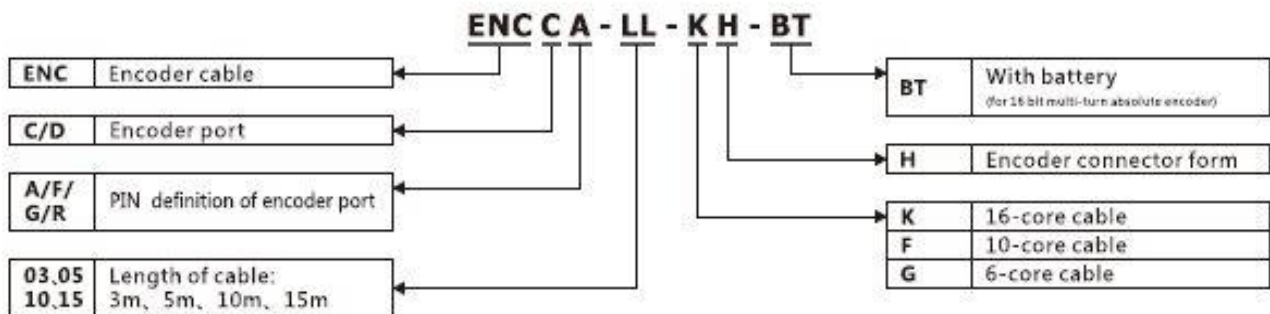
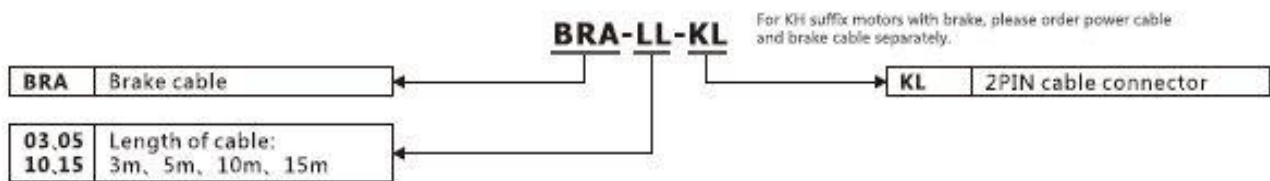
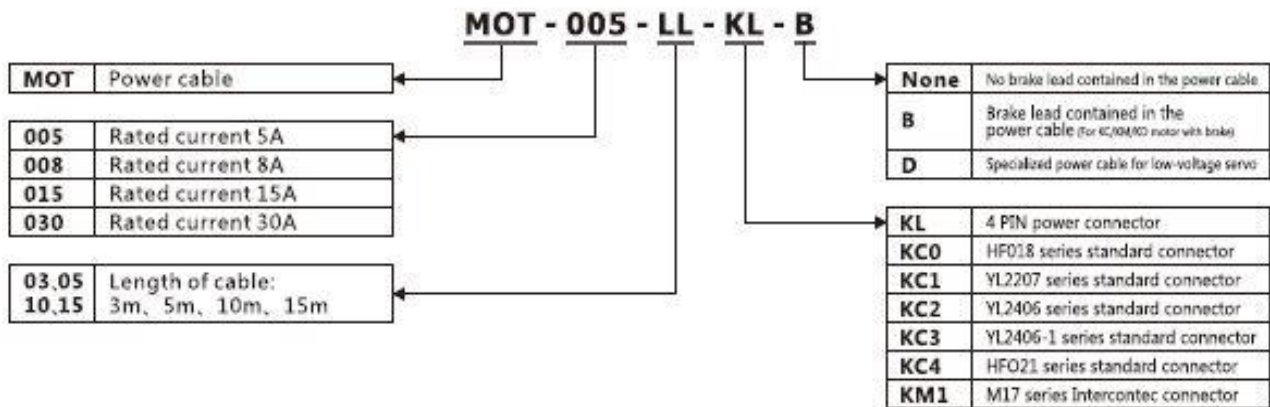
1.3.2 Servo Motors

SMH 60S-0040-30AAK-3LKH

SMH	SMH Series
SMS	SMS Series
SMC	SMC 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
R	SMT37 Resolver
J	20 bit single-turn encoder
K	16 bit multi-turn absolute encoder
N	Mechanical absolute encoder
E	2500PPR incremental wire swing encoder
M	Magnetolectric encoder
A	Without brake
B	With brake

H	Direct cable connector
N	HFO18 series standard connector (Towards the shaft)
O	HFO18 series standard connector (Opposite the shaft)
P	HFO21+HFO18 (Power HFO21 connector, Encoder HFO18 connector)
C	YL series standard connector
M	2×M17 series Intercontec connector
U	Communication encoder connector
K	History code
D	DC70V
L	AC220V
H	AC380V
F	50 Pole pairs
3	3 Pole pairs
4	4 Pole pairs
K	With keyway
A	Without keyway

1.3.3 Power, Brake and Encoder cable of Motors



Chapter 2 Precautions and Installation Requirements

A Kinco **CD2S** 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/s ²

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.

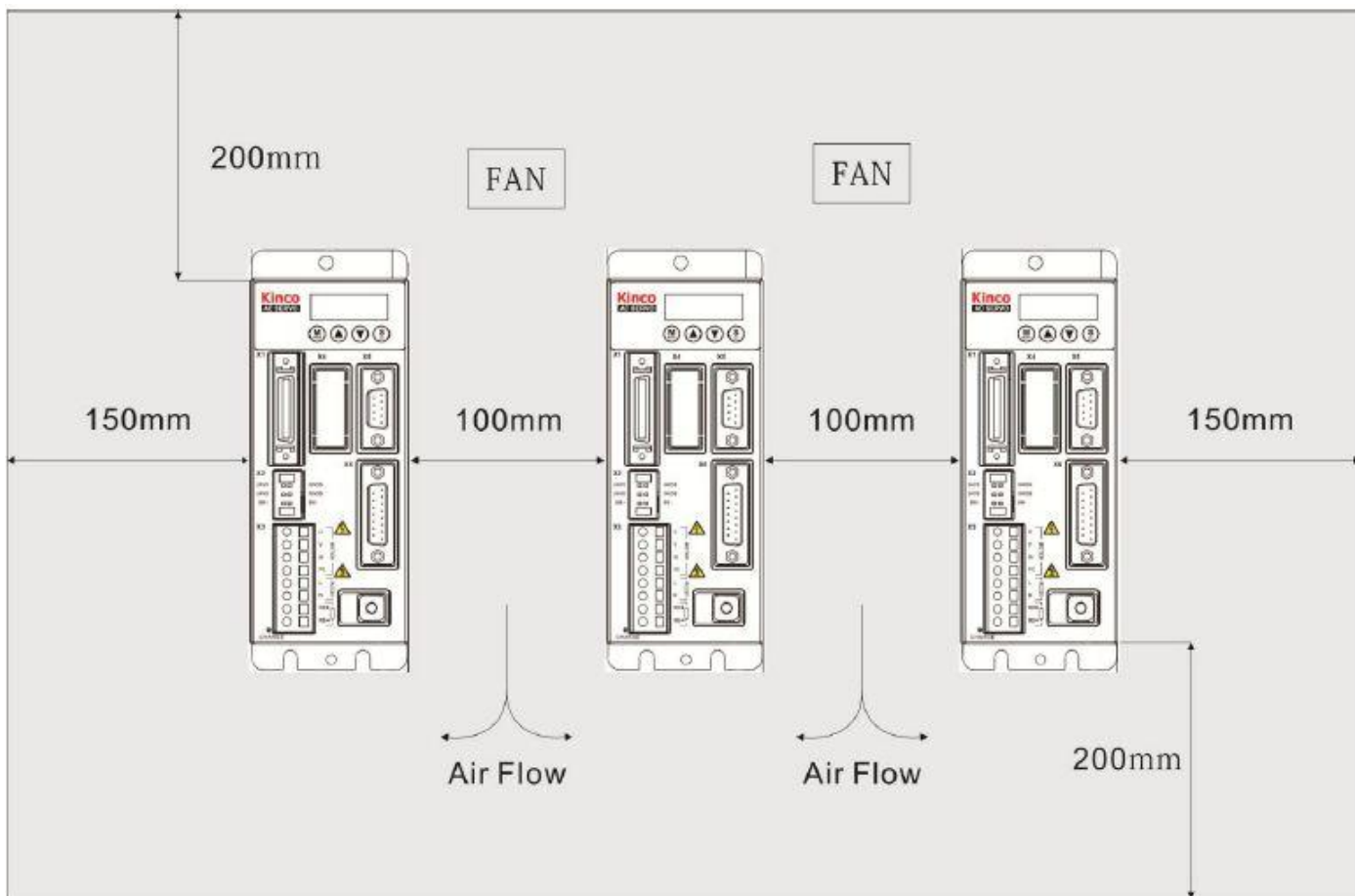


Fig. 2-2 Installing multiple servo drivers

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 **Wiring** of **CD2S** Driver

3.1 Interfaces of **CD2S** Driver

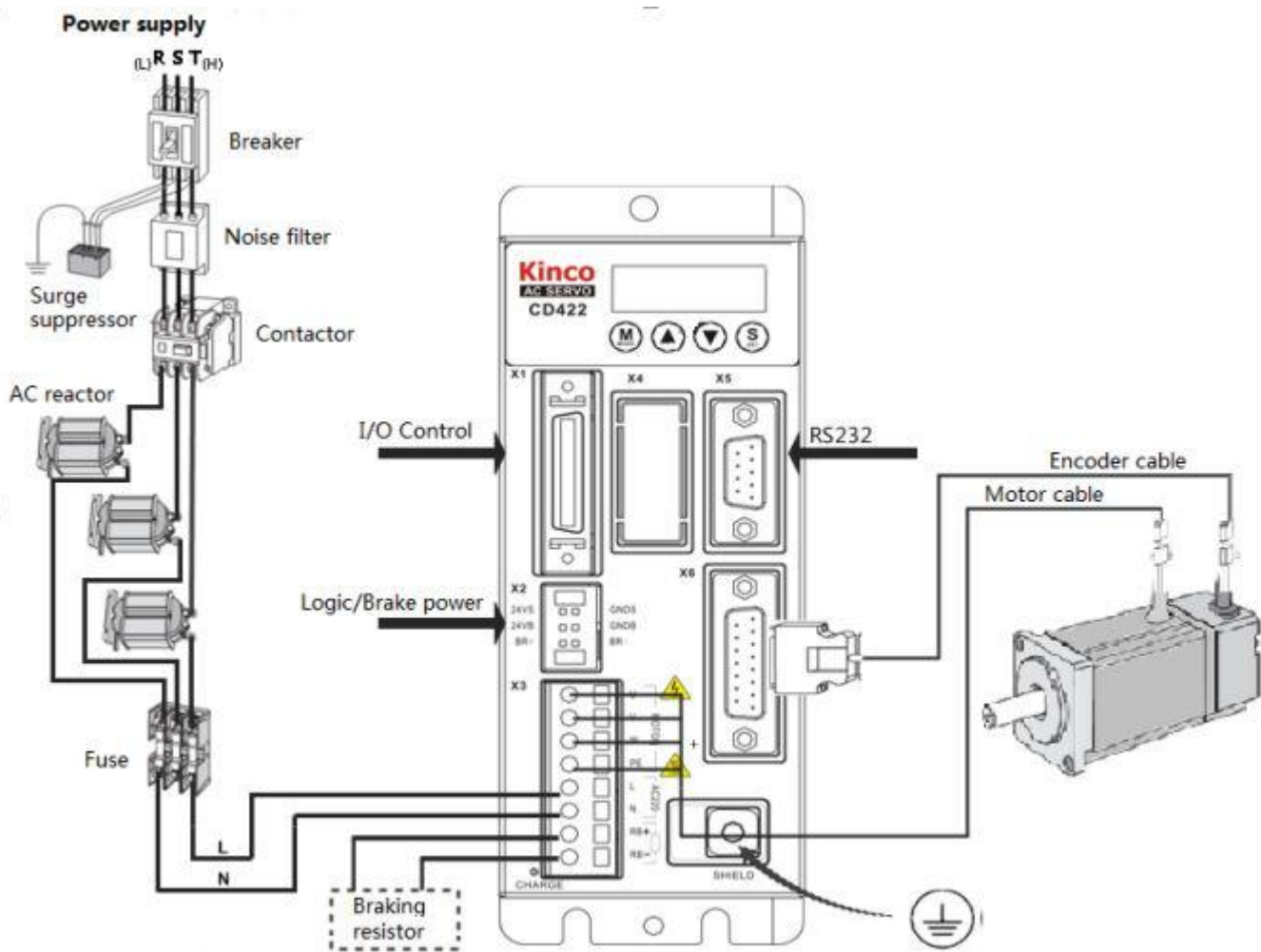
3.1.1 Interfaces

Table 3-1 Interfaces of CD412S/CD422S/CD432S/CD622S

Interface	Driver	Symbol	Function	
X1	CD412S CD422S CD432S CD622S	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: 3V~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:"18VDC~30VDC 1A"
		24VB/GNDB	Power supply for brake "18VDC~30VDC 0.5A" (CD622S 2A)
		BR+/BR-	Brake interface
X3	CD412S CD422S	U/V/W/PE	Motor cable interface
		L/N	Main power supply (Single-phase AC220V)
		RB+/RB-	Braking resistor interface
X5	CD412S	RS232	RS232 interface
X6	CD422S CD432S CD622S	ENCODER IN	Encoder cable interface
X7	CD432S CD622S	R/S/T	Main power supply (CD432S: Single phase or 3-phase AC220V, CD622S: 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



Note: For part of driving interface, please refer to figure 3-4.

Fig.3-1 Wiring diagram of CD2S driver

3.1.3 X1 interface of CD2S Driver

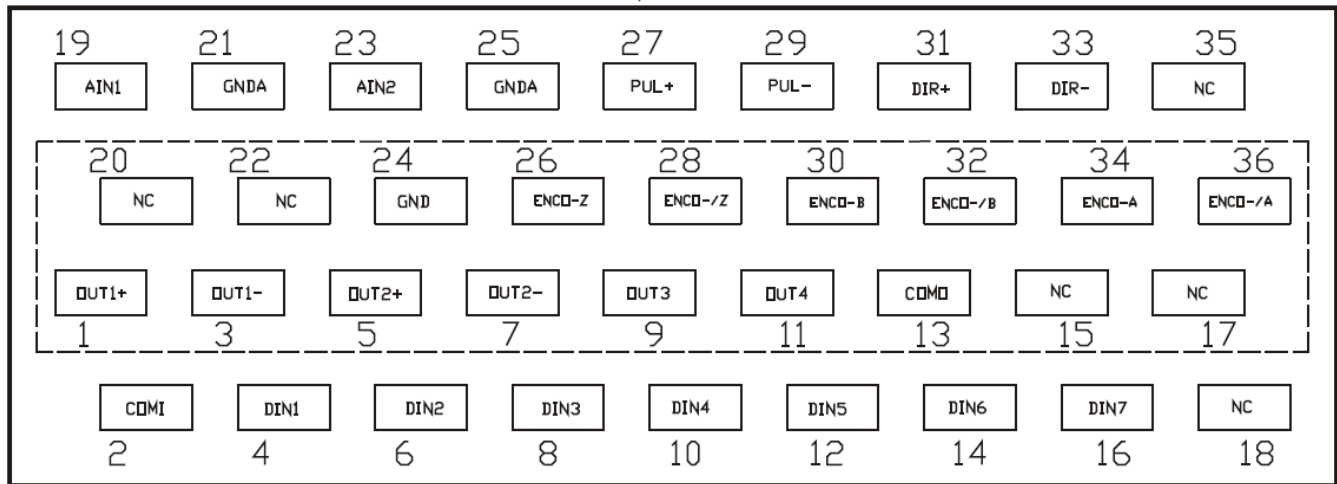
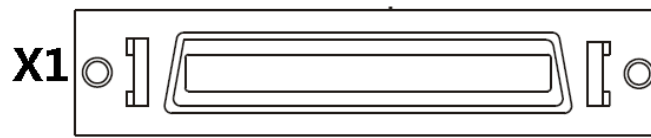


Fig.3-2 X1 interface

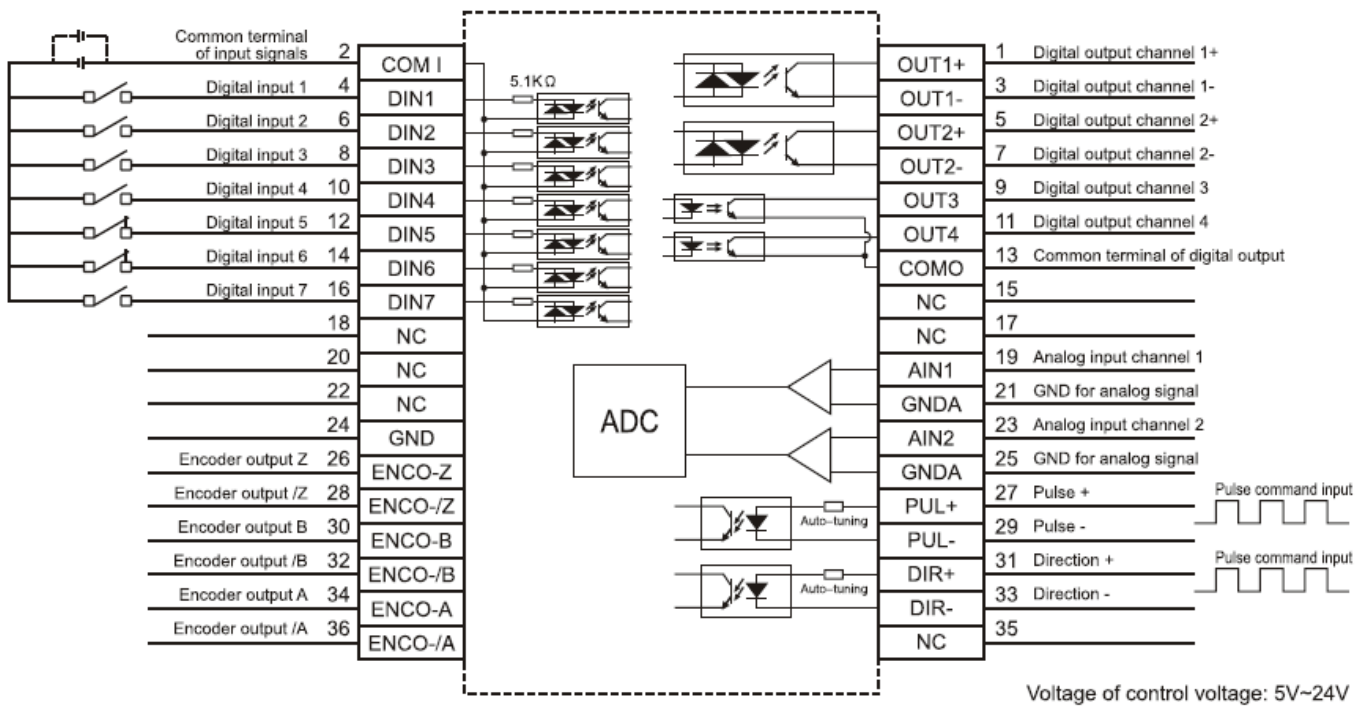


Fig.3-3 Wiring diagram of X1 interface

3.1.4 Power Interface X3 of CD2S Driver (CD432S/CD622S X3 and X7)

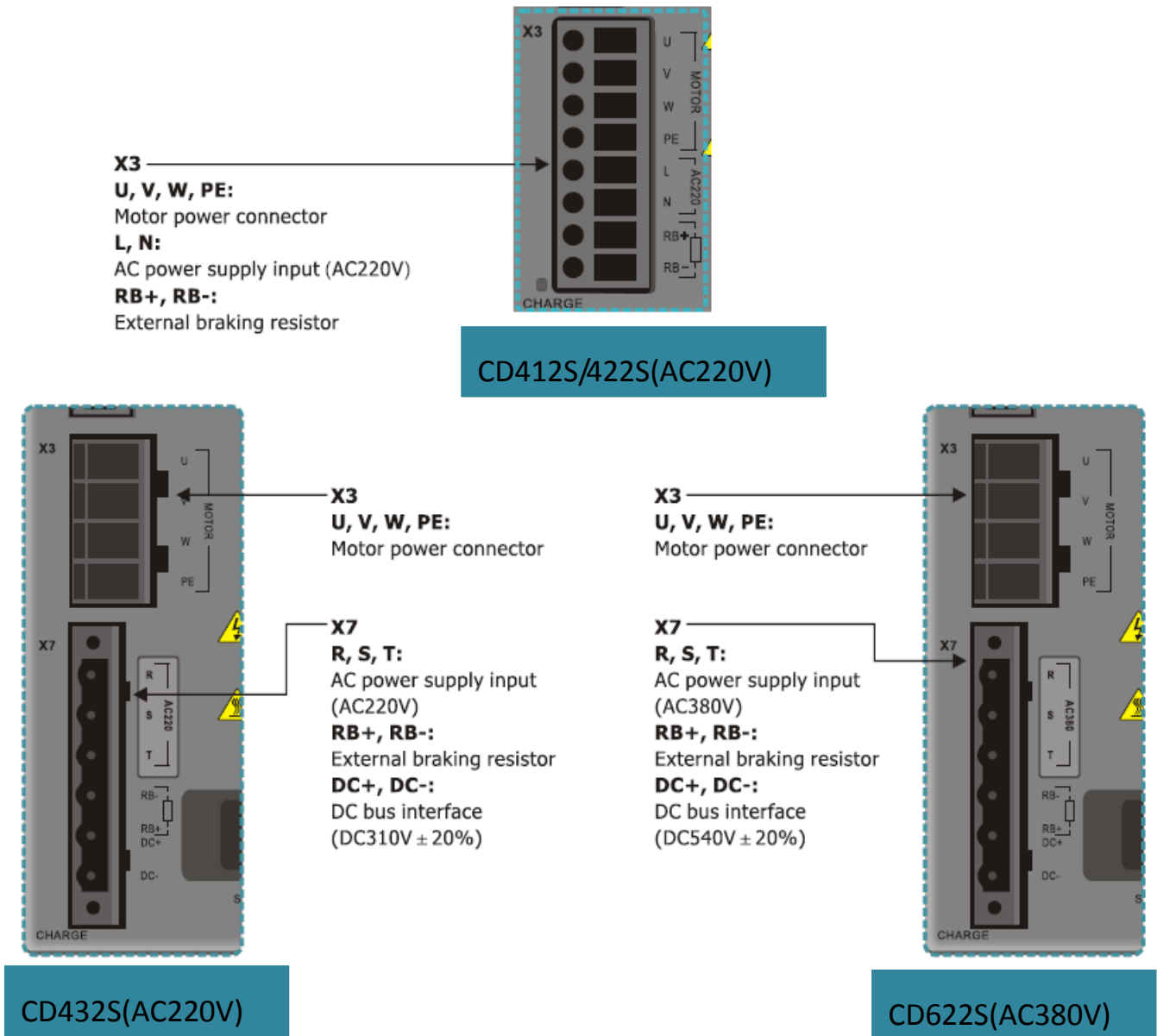
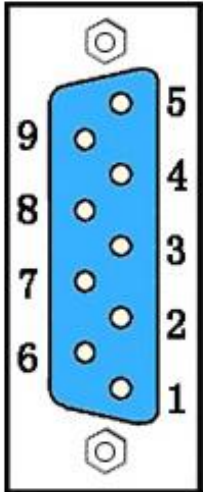


Fig.3-4 Power interface of CD2S driver

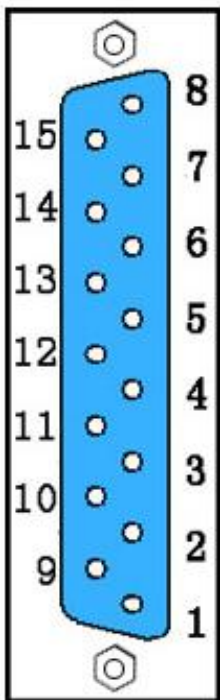
3.1.5 X5 and X6 Interfaces of CD2S Driver

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	

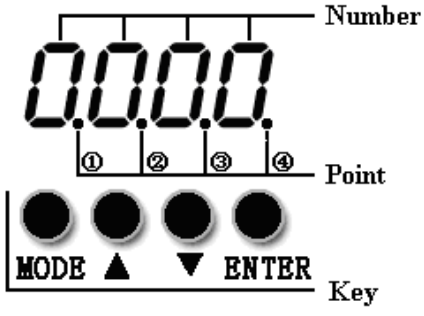
	15	/W	signals of encoder	
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Chapter 4 Digital Operation Panel

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	<ol style="list-style-type: none"> 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

	<p>real time.</p> <p>3. Indicates the earliest error when history records of errors (F007) are displayed.</p>
③	<p>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.</p> <p>2. Indicates the latest error when the history records of errors (F007) are displayed.</p>
④	<p>1. If it is on, it indicates that internal data is currently displayed.</p> <p>2. If it flickers, it indicates that the power part of the driver is in the working status.</p>
MODE	<p>1. Switches basic menus.</p> <p>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.</p>
▲	Presses ▲ to increase set values; long presses ▲ to increase numbers promptly.
▼	Presses ▼ to decrease set values; long presses ▼ to decrease numbers promptly.
ENTER	<p>1. Enters the selected menu by pressing this key.</p> <p>2. Keeps current parameters in the enabled status.</p> <p>3. Confirms input parameters after parameters are set.</p> <p>4. Long presses this key to switch to higher/lower 16 bits when internal 32-bit data is displayed in real time.</p>
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

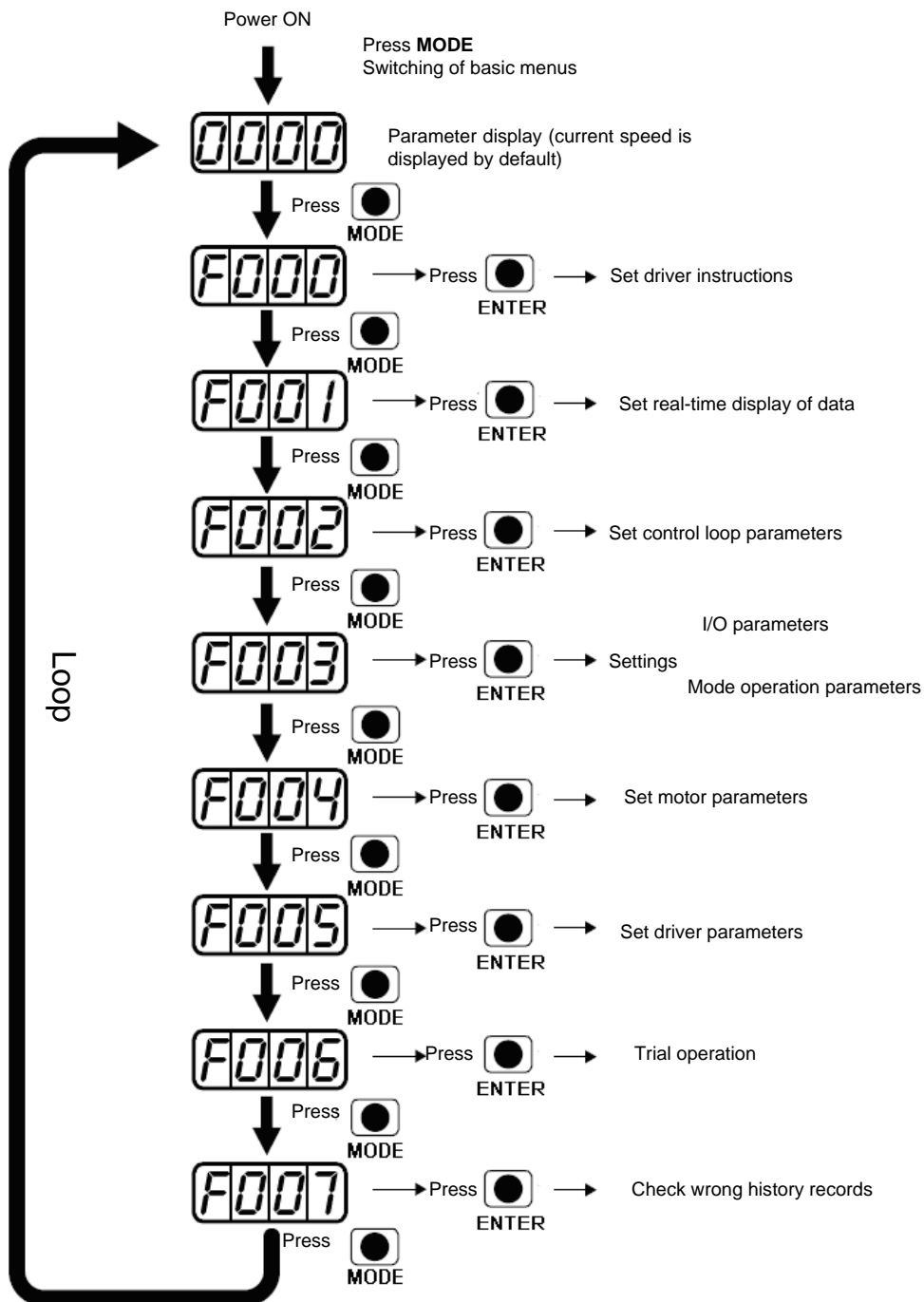


Fig. 4-1 Operation on a digital operation panel

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.

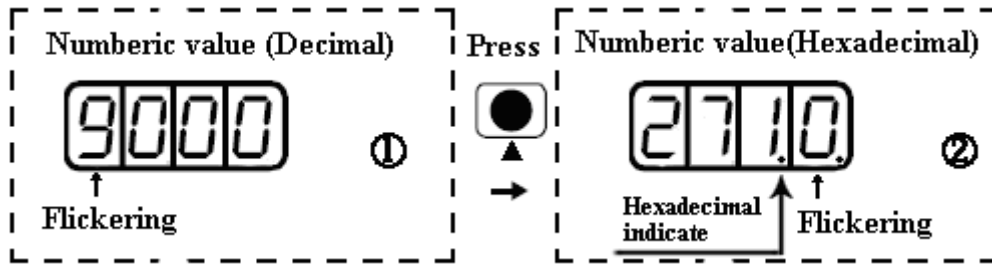


Fig. 4-2 Number system conversion

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.

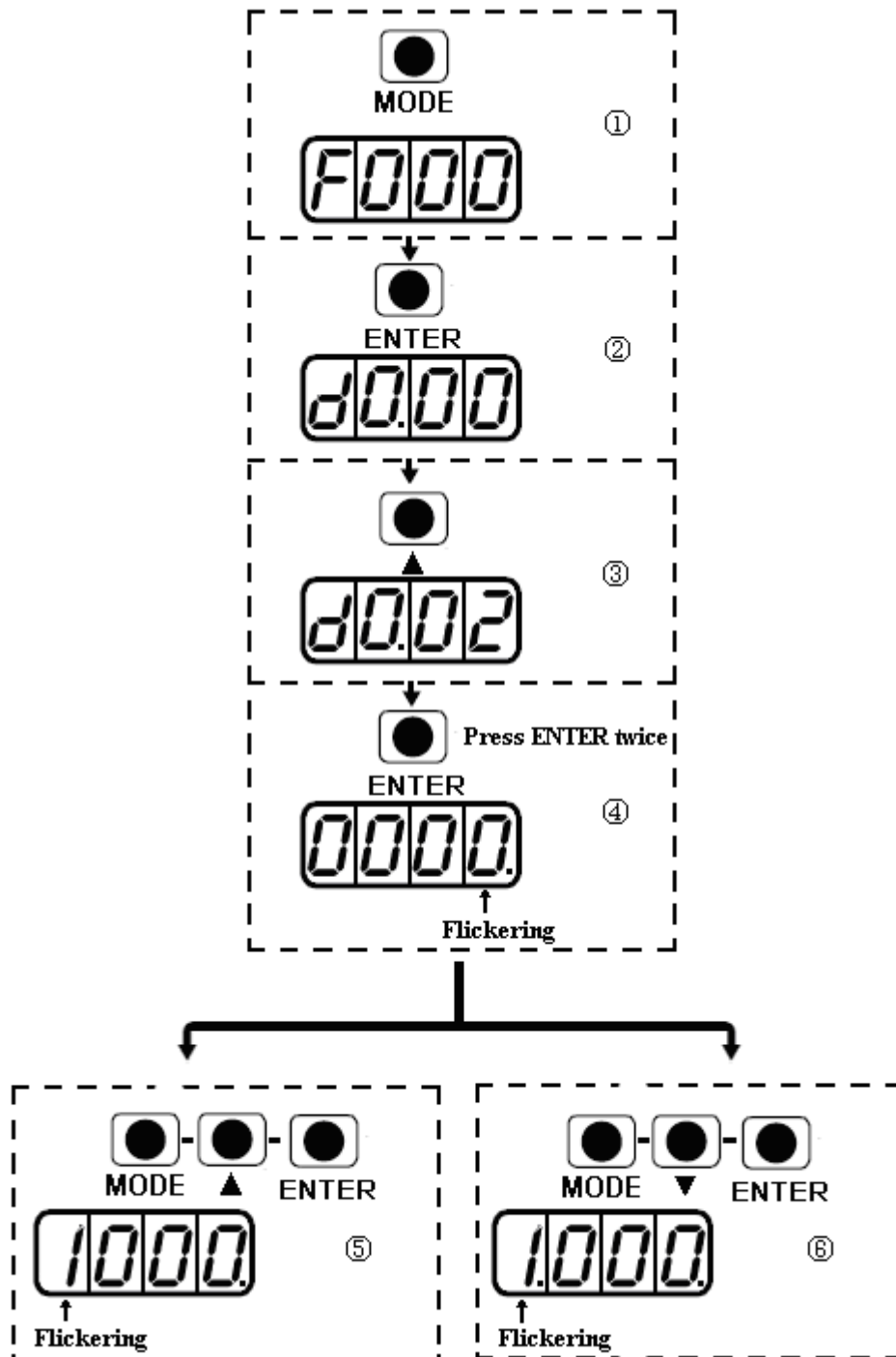


Fig. 4-3 Separate regulation of bits

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						
			CD412S	CD422S	With fan	CD432S	CD612S	CD622S	
			FD412S	FD422S	CD422S-AF FD422S-AF (CF, LF)	FD432S	FD612S	FD622S	
Operation address: EA01			Display FFF.F if not enable						
K@	404.b	Do not configure motor							
W0	305.7	SMC60S-0020-30E ■K-3LKH		✓					
W1	315.7	SMC60S-0040-30E ■K-3LKH		✓					
W2	325.7	SMC60S-0075-30E ■K-3LKH		✓					
WB	425.7	SMC130D-0100-20E ■K-4LKP			✓				
WC	435.7	SMC130D-0150-20E ■K-4HKP					✓		
WD	445.7	SMC130D-0200-20E ■K-4HKP					✓		
WO	4F5.7	SMC130D-0150-20E ■K-4LKP				✓			
WP	505.7	SMC130D-0200-20E ■K-4LKP				✓			
WQ	515.7	SMC130D-0300-30E ■K-4HKP							✓
WR	525.7	SMC130D-0300-20E ■K-4HKP							✓
Y0	305.9	SMS60S-0020-30J ■K-3LKH		✓					
Y1	315.9	SMS60S-0040-30J ■K-3LKH		✓					
Y2	325.9	SMS80S-0075-30J ■K-3LKH		✓					
Z0	305.A	SMS60S-0020-20K ■K-3LKH		✓					
Z1	315.A	SMS60S-0040-30K ■K-3LKH		✓					
Z2	325.A	SMS80S-0075-30K ■K-3LKH		✓					
KZ	5A4.b	SMH40S-0005-30A ■K-4LKH	✓						
KW	594.b	SMH40S-0010-30A ■K-4LKH	✓						
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	SMH130D-0230-20A ■K-4HK □							✓
F4	344.b	85S-0025-05AAK-FLFN-02		✓					
F6	364.b	85S-0035-05AAK-FLFN-02		✓					
F8	384.b	85S-0045-05AAK-FLFN-02		✓					

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/>

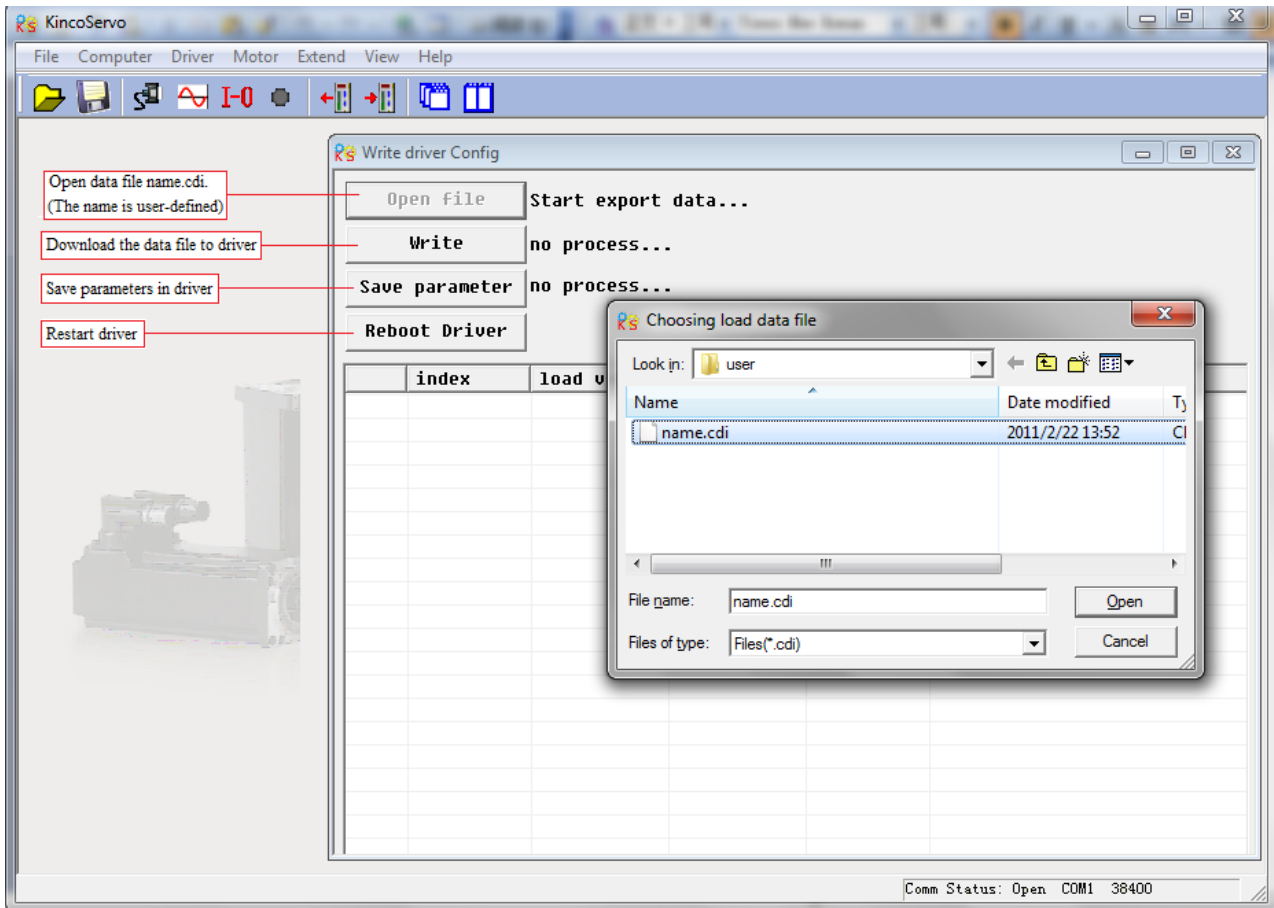


Fig.5-1 Data file downloading

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)

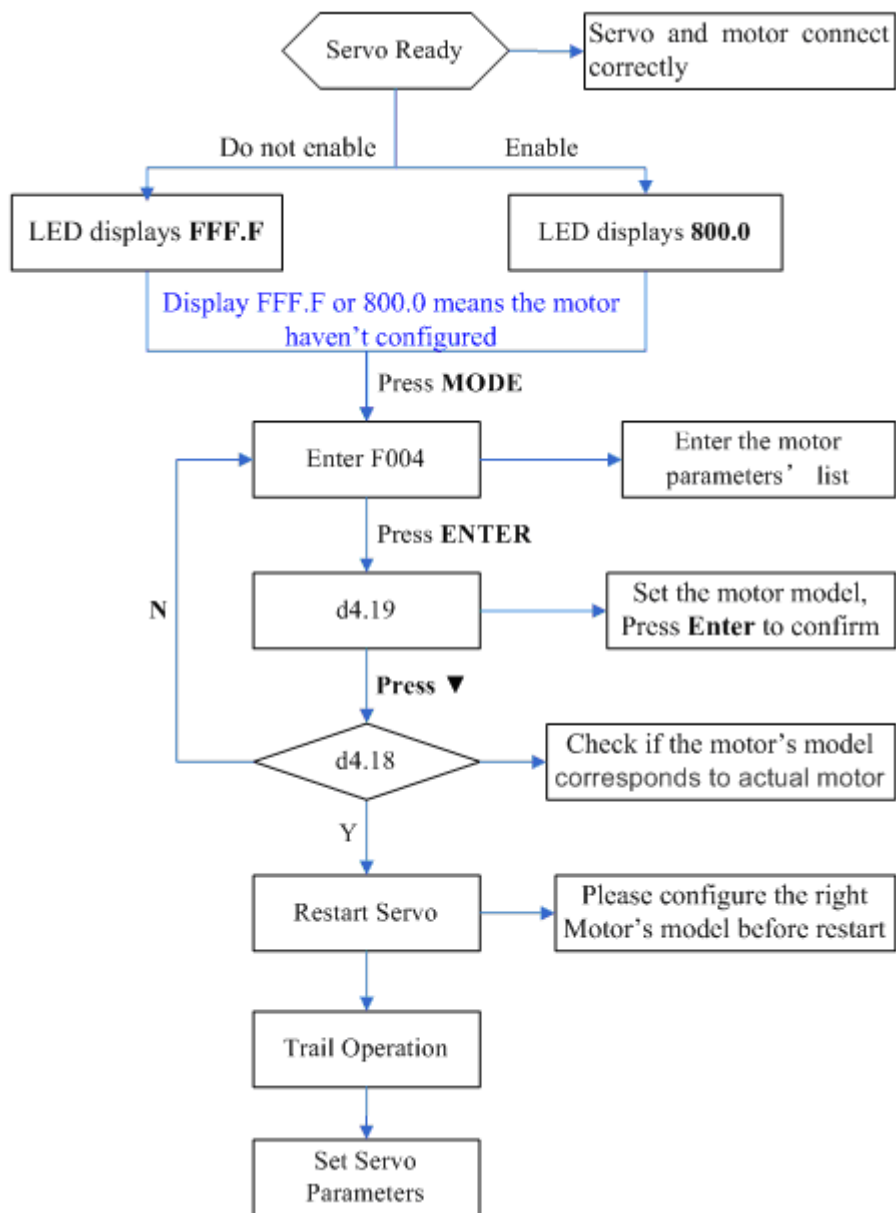


Fig.5-2 Flow chart for configuring motor by key

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.

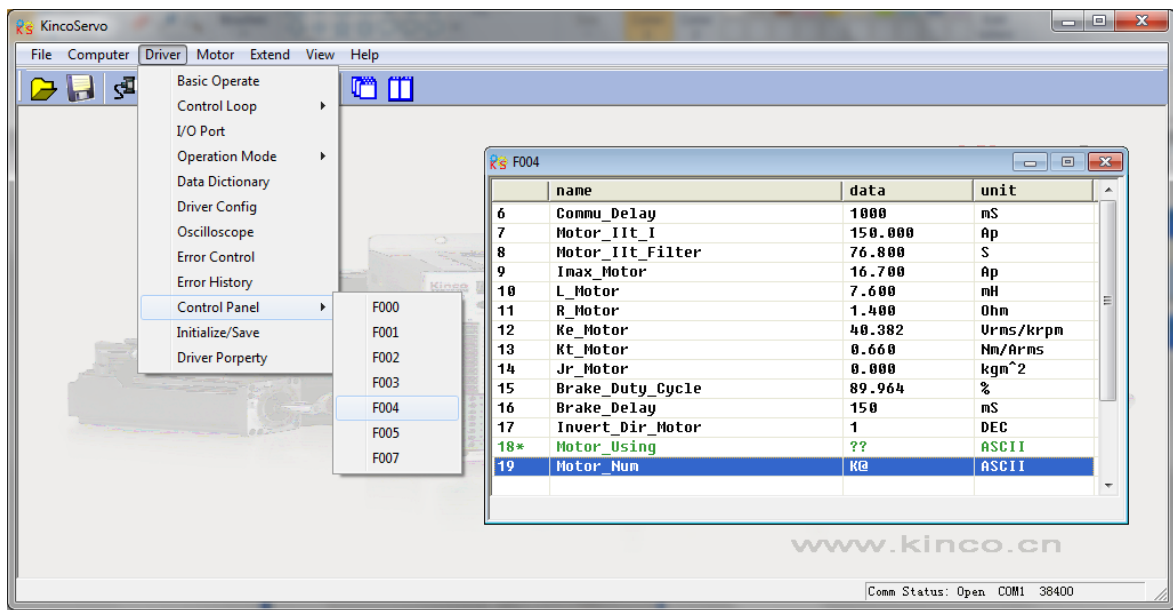


Fig.5-3 Configure motor by software

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 “abc.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

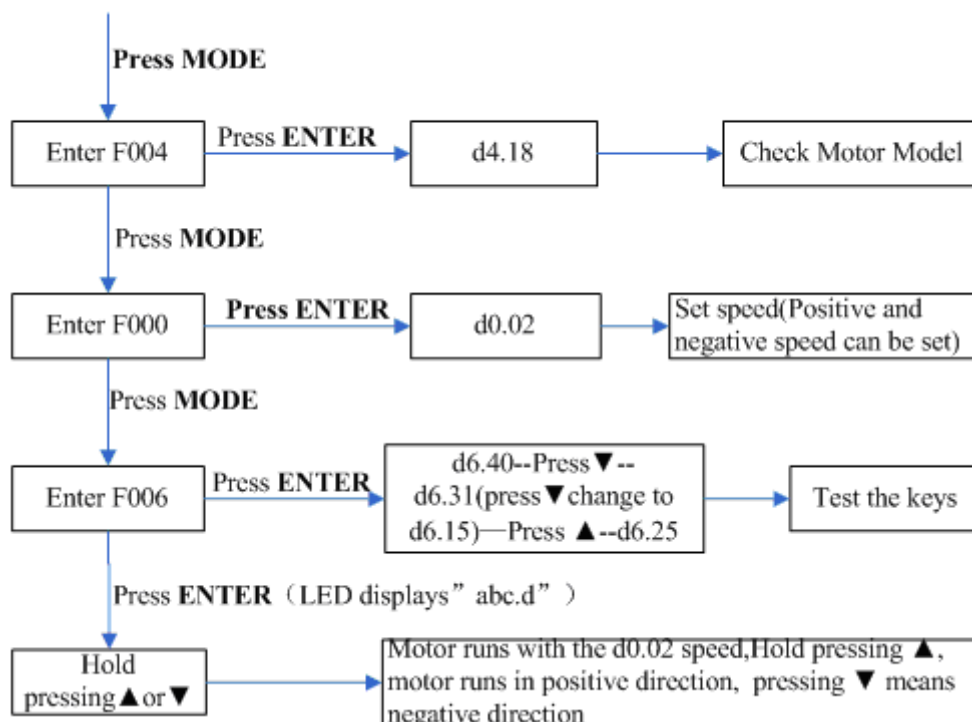


Fig.5-4 Flow chart for trial operation

5.3 EASY USE

Easy use is used to help users rapidly set control loop parameters, so as to avoid complex steps of adjusting servo.

After adjusting, driver's performance will be fine in most of applications. And this also open another isolated area, which is convenient for users to set significant parameters.

Easy Use operation steps

1. EASY includes common parameters. Please ensure each of them one by one and save by EA00.
 - 1.1 If motor type (EA01) does not change, set 1 to EA00 and save parameters in forward steps.
 - 1.2 If motor type (EA01) does not change, set 2 to EA00. Then save parameters in forward steps and reboot driver.
 - 1.3 After finishing EASY, please make motor run. If performance is good, it is unnecessary to operate TunE. Otherwise, re-operate TunE.
2. TunE process is inertia measuring process. It is valid after inputting value, but they are needed to be saved by Tn00.
 - 2.1 After making inertia measuring via Tn03, drive will change stiffness (Tn01) according to setting.
 - 2.2 Please run the driver and motor. If performance is not ideal, please modify stiffness step by step via Tn01. Please note that adjusting and observing performance should be at the same time.

Note:

1. Inertia measuring might cause shake of machine. Please close power supply or driver at once.
2. After execute EASY process, we strongly suggest to execute TunE and adjust stiffness level.
3. Design aim of EASY and TunE is to solve the problem of panel operation. If users use software to init parameters or change motor type, only EA00, EA01 and Tn00 can displayed on the menu of EASY and TunE. Users must ensure motor type via EA01, driver will restore defaults and display complete EASY and TunE menu.

Reason for the failure of tuning:

- Incorrect wiring
- Incorrect setting of motor type
- Mechanical stiffness is too low
- Mechanical intermittent exists.
- Acc/Dcc is lower than stickiness friction torque

Table 1 EASY menu parameters

LED	Parameter	Description	Default																				
EA01	Motor Type	<p>For a new motor controller, the set motor type is "00" and "3030" appears at the LED display. If the new motor controller is connected to a valid motor, the motor type is auto-recognized and saved.</p> <p>The motor type saved in the controller and the connected motor type are compared later on. If they are different, "FFFF" flashes at the LED display. The user needs to confirm the EA01 value, save motor data and reboot the controller to eliminate this state.</p> <p>Examples of motor type, motor code and EA01 display value.</p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Motor type</th> <th colspan="3" style="text-align: left;">Motor code/ LED display</th> </tr> <tr> <th></th> <th style="text-align: left;">AAK/LED</th> <th style="text-align: left;">JAK/LED</th> <th style="text-align: left;">KAK/LED</th> </tr> </thead> <tbody> <tr> <td>SMH40S-0010-30xxx-4LKH</td> <td>KY/594B</td> <td>JY/594A</td> <td>MY/594D</td> </tr> <tr> <td>SMH40S-0005-30xxx-4LKH</td> <td>KZ/5A4B</td> <td>JZ/5A4A</td> <td>MZ/5A4D</td> </tr> <tr> <td>SMH60S-0020-30xxx-3LKH</td> <td>K0/304B</td> <td></td> <td></td> </tr> </tbody> </table>	Motor type	Motor code/ LED display				AAK/LED	JAK/LED	KAK/LED	SMH40S-0010-30xxx-4LKH	KY/594B	JY/594A	MY/594D	SMH40S-0005-30xxx-4LKH	KZ/5A4B	JZ/5A4A	MZ/5A4D	SMH60S-0020-30xxx-3LKH	K0/304B			/
Motor type	Motor code/ LED display																						
	AAK/LED	JAK/LED	KAK/LED																				
SMH40S-0010-30xxx-4LKH	KY/594B	JY/594A	MY/594D																				
SMH40S-0005-30xxx-4LKH	KZ/5A4B	JZ/5A4A	MZ/5A4D																				
SMH60S-0020-30xxx-3LKH	K0/304B																						

		SMH60S-0040-30xxx-3LKH K1/314B	
EA02	Command Type	<p>The command type affects controller-internal interface settings, the initial operation mode after power on and the default settings for DIN- and OUT functions (refer to table 4-3).</p> <p>0: CW/CCW pulse train mode Operation mode = -4 1: P/D pulse train mode Operation mode = -4 2: A/B phase control master / slave mode Operation mode = -4 6: Analog velocity mode by AIN1 Operation mode = -3 7: Analog velocity mode by AIN2 Operation mode = -3 8: Communication 9: Position table mode Operation mode = 1</p>	1
EA03	Gear Factor Numerator	Used when EA02 is set to 0-2.	1000
EA04	Gear Factor Denominator	By default, the display shows the values in decimal format. If the number is greater than 9999, the display is in hexadecimal format.	1000
EA05	Analog Speed Factor	<p>Used when EA02 is set to 6 or 7.</p> <p>The relationship between analog input voltage and motor velocity the unit of measure is rpm/V.</p> <p>For controller use with standard KINCO-AS motors, the maximum value is 374, the maximum velocity is 3740rpm/10v/.</p> <p>For more details see chapter 9.3 (d3.29).</p>	300
EA06	1.Load type 2.Application 3.Limit switch 4. Alarm output polarity	<p>The meaning of each digit of the LED display from right to left.</p> <p>(1) Load type, influences the control loop. 0: No load 1: Belt drive 2: Ball screw</p> <p>(2) Application, influences the control loop. 0: P2P 1: CNC 2: Master / slave mode</p> <p>(3) Limit switch. 0: Controller default 1: Delete the limit switch function</p> <p>(4) Polarity of OUT5 0: Normally closed contacts 1: Normally open contacts</p>	1001
EA07	Homing method	Refer to chapter 6.6	0
EA00	Save Parameters	<p>Write "1" to save control and motor parameters.</p> <p>Write "2" to save control and motor parameters and reboot the servo.</p> <p>Write "3" to reboot the servo.</p> <p>Write "10" to initialize the control parameters.</p> <p>Notice:</p>	/

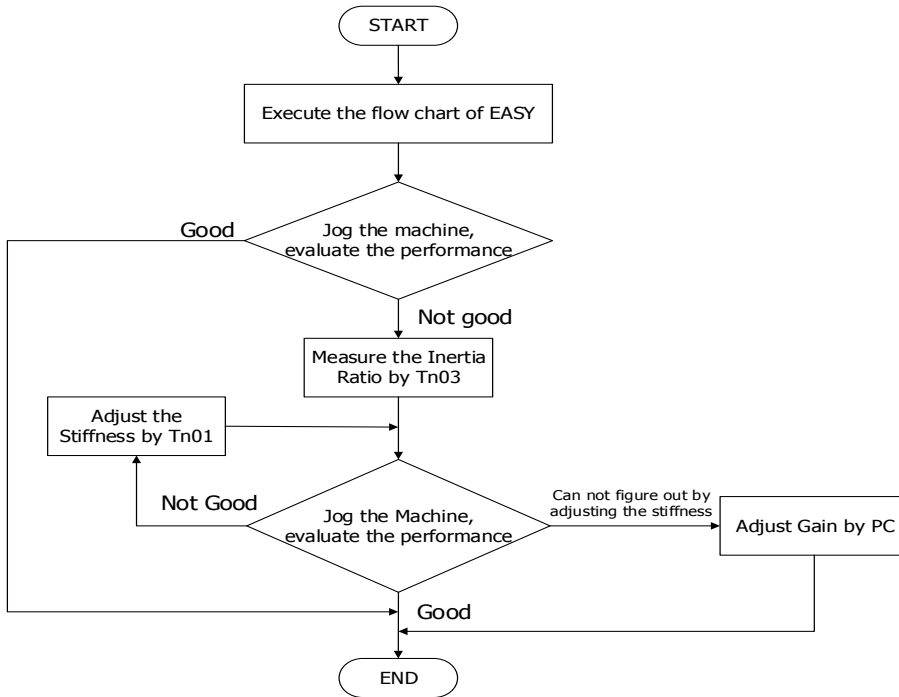
		<p>Users must save control and motor parameters and reboot the controller after changing the motor type in EA01.</p> <p>After saving the parameters, the servo will set the control loop parameters according to the load type and application.</p>	
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Table 2 Stiffness and control loop settings

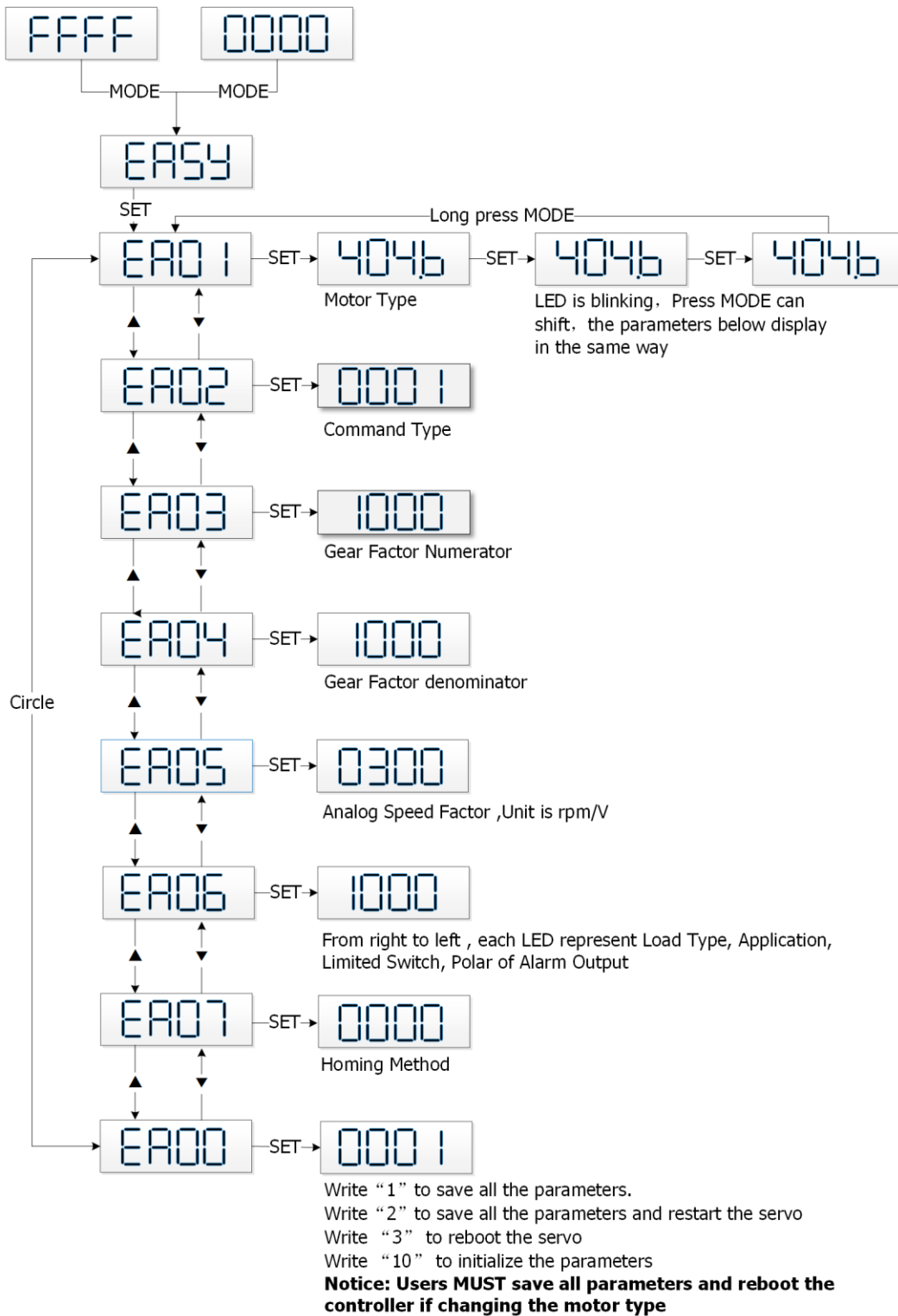
Stiffness	Kpp/[0.01Hz]	Kvp/[0.1Hz]	Output filter [Hz]	Stiffness	Kpp/[0.01Hz]	Kvp/[0.1Hz]	Output filter [Hz]
0	70	25	18	16	1945	700	464
1	98	35	24	17	2223	800	568
2	139	50	35	18	2500	900	568
3	195	70	49	19	2778	1000	733
4	264	95	66	20	3334	1200	733
5	334	120	83	21	3889	1400	1032
6	389	140	100	22	4723	1700	1032
7	473	170	118	23	5556	2000	1765
8	556	200	146	24	6389	2300	1765
9	639	230	164	25	7500	2700	1765
10	750	270	189	26	8612	3100	1765
11	889	320	222	27	9445	3400	∞
12	1056	380	268	28	10278	3700	∞
13	1250	450	340	29	11112	4000	∞
14	1500	540	360	30	12500	4500	∞
15	1667	600	392	31	13889	5000	∞

Note: When setting for the stiffness or inertia ratio results in a Kvp value of greater than 4000, it isn't useful to increase stiffness any more.

Flowchart of EASY use function

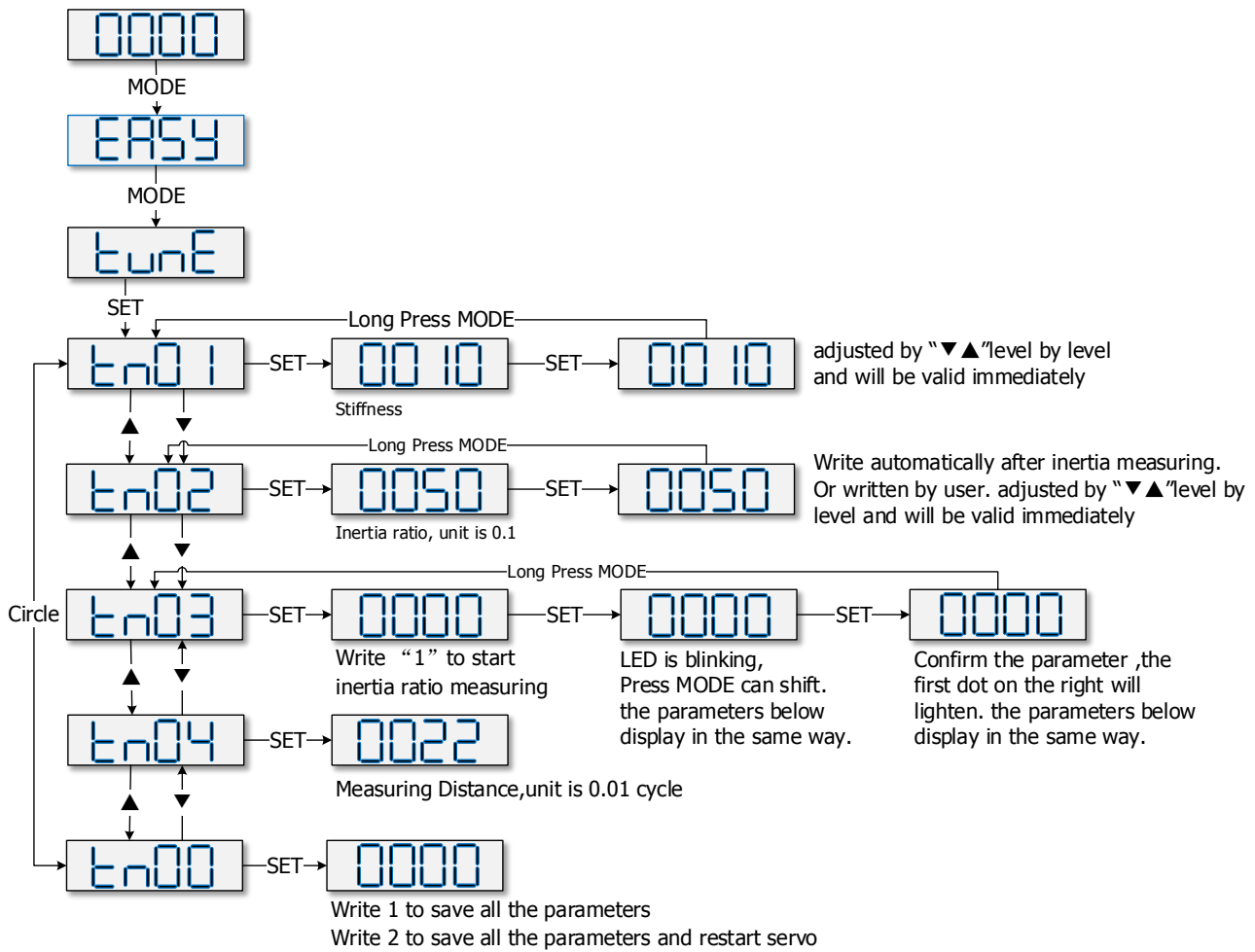


EASY flowchart



Note: The menu is exited automatically if there is no operation in 60s, and users have to start again. Entered data is valid immediately, but must be saved via EA00.

Flowchart for the TunE menu



Note: Note: Data inputted are valid at once, but must be saved via Tn00.

Considering about safety, it is unnecessary to press "SET" to verify when users need to modify stiffness or inertia ratio. Data are also valid but are only adjusted step by step.

5.4 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 d5.00 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 when auto tuning is unavailable. After setting this parameter, apply d2.00 to save the settings as required.	60	0~600
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.	10	0~100
d0.06	2FF00C10	Tuning_Start	If the variable is set to 11, auto tuning	0	N/A

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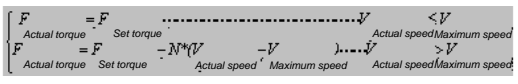
Parameter List: Group F001 (To Set Real-Time Display Data)

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_Ilt_Rate	Ratio of real iit to the maximum iit of a motor
d1.03	60F61210	Motor_Ilt_Real	Actual data of motor overheat protection $I_{rms} = \frac{\sqrt{Motor_Ilt_Real * 512}}{2047} * \frac{I_{peak}}{\sqrt{2}}$
d1.04	2FF01108	Driver_Ilt_Rate	Ratio of real iit to the maximum iit of a driver
d1.05	60F61010	Driver_Ilt_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	N/A	0~32767
d2.02	60F90210	Kvi	Time used to adjust speed control to compensate minor errors	N/A	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 $F = \text{Notch_N} * 10 + 100$. 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	0~1
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 $F = \text{Speed_Fb_N} * 20 + 100$. 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	0	0~2

			low-pass filter 1: Direct speed response without filtering 2: Feedback on output feedback		
d2.07	60FB0110	Kpp	Proportional gains on position loop Kpp	1000	0~10000
d2.08	60FB0210	K_Speed_FF	0 indicates no feedforward, and 256 indicates 100% feedforward	255	0~255
d2.09	60FB0310	K_Acc_FF	The data is inversely proportional to the feedforward	32767 (7FF.F)	32767~1 0
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	0~1
d2.17	60F90E10	K_Load	Indicates load parameters	N/A	20~1500 0
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 the data is too small, the auto tuning error becomes greater, or even causes a mistake.	64	0~1000
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

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	000.1	N/A
d3.02	20100410	Din2_Function	000.2: Driver fault reset	000.2	N/A
d3.03	20100510	Din3_Function	000.4: Operation mode control	000.4	N/A
d3.04	20100610	Din4_Function	000.8: P control for velocity loop	000.8	N/A
d3.05	20100710	Din5_Function	001.0: Position positive limit	001.0	N/A
d3.06	20100810	Din6_Function	002.0: Position negative limit	002.0	N/A
d3.07	20100910	Din7_Function	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	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	0~1
d3.11	20100F10	Dout1_Function	000.1: Ready	000.1	N/A
d3.12	20101010	Dout2_Function	000.2: Error	000.2	N/A
d3.13	20101110	Dout3_Function	000.4: Position reached	00a.4	N/A
d3.14	20101210	Dout4_Function	000.8: Zero velocity	000.8	N/A

d3.15	20101310	Dout5_Function	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	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) = $4000 / (2\pi * \text{Analog1_Filter})$ T (Time Constant) = $\text{Analog1_Filter} / 4000$ (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: $f = 4000 / (2\pi * \text{Analog1_Filter})$ Time Constant: $T = \text{Analog1_Filter} / 4000$ (S)	5	1~127
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)"	0	0~2 10~17 20~27

			Valid in mode -3, 3 and 1.		
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	0~2
d3.31	25020B10	Analog_Torque_Factor	Sets the proportion between analog signals and output speed (current)	1000	-32768~32767
d3.32	25020908	Analog_MaxT_Con	0: No control 1: Max. torque controlled by AIN 1 2: Max. torque controlled by AIN 2	0	0~2
d3.33	25020C10	Analog_MaxT_Factor	Indicates the max torque factor on analog signal control	8192	0~32767
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	0~2
d3.37	25080610	PD_Filter	To flat the input pulse. Filter frequency: $f=1000/(2\pi * PD_Filter)$ 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	0~7

d3.41	2FF10210	Din_Position_M	Refer to d3.42	0	N/A
d3.42	2FF10310	Din_Position_N	Din_Pos L(Pulse number) = Din_Position_M *10000+ Din_Position_N	0	N/A
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 $I_r[A_{rms}] * 1.414 * 10$
d4.08	64100A10	Motor_Ilt_Filter	Indicates time settings on overheat protection of motors Time: $N * 256 / 1000$ Unit: S
d4.09	64100B10	I _{max} _Motor	Indicates max peak current of motors $I[A_{peak}] * 10$
d4.10	64100C10	L_Motor	Indicates phase inductance of motors $L[mH] * 10$
d4.11	64100D08	R_Motor	Indicates phase resistance of motors $R[\Omega] * 10$
d4.12	64100E10	Ke_Motor	Indicates the reverse electromotive force of motors $K_e[Vp/krpm] * 10$
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. <table border="1"> <thead> <tr> <th>PC Software</th> <th>Numeric Display</th> <th>Model</th> </tr> </thead> <tbody> <tr><td>"K0"</td><td>304.B</td><td>SMH60S-0020-30</td></tr> <tr><td>"K1"</td><td>314.B</td><td>SMH60S-0040-30</td></tr> <tr><td>"K2"</td><td>324.B</td><td>SMH80S-0075-30</td></tr> <tr><td>"K3"</td><td>334.B</td><td>SMH80S-0100-30</td></tr> <tr><td>"K4"</td><td>344.B</td><td>SMH110D-0105-20</td></tr> <tr><td>"K5"</td><td>354.B</td><td>SMH110D-0125-30</td></tr> <tr><td>"K6"</td><td>364.B</td><td>SMH110D-0126-20</td></tr> <tr><td>"K7"</td><td>374.B</td><td>SMH110D-0126-30</td></tr> <tr><td>"K8"</td><td>384.B</td><td>SMH110D-0157-30</td></tr> <tr><td>"K9"</td><td>394.B</td><td>SMH110D-0188-30</td></tr> <tr><td>"KB"</td><td>424.B</td><td>SMH130D-0105-20</td></tr> <tr><td>"KC"</td><td>434.B</td><td>SMH130D-0157-20</td></tr> <tr><td>"KD"</td><td>444.B</td><td>SMH130D-0210-20</td></tr> <tr><td>"KE"</td><td>454.B</td><td>SMH150D-0230-20</td></tr> <tr><td>"S0"</td><td>305.3</td><td>130D-0105-20AAK-2LS</td></tr> <tr><td>"S1"</td><td>315.3</td><td>130D-0157-20AAK-2LS</td></tr> <tr><td>"S2"</td><td>325.3</td><td>130D-0157-15AAK-2LS</td></tr> <tr><td>"S3"</td><td>335.3</td><td>130D-0200-20AAK-2HS</td></tr> <tr><td>"S4"</td><td>345.3</td><td>130D-0235-15AAK-2HS</td></tr> <tr><td>"F8"</td><td>384.6</td><td>85S-0045-05AAK-FLFN</td></tr> <tr><td>"E0"</td><td>304.5</td><td>SME60S-0020-30</td></tr> <tr><td>"E1"</td><td>314.5</td><td>SME60S-0040-30</td></tr> <tr><td>"E2"</td><td>324.5</td><td>SME80S-0075-30</td></tr> </tbody> </table>	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
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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)

Numerical Display	Internal Address	Variable Name	Meaning	Default Value	Note
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	d5.00 need be used to save and restart when users change this parameter
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	d5.00 need be used to save and restart when users change this parameter
d5.03	2FE10010	U2BRG	Sets the baud rate of the serial port 540 19200 270 38400 90 115200 You need not restart driver.	270	Unnecessary to restart
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	Please don't adjust
d5.08	25010210	ADC_Shift_V	Indicates data configuration of V phase shift Note:Factory parameters	N/A	Please don't adjust
d5.09	30000110	Voltage_200	ADC original data when DC bus voltage is 200 V Note:Factory parameters	N/A	Please don't adjust
d5.10	30000210	Voltage_360	ADC original data when DC bus voltage is	N/A	Please don't

	0		360 V Note:Factory parameters		adjust
d5.11	60F6061 0	Comm_Shift_UVW	Indicates the excitation pointer of a motor Note:Factory parameters	N/A	Please don't adjust
d5.12	2600001 0	Error_Mask	Indicates error masks Note:Factory parameters	FFF.F	Please don't adjust
d5.13	60F7051 0	RELAY_Time	Indicates the relay operating time of capacitor short-circuits Unit: mS Note:Factory parameters	150	
d5.14	2FF0040 8	Key_Address_F00 1	Sets numeric display data	N/A	
d5.15	65100B1 0	RS232_Loop_Ena ble	0: 1 to 1. 1: 1 to N	0	
d5.16	2FFD001 0	User_Secret	User password.16bits.	0~ 65535	
d5.17	2F81000 8	CAN_Baudrate	CAN baudrate setting 100:1M 50:500K 25:250K 12:125K 5:50K 1:10K	50	Need save and restart
d5.18	2FE2001 0	RS485_Baudrate	Baudrate of RS485 1080: 9600 540: 19200 270: 38400 90: 115200	540	Need save and restart
d5.19	65100C0 8	RS485_Protocol	RS485 communication protocol select 0: Modbus 1: Same protocol as RS232	1	Need save and restart

Chapter 6 Operation on Input/Output Ports

KINCO CD2S 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 500 mA load, and can directly drive the internal contracting brake device (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.

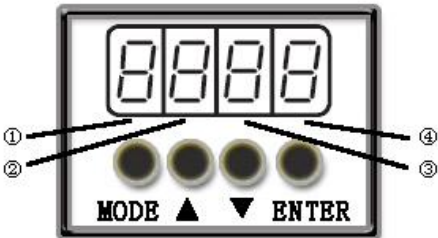
6.1 Digital Input Signals

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

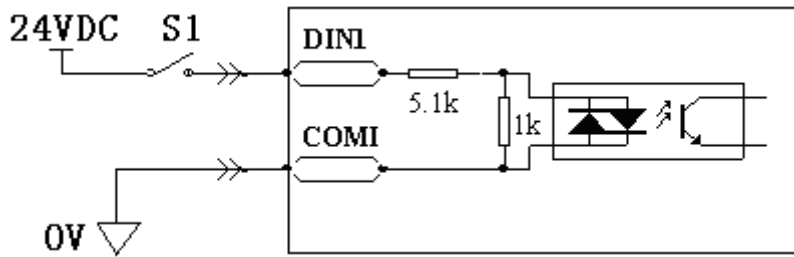


Fig. 6-1 Polarity setting for digital input signal DIN1

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: DIN1 is enabled when S1 opens 1: DIN1 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

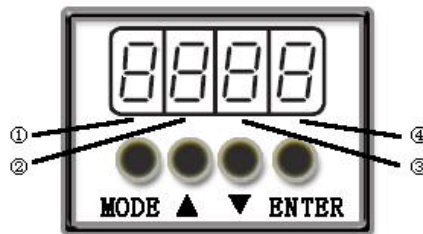
Table 6-4 IO simulation variable

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: 1-4	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	000.1 (Driver enable)
d3.02	Din2_Function	000.4: Operation mode control 000.8: P control for velocity loop	000.2 (Driver fault reset)
d3.03	Din3_Function	001.0: Position positive limit 002.0: Position negative limit 004.0: Homing signal	000.4 (Operation mode control)
d3.04	Din4_Function	008.0: Reverse speed demand 010.0: Internal speed control 0	000.8 (P control for velocity loop)
d3.05	Din5_Function	020.0: Internal speed control 1 800.1: Internal speed control 2	001.0 (Position positive limit)
d3.06	Din6_Function	040.0: Internal position control 0 080.0: Internal position control 1 800.2: Internal position control 2	002.0 (Position negative limit)
d3.07	Din7_Function	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	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.
Internal speed control 1	Note: For details, see Section 7.5 Internal Multi-Speed Control.
Internal speed control 2	
Internal position control 0	
Internal position control 1	Note: For details, see Section 7.4 Internal Multi-Position Control.
Internal position control 2	
Multi Din 0	
Multi Din 1	To switch multiple electronic gear
Multi Din 2	
Gain switch 0	
Gain switch 1	To switch multiple gain parameters(P-gain of velocity loop,i-gain of velocity loop,p-gain of position loop)
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
------------------	---

6.1.5 Multiple electronic gear ratio switch function and multiple gain switch function

1. Multiple electronic gear ratio switch function

Multiple electronic gear ratio is determined by combined with Multi Din 0, Multi Din 1 and Multi Din 1 defined in I/O. For electronic gear molecular (0~7) and electronic gear denominator (0~7), the default value is 1000. They can not set by panel on the driver temporarily and need to be set via software.

When electronic gear ratio changes, the pulse count might deviates. This is normal. Please be careful.

Multi Din 2	Multi Din 1	Multi Din 0	Name	Parameter	
				Name	Address
0	0	0	The 0 th electronic ratio	Molecular 0	25080110
				Denominator 0	25080210
0	0	1	The 1 st electronic ratio	Molecular 1	25090110
				Denominator 1	25090210
0	1	0	The 2 nd electronic ratio	Molecular 2	25090310
				Denominator 2	25090410
0	1	1	The 3 rd electronic ratio	Molecular 3	25090510
				Denominator 3	25090610
1	0	0	The 4 th electronic ratio	Molecular 4	25090710
				Denominator 4	25090810
1	0	1	The 5 th electronic ratio	Molecular 5	25090910
				Denominator 5	25090A10
1	1	0	The 6 th electronic ratio	Molecular 6	25090B10
				Denominator 6	25090C10
1	1	1	The 7 th electronic ratio	Molecular 7	25090D10
				Denominator 7	25090E10

2. Multiple gain switch function

For convenience in test, gain switch 0, gain switch 1 are defined in I/O to choose gain. Multiple gain PI pointer (60F92808) is used to display current used gain data.

Auto-tuning can only be used to set PI parameter in the group 0. Bandwidth of speed loop (2FF00A100) and bandwidth of position loop (2FF00B10) are only connected with data in group 0. Others need to be set manually.

PI_switch (60F90908) is used to automatically switch gain, only in the 0 gain and 1st gain. Under mode -4, 1, 3, when position-to-signal is invalid, the 0 PI can be used. When it is valid, the first PI can be used. If gain switch function is defined in I/O, PI_switch is valid.

Gain switch input 1	Gain switch 0	Name	Parameter	
			Name	Address

0	0	The 0 gain	Kvp 0	60F90110
			Kvi 0	60F90210
			Kpp 0	60FB0110
0	1	The 1 st gain	Kvp 1	23400410
			Kvi 1	23400510
			Kpp 1	23400610
1	0	The 2 nd gain	Kvp 2	23400710
			Kvi 2	23400810
			Kpp 2	23400910
1	1	The 3 rd gain	Kvp 3	23400A10
			Kvi 3	23400B10
			Kpp 3	23400C10

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	Variable Name	Parameter Settings
---------	---------------	--------------------

Display		
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.

6.1.6 Wiring of Digital Input Port

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

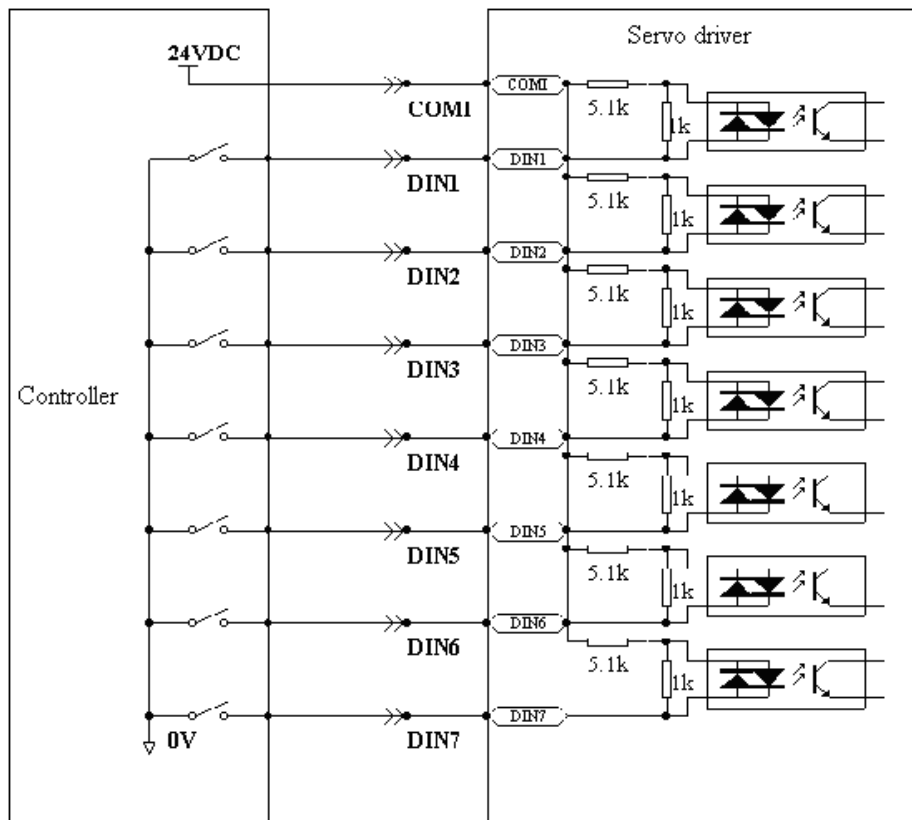


Fig. 6-2 NPN wiring diagram (to the controller that supports low level output)

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

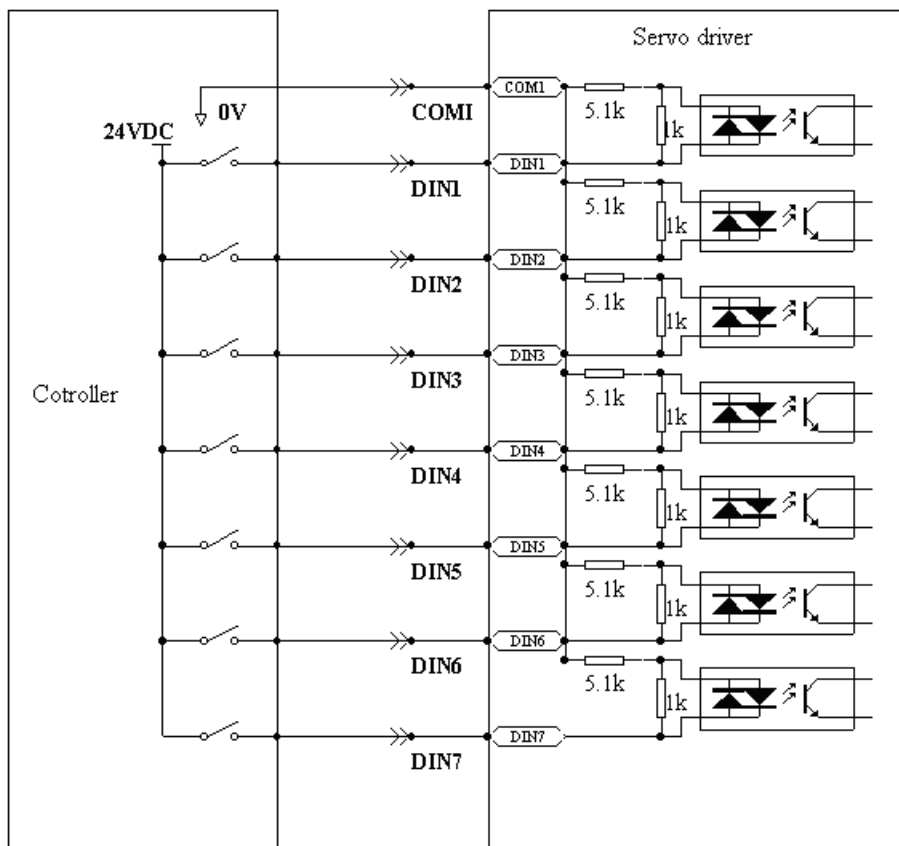


Fig. 6-3 PNP wiring diagram (to the controller that supports high level output)

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	Variable Name	Meaning	Default	Range
---------	---------------	---------	---------	-------

Display			Value	
d3.09	Dio_Simulate	Simulates input signals, and the output signal is outputted compulsorily	0	N/A

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	000.1 (Ready)
d3.12	Dout2_Function	000.2: Error	000.2 (Error)
		000.4: Position reached	
d3.13	Dout3_Function	000.8: Zero velocity	00a.4 (Position reached/Velocity reached/Max. velocity limit)
		001.0: Motor brake	
d3.14	Dout4_Function	002.0: Velocity reached	000.8 (Zero velocity)
		004.0: Index	
d3.15	Dout5_Function	008.0: The maximum speed obtained in the torque mode	001.0 (Motor brake)
		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	

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

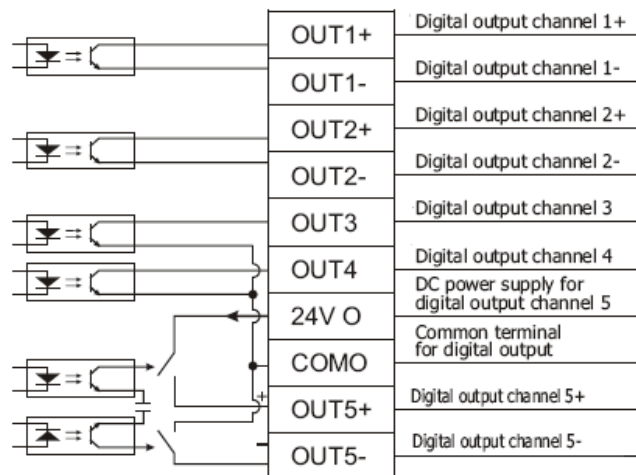
Requirement: The digital output port 1 is defined as the “Ready” function. For details on settings, see Table 6-19.

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



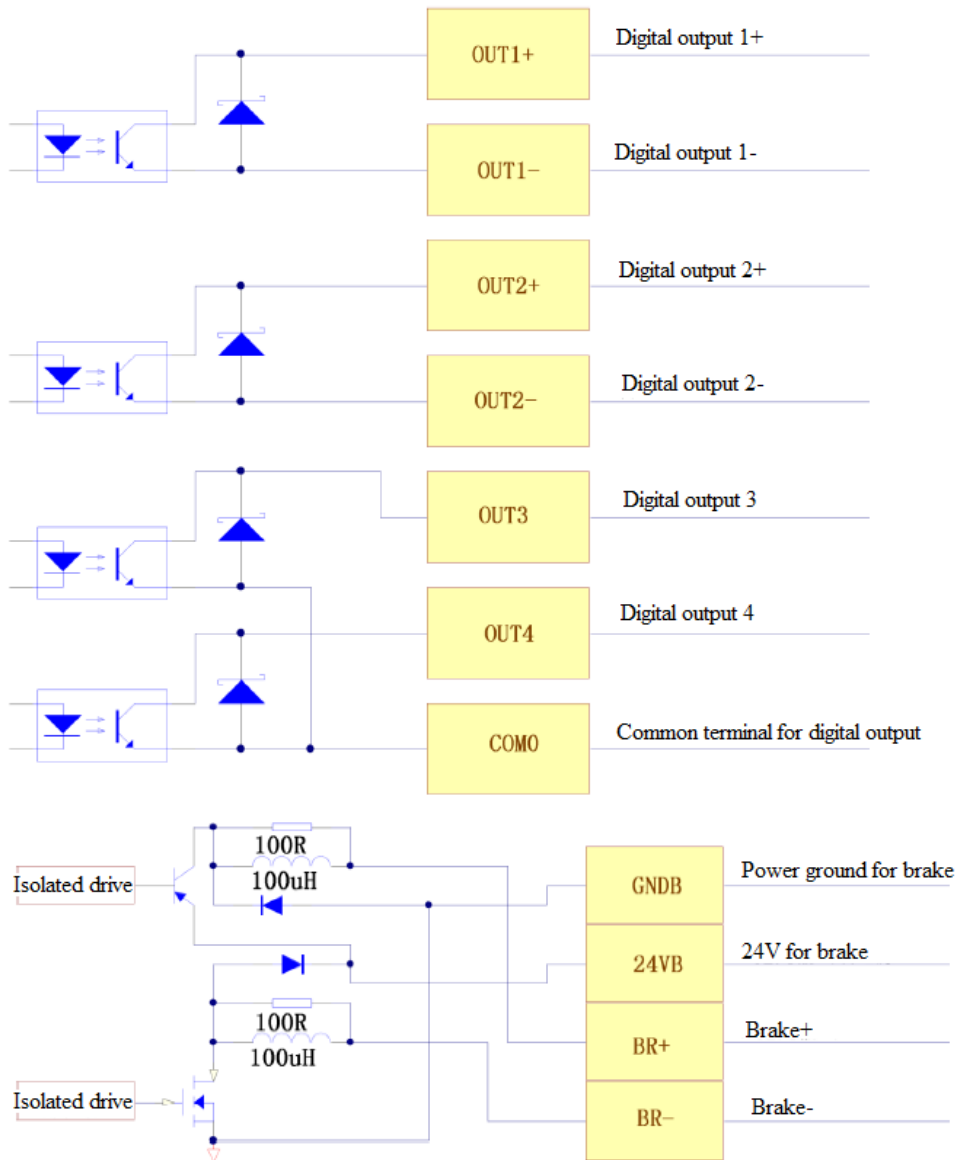


Fig. 6-4 Internal circuit diagram of digital output ports

Note: To apply the OUT3 or OUT4 port, the COMO port must be connected. To apply the BR+/BR- port, both the 24VO and COMO ports must connect to the external input power.

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

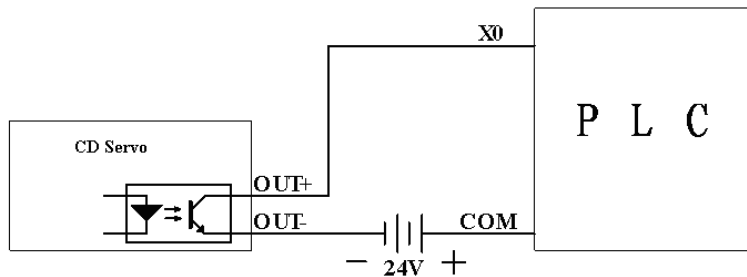


Fig. 6-5 NPN wiring diagram (to controllers that support valid low level input)

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

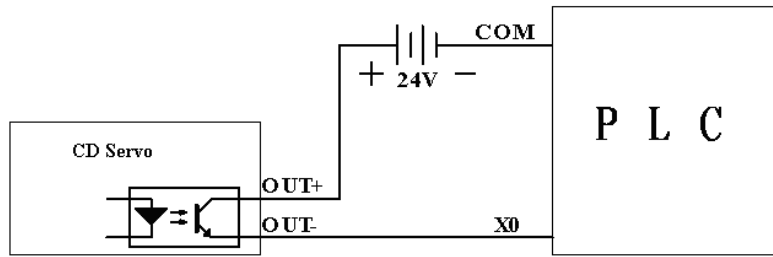


Fig. 6-6 PNP wiring diagram (to controllers that support valid low level input)

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

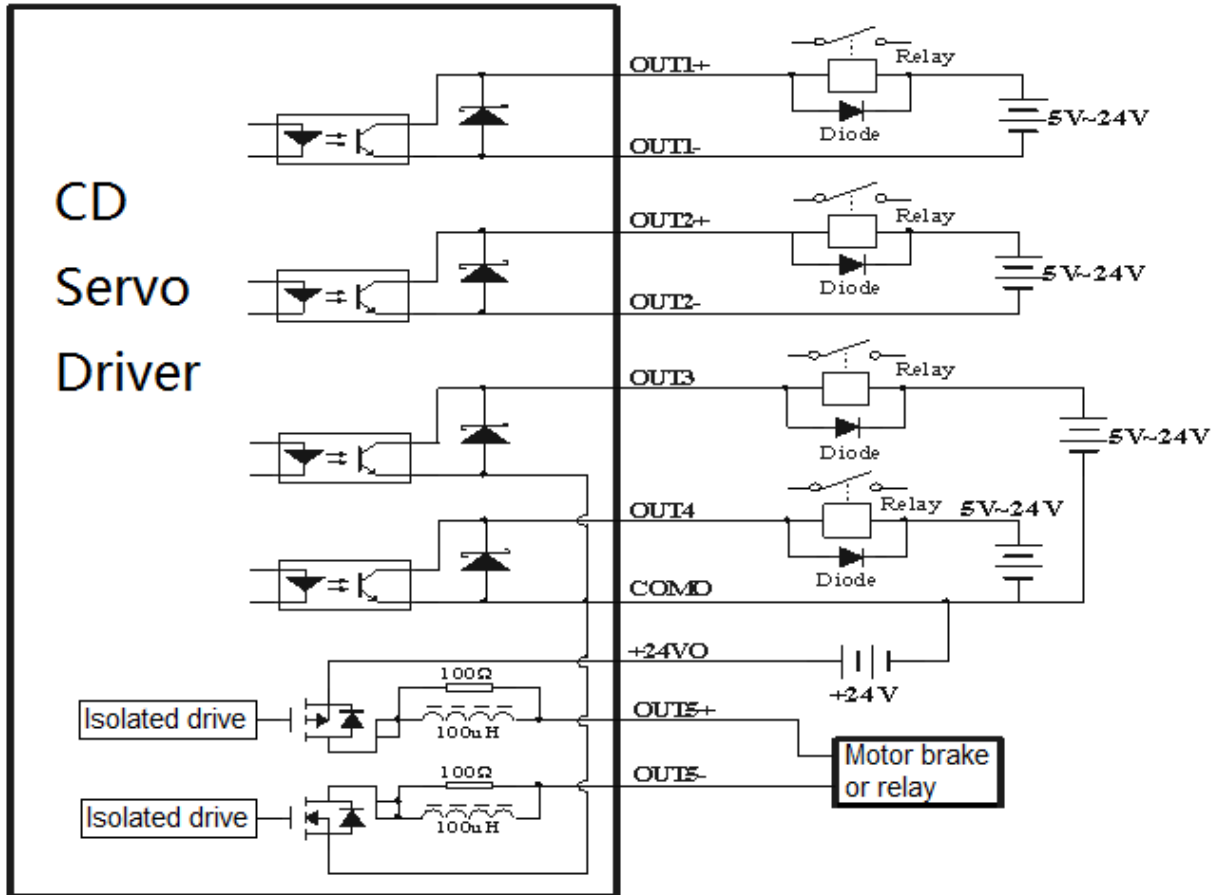


Fig. 6-7 Connect a relay to the digital output port (Reverse parallel connect diode)

Note: When OUT3 and OUT4 are used, COM0 must be connected.

When ports, BR+/BR-, are used, two ports, 24VB and COMB, must connect with external input.

Chapter 7 Mode Operation

7.1 Pulse Control Mode (“-4” Mode)

7.1.1 Wiring in Pulse Control Mode

1. Wiring diagram of CD2S driver in pulse control mode

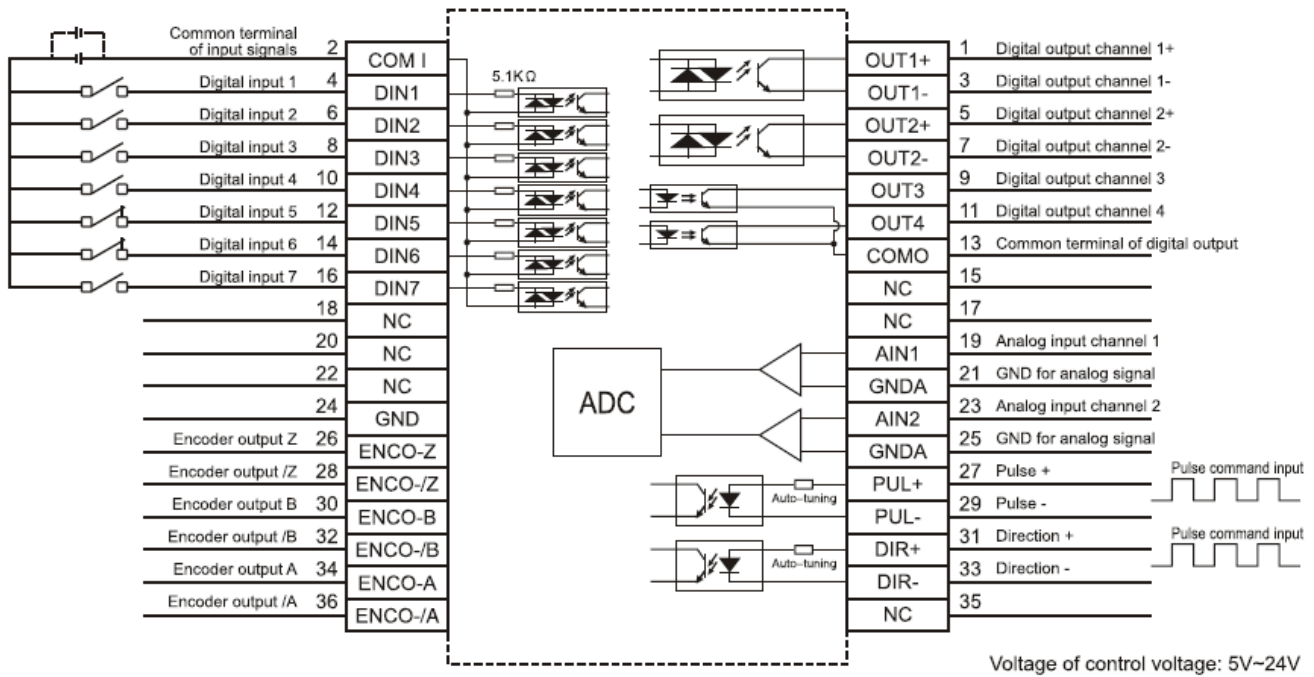


Fig. 7-1 Wiring diagram of CD2S driver in pulse control mode

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

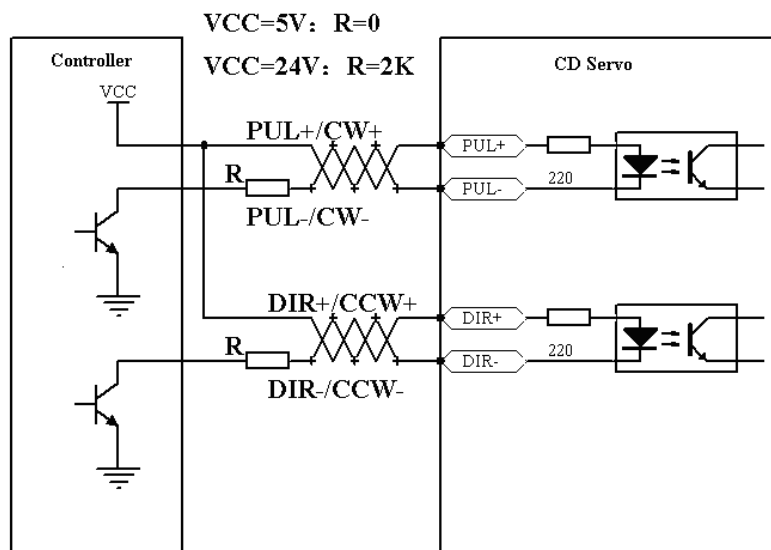


Fig. 7-3 Common anode connection (to controllers that support valid low level output)

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

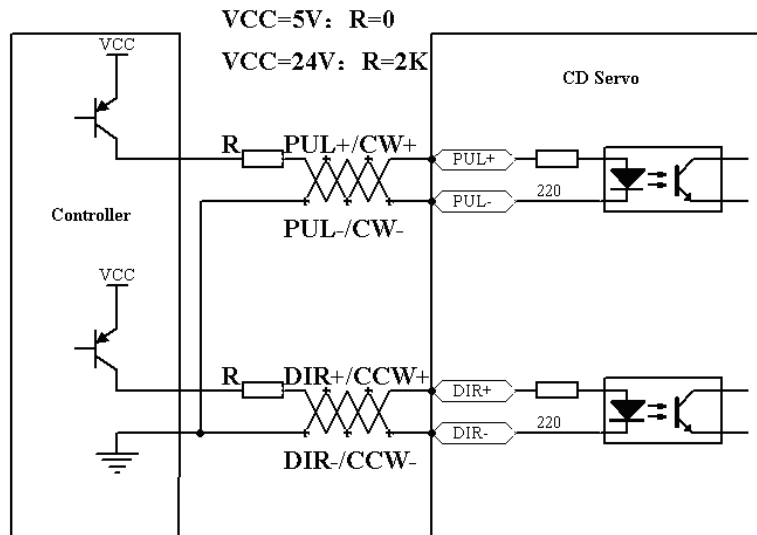


Fig. 7-4 Common cathode connection (to controllers that support valid high level output)

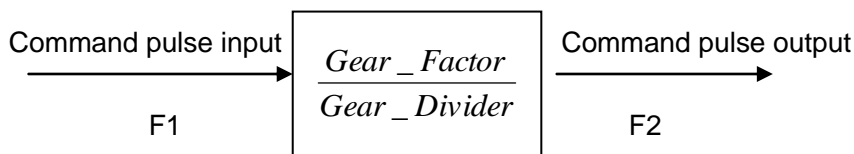
7.1.2 Parameters for Pulse Control Mode

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.

2. Parameters for pulse mode selection

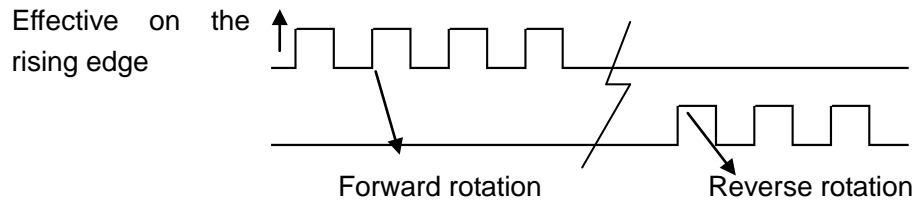
Table 7-2 Parameters for pulse mode selection

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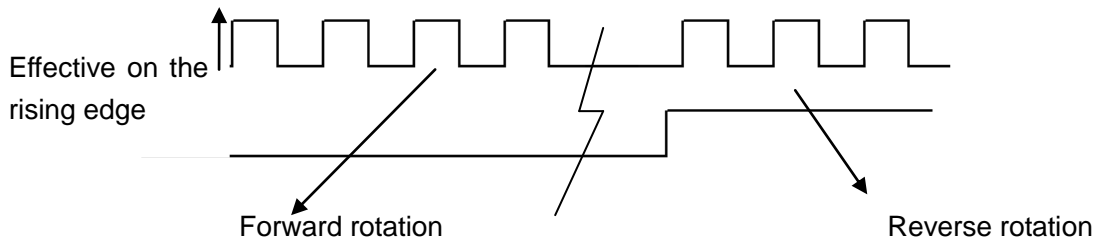
Display	PD_CW		Value	
d3.36	PD_CW	0: Double pulse (CW/CCW) mode 1. Pulse direction (P/D) mode 2. Incremental encoder mode Note: To change this parameter, you need to save it with d3.00, and restarts it later.	1	0~2

Note: CD series doesn't support AB phase signal.

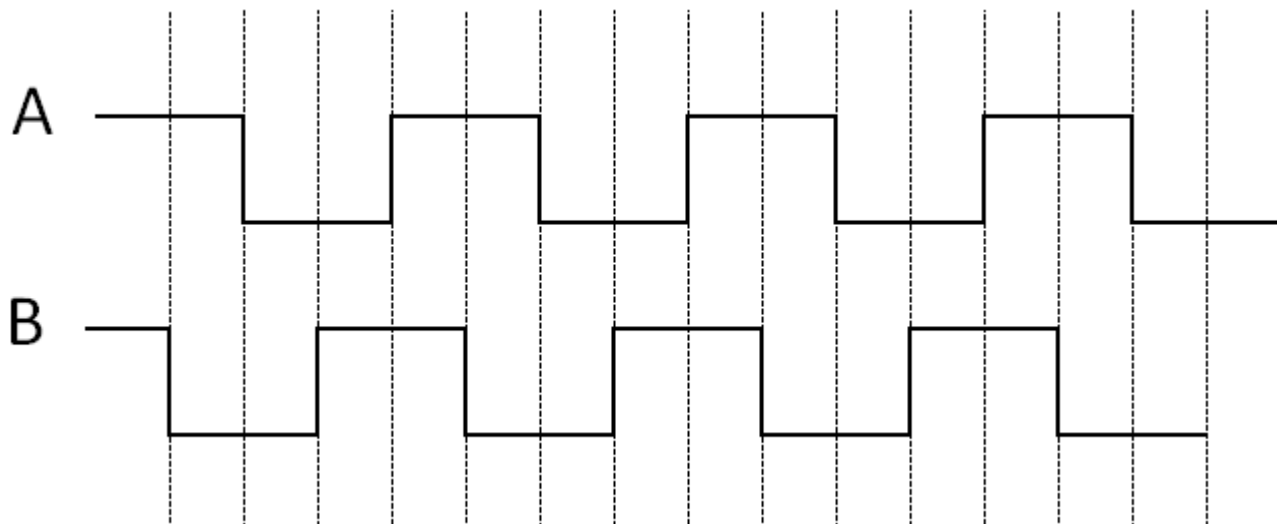
Double pulse (CW/CCW) mode (d3.36 = 0)



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: $f = 1000/(2\pi * PD_Filter)$ 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	0~10000
d2.08	K_Velocity_FF	0 indicates no feedforward, and 256 indicates 100% feedforward	255	0~255
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.	10	0~100
d2.26	Pos_Filter_N	Average filter parameter	1	1~255

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.

$$K_Acc_FF = \frac{I_p * K_t * Encoder_R}{250000 * \sqrt{2} * J_t * \pi}$$

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	/	0~3276 7
d2.02	Kvi	Adjusts speed control so that the time of minor errors is compensated	/	0~1638 4
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.	7	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.

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	Default value is 1 (pulse direction)

		"d3.00", and restarts it later.	
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	Default value is 1

		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.	(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.

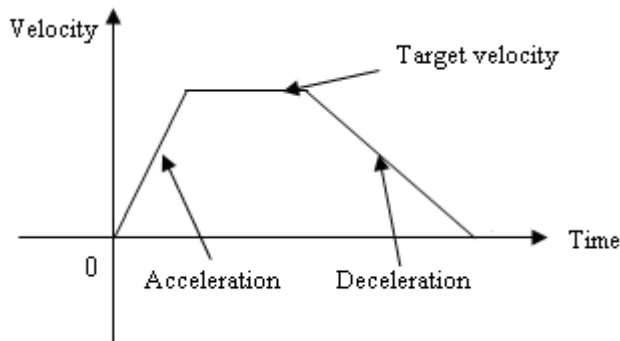


Fig. 7-5 The speed mode "3" with acceleration/deceleration

7.2.1 Wiring in Analog – Speed Mode

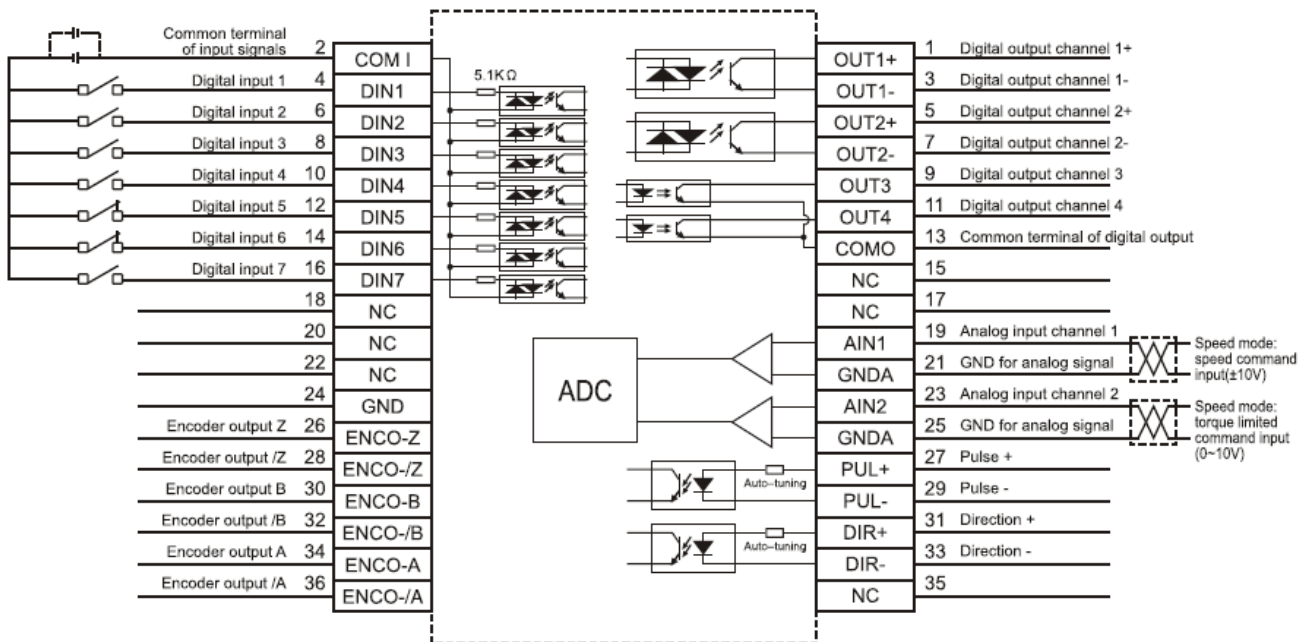


Fig. 7-6 Wiring diagram of CD2S Servo in analog-speed mode

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: $f=4000/(2\pi^*$ 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	0~10V
d3.24	Analog1_Offset	Sets offset data for external analog signal 1	0	-10~10V
d3.25	Analog2_Filter	Used to smooth the input analog signals. Filter frequency: $f=4000/(2\pi^*$ 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	0~10V
d3.27	Analog2_Offset	Sets offset data for external analog signal 2	0	-10~10V

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.	0	0~2 10~17 20~27
d3.29	Analog_Speed_Factor	Sets the proportion between analog signals and output speed	0	/
d3.32	Analog_MaxT_Con	0: No control 1: Max torque that Ain1 can control 2: Max torque that Ain2 can control	0	0~2
d3.33	Analog_MaxT_Factor	Indicates the max torque factor for analog signal control	8192	0~3276 7

7.2.3 Analog Signal Processing

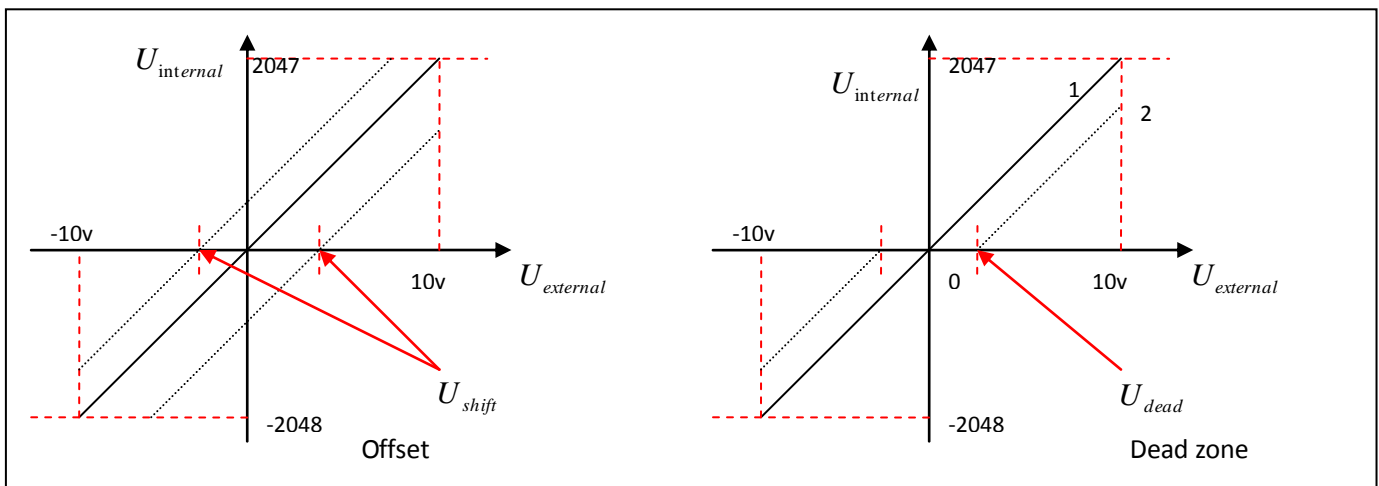


Fig. 7-8 Analog signal processing

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.

7.2.4 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.

7.3 Torque Mode (“4” Mode)

7.3.1 Wiring in Analog – Torque Mode

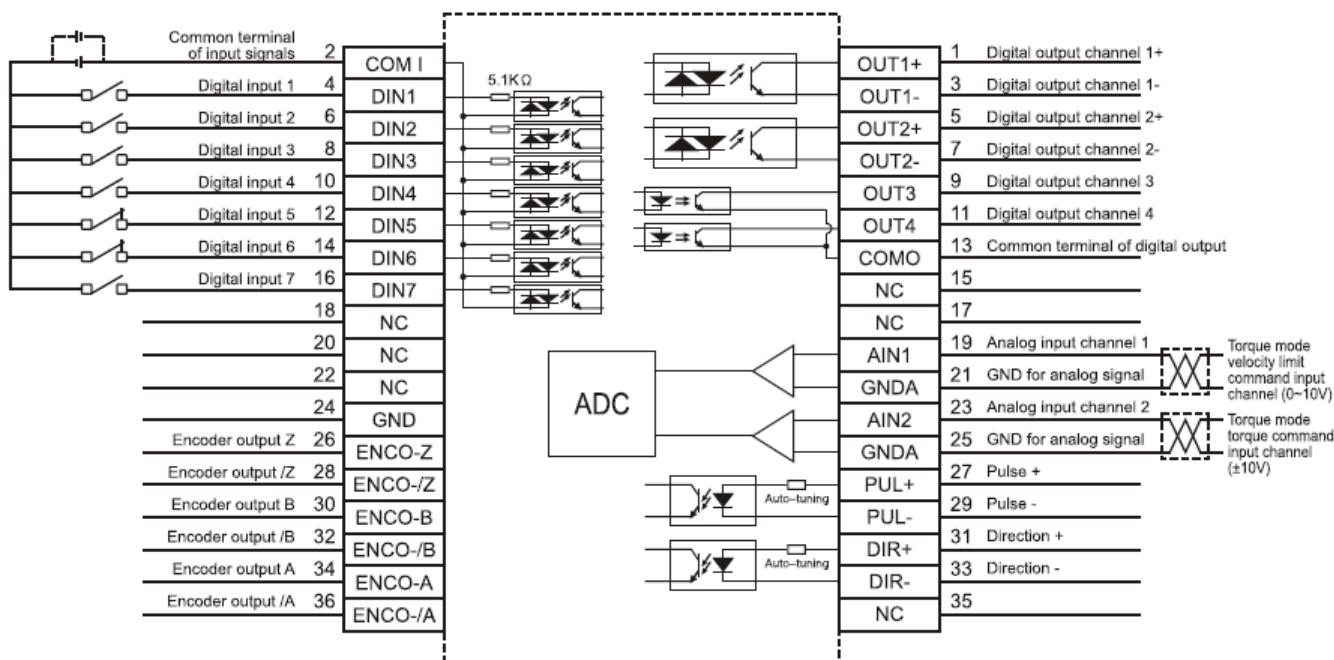


Fig. 7-13 Wiring diagram of CD2S Servo in analog – torque mode

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: $f=4000/(2\pi \cdot \text{Analog1_Filter})$ Time Constant: $\tau = \text{Analog1_Filter}/4000$ (S)	5	1~127

d3.23	Analog1_Dead	Sets dead zone data for external analog signal 1	0	0~10V
d3.24	Analog1_Offset	Sets offset data for external analog signal 1	0	-10~10V
d3.25	Analog2_Filter	Used to smooth the input analog signals. Filter frequency: $f=4000/(2\pi * \text{Analog1_Filter})$ Time Constant (T) = $\text{Analog2_Filter}/4000$ (S)	5	1~127
d3.26	Analog2_Dead	Sets dead zone data for external analog signal 2	0	0~10V
d3.27	Analog2_Offset	Sets offset data for external analog signal 2	0	-10~10V
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	0~2
d3.31	Analog_Torque_Factor	Sets the proportion between analog signals and output torque (current)	0	/
d2.15	Speed_Limit_Factor	The factor that limits the maximum speed in the torque mode $\begin{cases} F_{\text{Actual_torque}} = F_{\text{Demand_torque}} & \dots\dots\dots \\ F_{\text{Actual_torque}} = F_{\text{Demand_torque}} - N * (V_{\text{Actual_speed}} - V_{\text{Max_speed}}) & \dots\dots\dots \end{cases}$ $V_{\text{max_speed}}$ complies with d2.24 Max_Speed_RPM parameter settings.	0	/
d2.24	Max_Speed_RPM	Limits the max rotation speed of the motor	5000	0~1000rpm

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.

Table 7-17 K_t and I_{peak} parameters

Motor Model	K_t (Nm/A)	Driver Model	I_{peak} (A)
SMH40S-0050-30AXK-4LKH	0.265	CD412S-AA-000	12

SMH40S-0010-30AXK-4LKH	0.265		
SMH60S-0020-30AXK-3LKX	0.48	CD422S-AA-000	15
SMH60S-0040-30AXK-3LKX	0.48		
SMH80S-0075-30AXK-3LKX	0.662		
SME60S-0020-30AXK-3LKX	0.48		
SME60S-0040-30AXK-3LKX	0.48		
SME80S-0075-30AXK-3LKX	0.662		
SMH80S-0100-30AXK-3LKX	0.562		
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	CD622S-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-4KHX	1.65		

7.3.4 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.

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: $f=4000/(2\pi*$ Analog1_Filter) Time Constant: $\tau =$ Analog2_Filter/4000 (S)	Default value is 5
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 parameters for the control loop	Set to 1

		10: Initializing all parameters for the control loop	
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7.4 Internal Multi-position Control Modes (“1” Mode)

In Internal **Multi-position** control mode, we can activate internal set target position through 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”.

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

Internal position 0	Internal position 1	Internal position 2	Corresponding position	Position section numeric display	Corresponding speed	Numeric display
0	0	0	Din_Pos0	d3.40select position section sequence number d3.41select position section high bit d3.42select position section low bit	Din_Speed0_RPM	d3.18
0	0	1	Din_Pos1		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

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.

Example7-8: 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

Numeric 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)
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2. Set position and speed:

Table 7-23 Internal Multi-position and Speed Configuration

Numeric display	Variable Name	Parameters Settings
d3.43	Relative / Absolute position selection	Set to 2F(absolute location)
d3.40	Multi-position control L(The range of L is 0 to 7, which presents 7 positions(0-7))	L (0~7)
d3.41	Set position M (M*10000)	Set to 0
d3.42	Set position N	Set to 5000 (set the position of section 0 to 5000)
d3.18	Set the speed of section 0	Set to 100 (set the speed of section 0 to 100)
d3.41	Set position M (M*10000)	Set to 1
d3.42	Set position N	Set to 15000 (set the position of section 1 to 15000)
d3.19	Set the speed of position section 1	Set to 150 (set the speed of section 1 to 150)
d3.41	Set position M (M*10000)	Set to 2
d3.42	Set position N	Set to 28500 (set the position of section 2 to 28500)
d3.20	Set the speed of position section 2	Set to 175 (set the speed of section 2 to 175)
d3.41	Set position M (M*10000)	Set to -1 (0.001)
d3.42	Set position N	Set to -500 (0.500) (set the position of section 3 to -10500)
d3.21	Set the speed of position section 3	Set to 200 (set the speed of section 3 to 200)
d3.41	Set position M (M*10000)	Set to -2 (0.002)
d3.42	Set position N	Set to -680 (0.680) (set the position of section 4 to -20680)
d3.44	Set the speed of position section 4	Set to 300 (set the speed of section 4 to 300)
d3.41	Set position M (M*10000)	Set to -3(0.003)
d3.42	Set position N	Set to -550 (0.550) (set the position of section 5 to -30550)
d3.45	Set the speed of position section 5	Set to 325 (Set the speed of

		section 5 to 325)
d3.41	Set position M (M*10000)	Set to 0
d3.42	Set position N	Set to 850 (Set the position of section 6 to 850)
d3.46	Set the speed of position section 6	Set to 275 (Set the speed of section 6 to 275)
d3.41	Set position M (M*10000)	Set to 1
d3.42	Set position N	Set to 5000 (Set the position of section 7 to 15000)
d3.47	Set the speed of position section 7	Set to 460 (set the speed of section 7 to 460)
d2.10	Acceleration	Default 610 rps/s
d2.11	Deceleration	Default 610 rps/s
d3.00	Save control loop parameters	Set to 1

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 Control 0 (Din_Sys.Bit8)	Speed	Internal Control 1 (Din_Sys.Bit9)	Speed	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.

Multi-speed control (0-7) data can be controlled by external analog signal mapping. When analog signals control speed, original data of influenced speed will be covered by analog signal's value. Its setting is shown below:

Parameter	Description	Setting
d3.28 Analog_Speed_Con	Analog signal control speed 0: Invalid 1: Ain 1 Control Speed 2: Ain 2 Control Speed 10~17: Ain 1 control the "Din_Speed[x-10]" 20~27: Ain 1 control the "Din_Speed[0~20]" Valid at operation mode 1, 3 or -3.	If d3.28 is set to 10~17, Ain1 is valid, which corresponds to multi speed control 0~7; If d3.28 is set to 20~27, Ain2 is valid, which corresponds to multi speed control 0~7

Example 7-4: 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

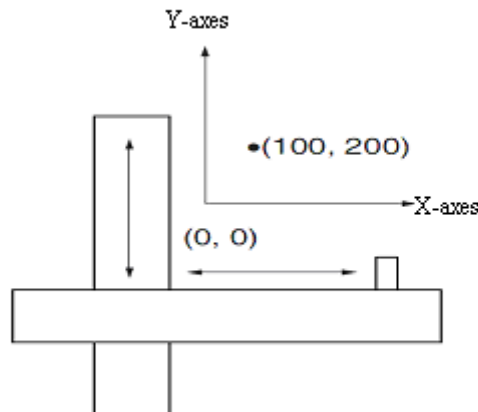
Numeric Display	Variable Name	Setting Method
d3.01	Din1_Function	Set to 000.1 (Driver enable)

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

7.7 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 $(X, Y) = (100\text{mm}, 200\text{mm})$, 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 on	Every time after power on,it will start homing once.
0x609A0020	Homing_AccelARATION	Homing acceleration	Control the acceleration of homing

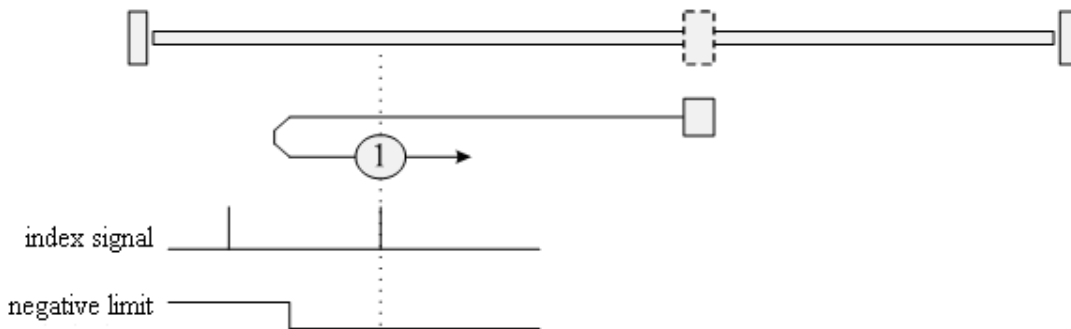
CD has 27 methods for homing, referring the CANopen's definition of DSP402.

1st-14th methods use Z signal as homing signal.

17th-30th methods use external signal as homing signal.

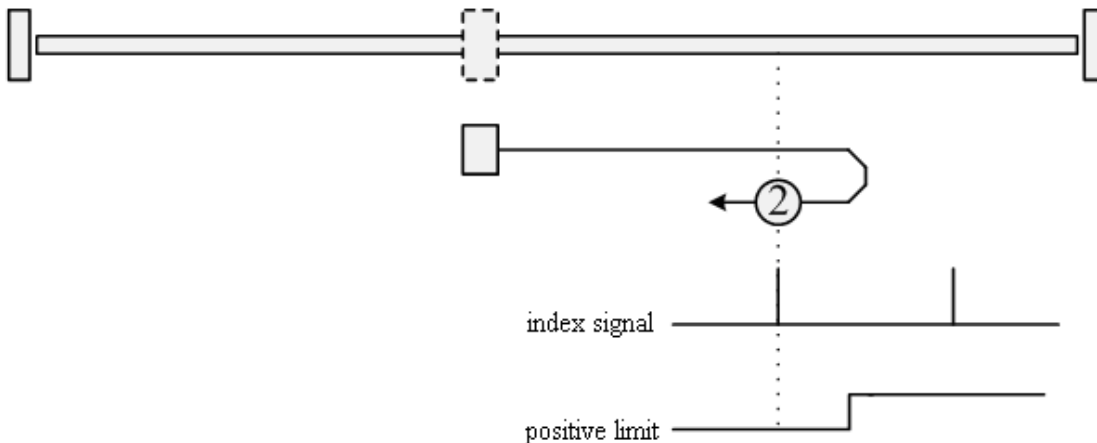
Method 1: Homing on the negative limit switch and index pulse

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.



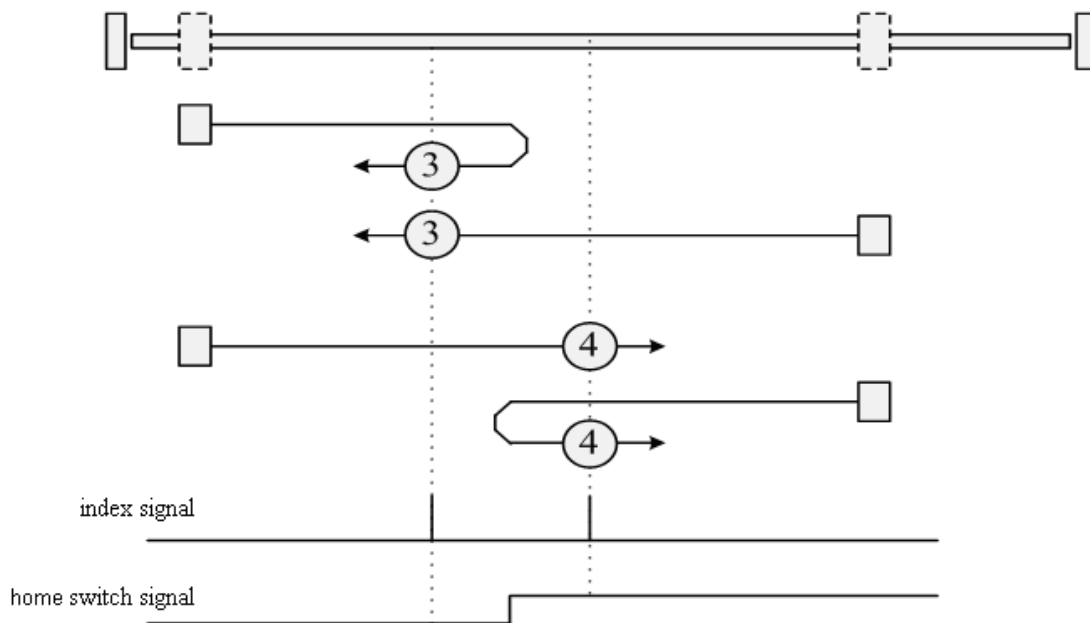
Method 2: Homing on the positive limit switch and index pulse

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.



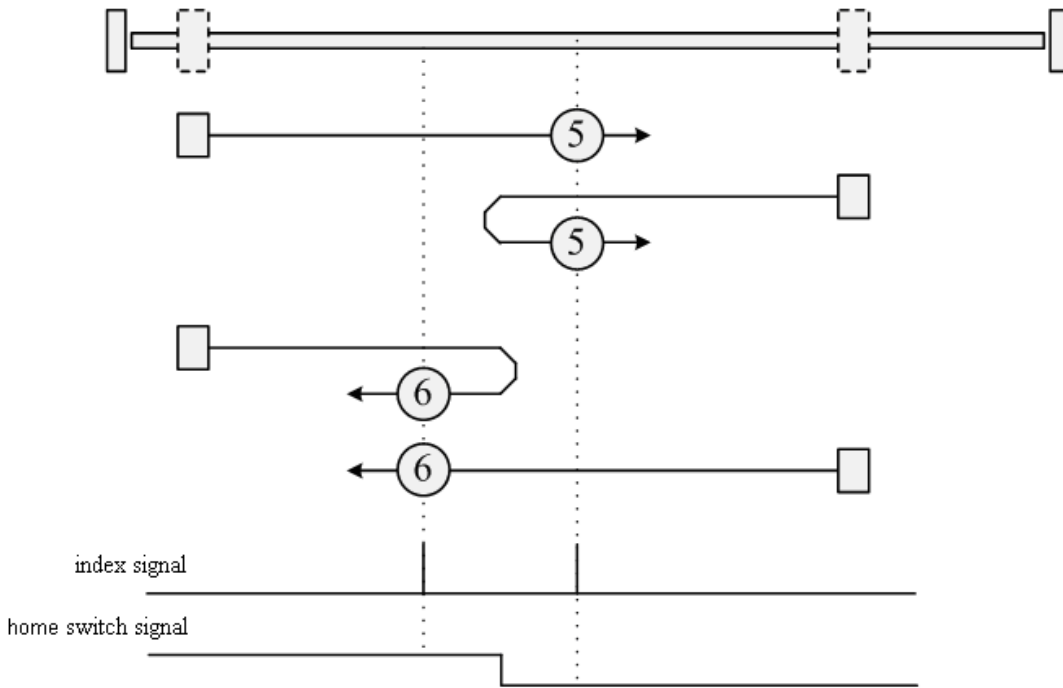
Methods 3 and 4: Homing on the positive home switch and index pulse

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 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.



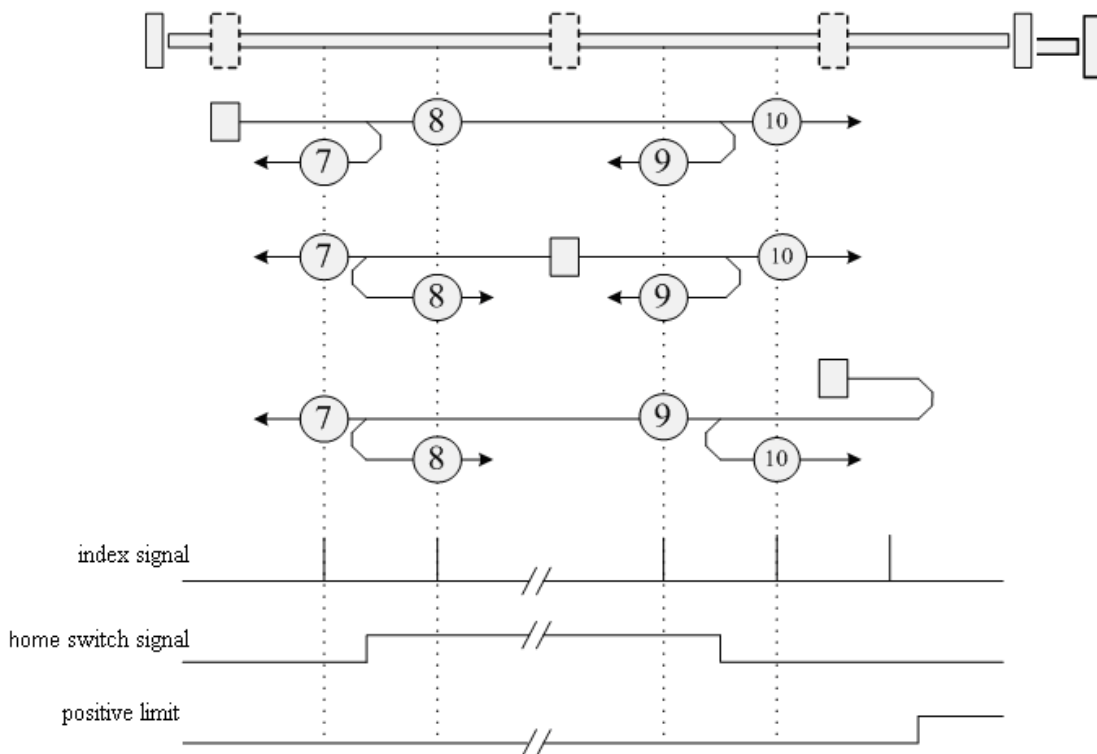
Methods 5 and 6: Homing on the negative home switch and index pulse

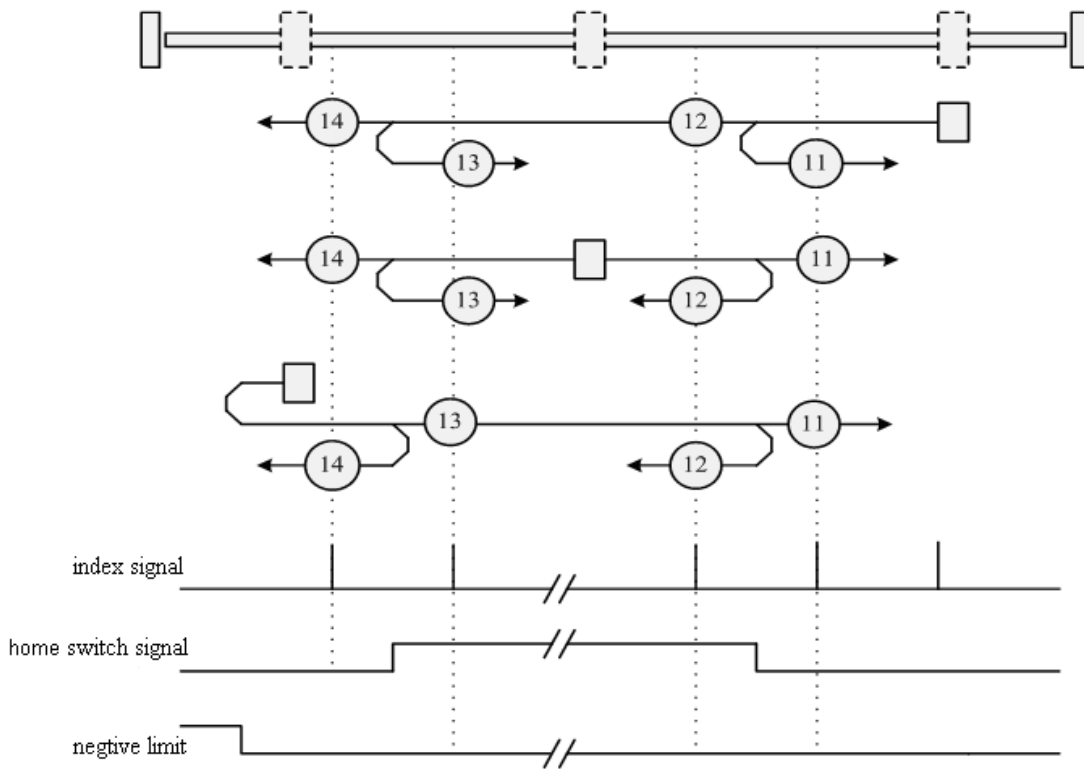
Using methods 5 or 6, the initial direction of movement is dependent on the state of the home switch. The home position is at the index pulse to either the left or the right of the point where the home switch changes state. If the initial position is sited so that the direction of movement must reverse 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.



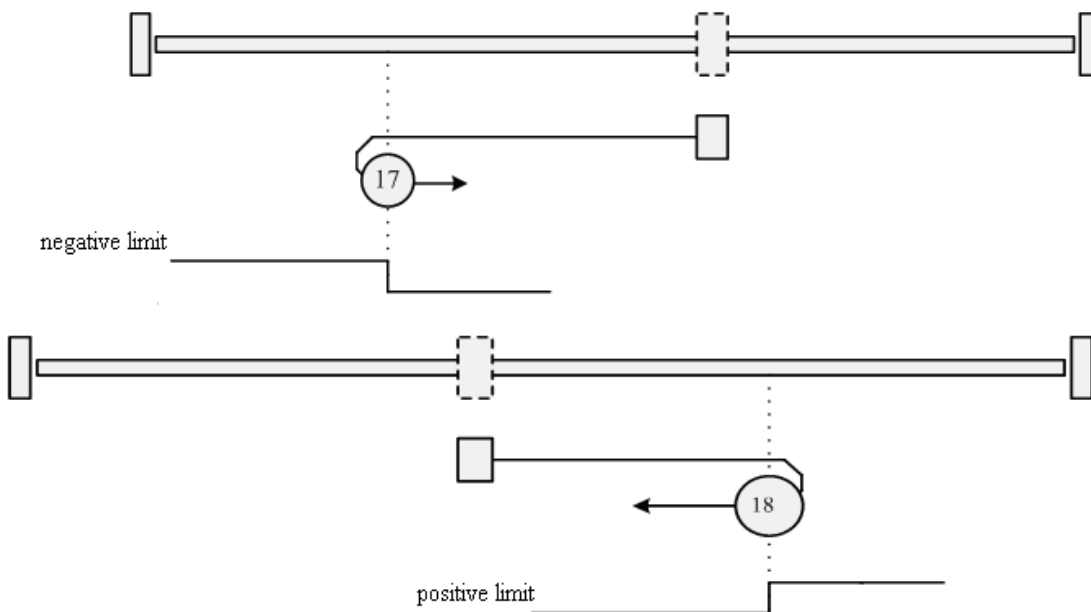


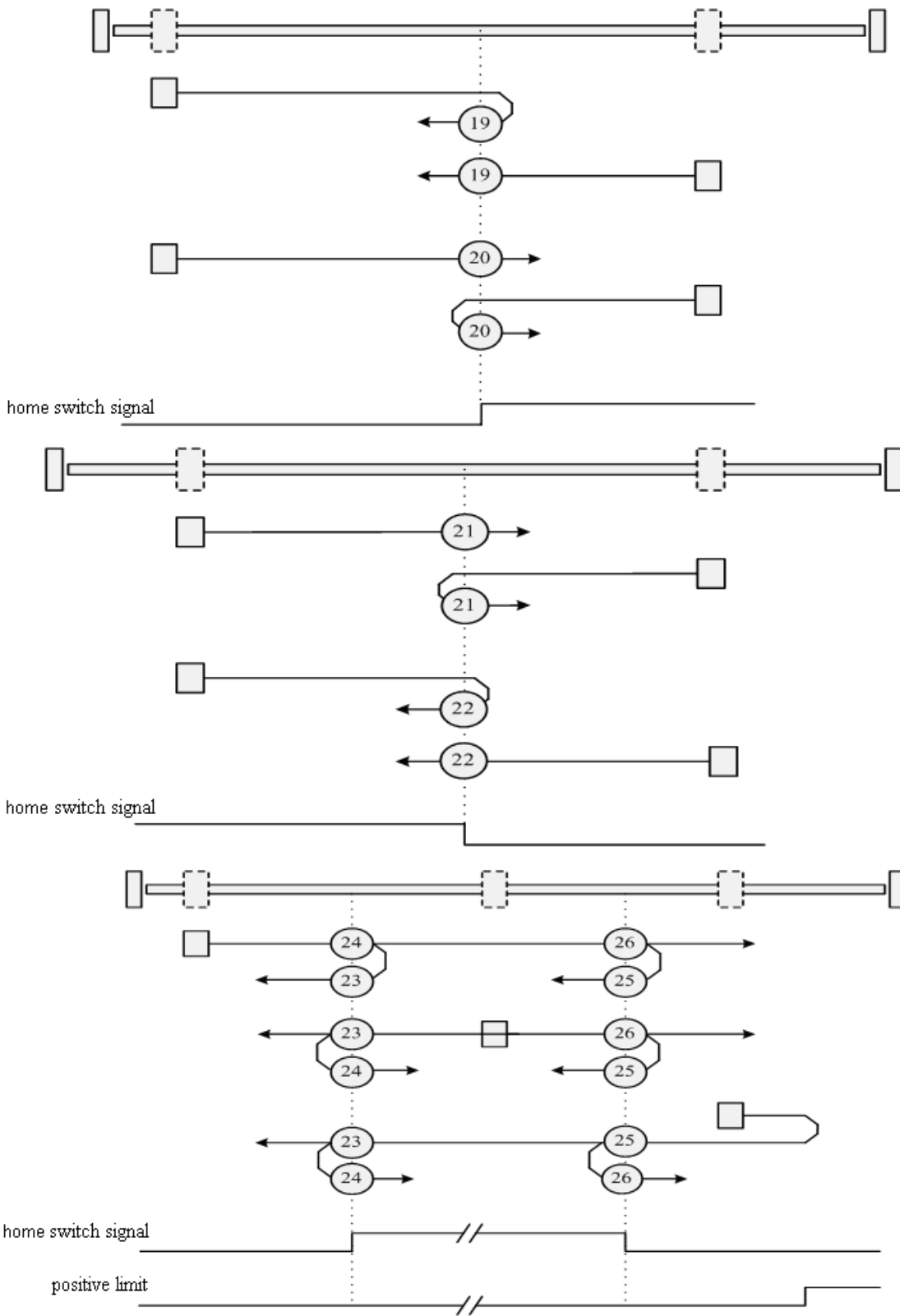
Methods 15 and 16: Reserved

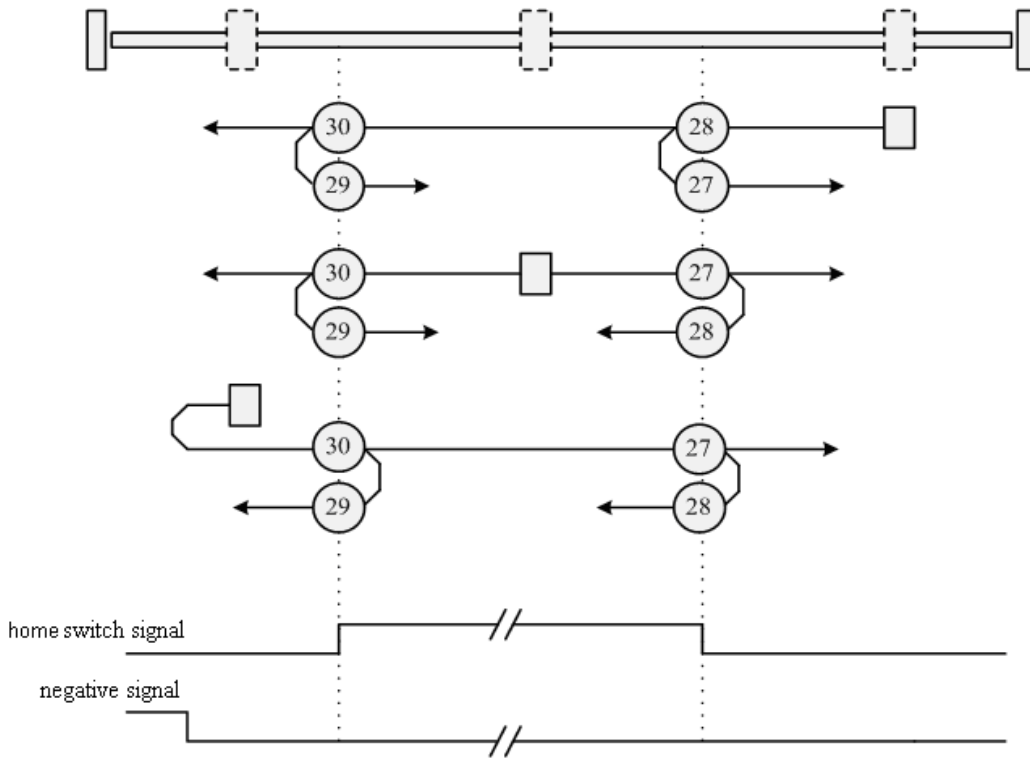
These methods are reserved for future expansion of the homing mode.

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:



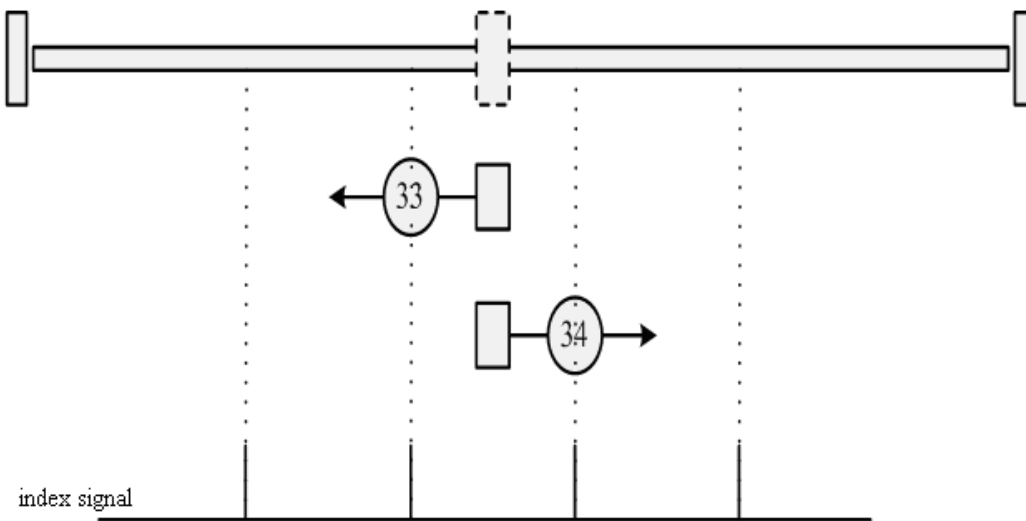




Methods 31 and 32: Reserved

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

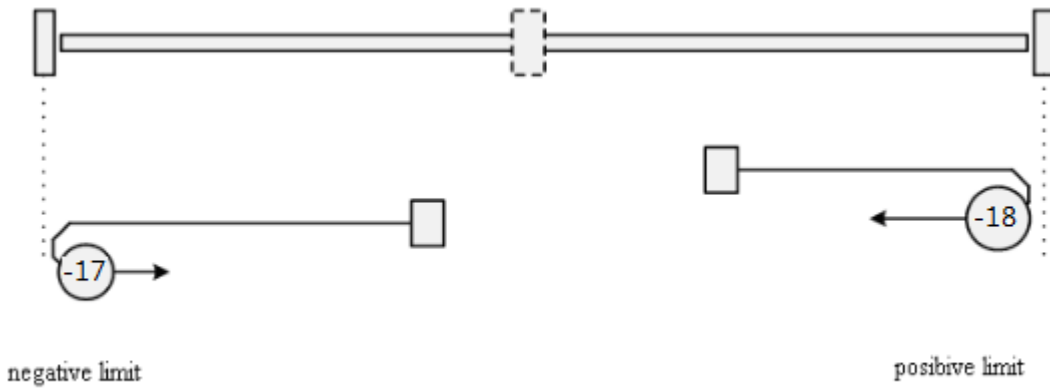
Methods 33 and 34: Homing on the index



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



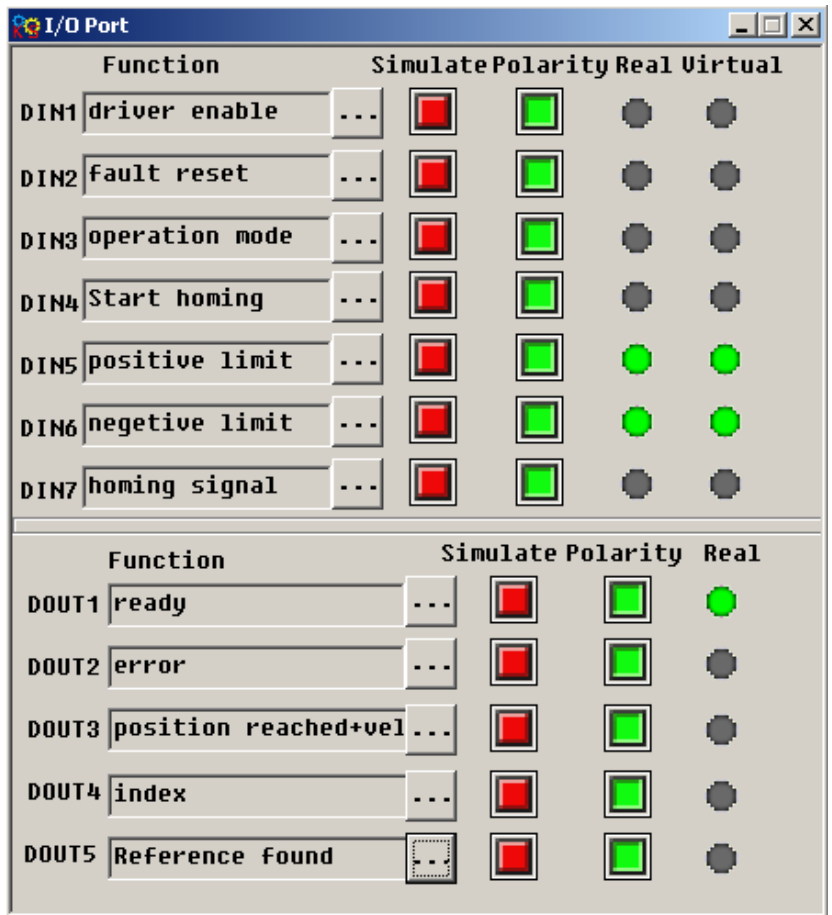
Example 7-5: Using method 7 for homing.

1. Set parameters.

Numeric 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 200.0: Start homing	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)
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	0001 (1)

		motor	
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At this time, computer software shows:

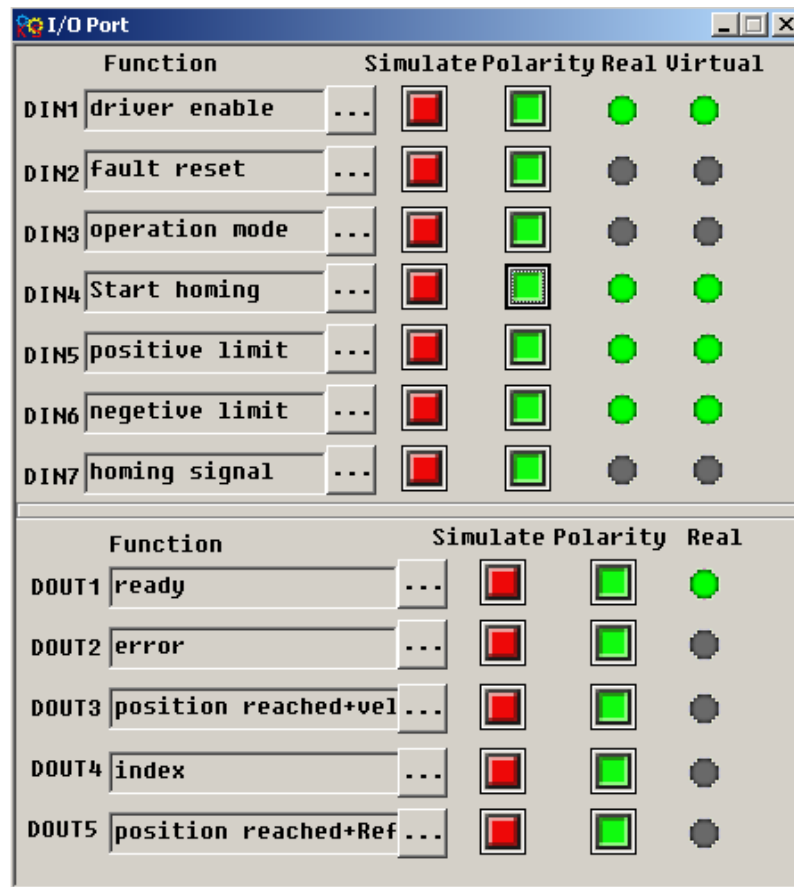


Notice: The positive and negative limits are default to normally closed point. Otherwise, the Panel will alarm and display P.L (positive limit) and N.L (No limit). Only when the alarm is eliminated, the origin control mode can be normally used.

Computer monitoring status is:

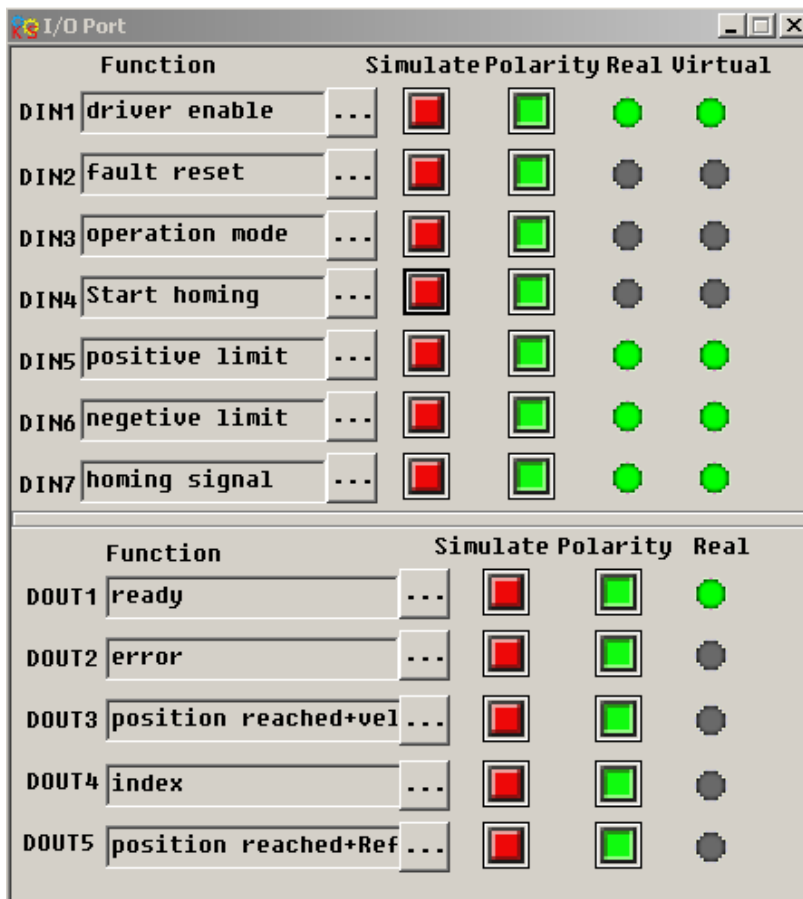
	name	data	unit
1*	Operation_Mode_Buff	-4	DEC
2*	Status_Word	4437	HEX
3*	Pos_Actual	0	inc
4*	Real_Speed_RPM	0	rpm
5*	I_q	0.000	Ap
6	Operation_Mode	-4	DEC
7	CMD_q	0.000	Ap
8	Pos_Target	0	inc
9	SpeedDemand_RPM	0	rpm
10	Control_Word	2F	HEX
11	Switch_On_Auto	0	DEC
12	CMD_q_Max	6.797	Ap

2. Set parameters for homing.

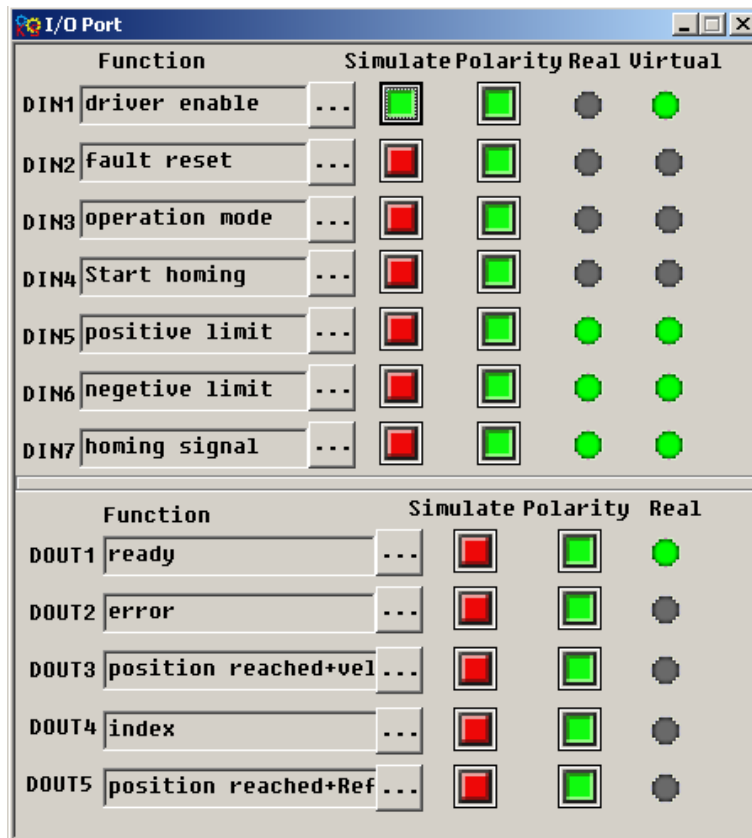


Note: "Start finding the origin" signal is a pulse signal, requires only a rise, not need to always be on. If you want to start next time, a rise pulse is enough.

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

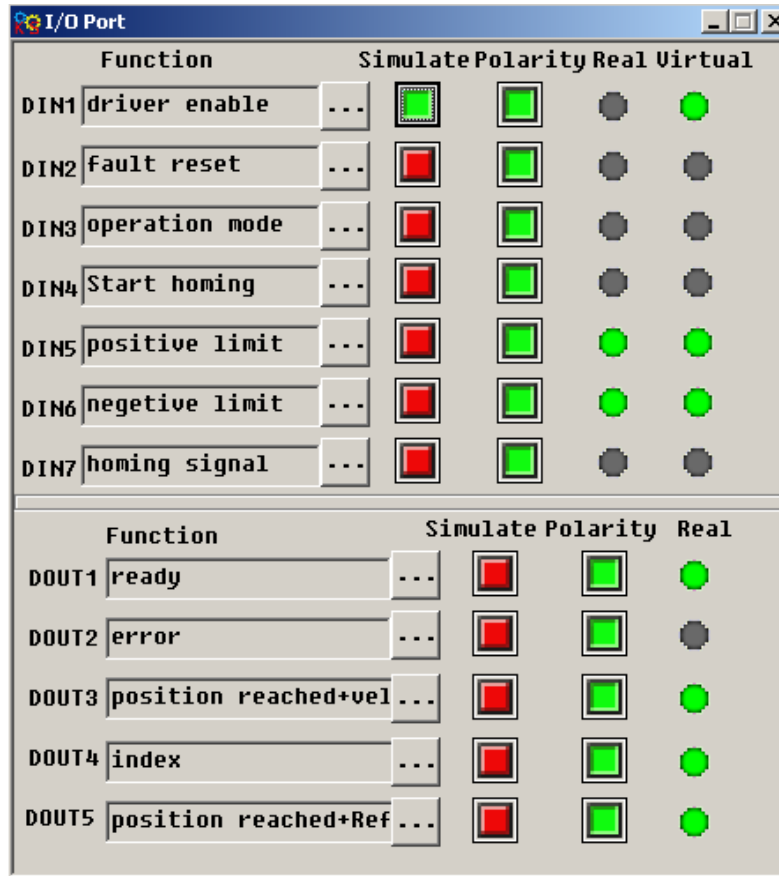


(5). Driver searches the Z phase signal in mode 7, and ultimately find the origin. Computer monitoring picture is shown as follows:



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:

The screenshot shows the 'Basic Operate' window with a table of system parameters. The table has columns for 'name', 'data', and 'unit'. The 'Pos_Actual' row is highlighted in blue.

	name	data	unit
1*	Operation_Mode_Buff	-4	DEC
2*	Status_Word	c437	HEX
3*	Pos_Actual	0	inc
4*	Real_Speed_RPM	0	rpm
5*	I_q	0.044	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

Chapter 8 Control Performance

8.1 Driver Performance Tuning

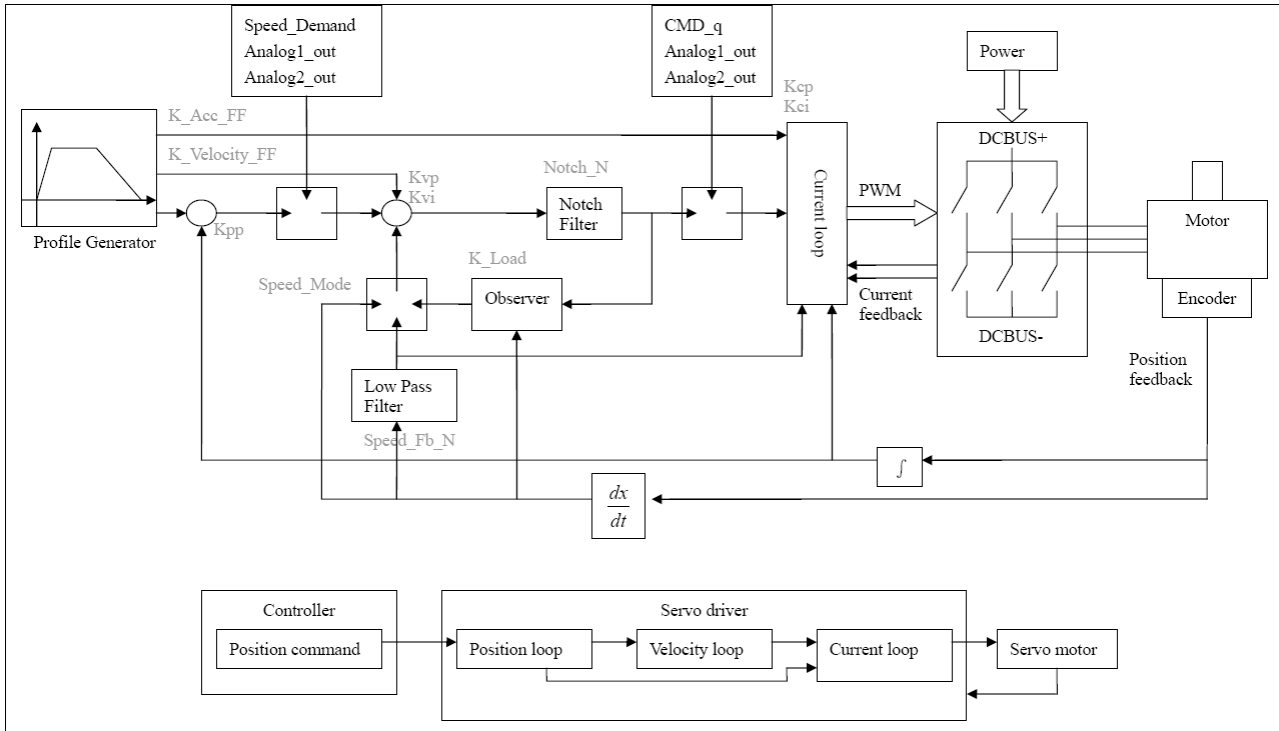


Fig. 8-1 Schematic diagram for control loop adjustment

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	-	0~32767
d2.02	Kvi	Adjusts speed control so that the time of minor errors is compensated	-	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 $F = \text{Speed_Fb_N} * 20 + 100$. For example, to set the filter bandwidth to "F = 500 Hz", you need to set the parameter to 20.	7	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 JI of the motor shaft, and then add the inertia Jr of the motor itself to obtain $J_t = J_r + J_I$. Put the result into the formula:

$$Vc_Loop_BW = Kvp * \frac{I_p * K_t * Encoder_R}{J_t * 204800000 * \sqrt{2} * 2\pi}$$

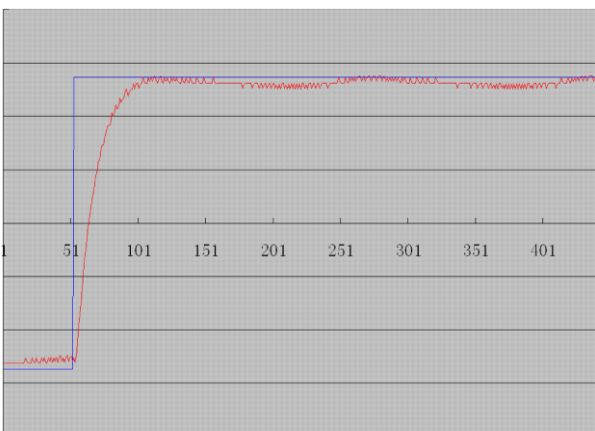
To calculate the bandwidth of the velocity loop

Vc_Loop_BW according to the adjusted the gain of velocity loop Kvp, only adjust Kvi according to actual requirements.

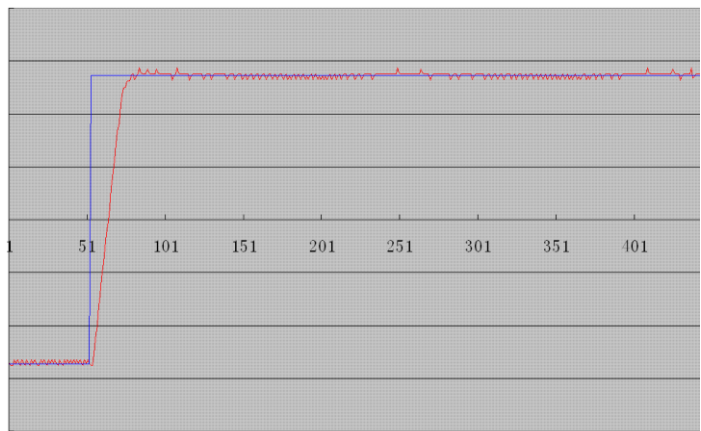
Adjust the impact of Kvp and Kvi, as shown in Fig. 8-2.

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.

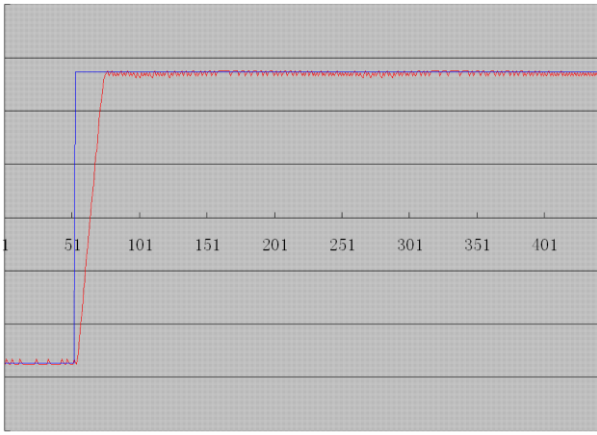
For the effect of Kvi adjustment, see the first to the fourth from right of Fig. 8-2. Kvi gradually increases from the first to the fourth from right. The value of Kvp remains unchanged.



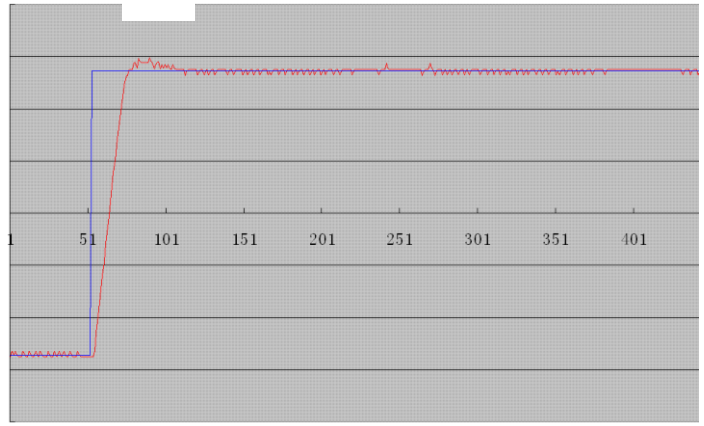
Left 1



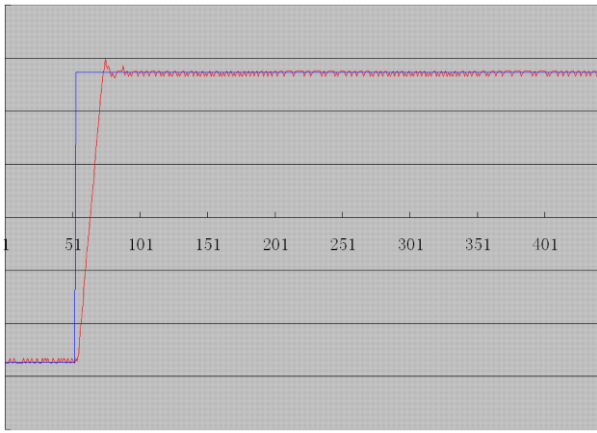
Right 1



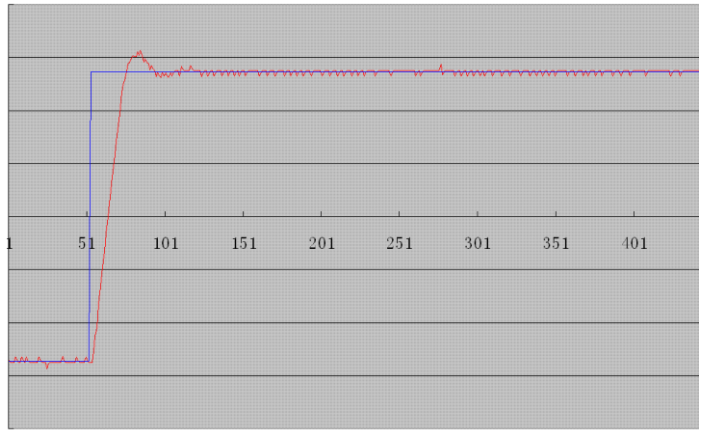
Left 2



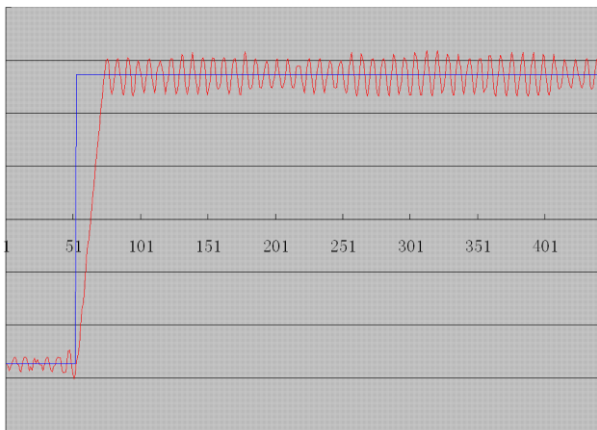
Right 2



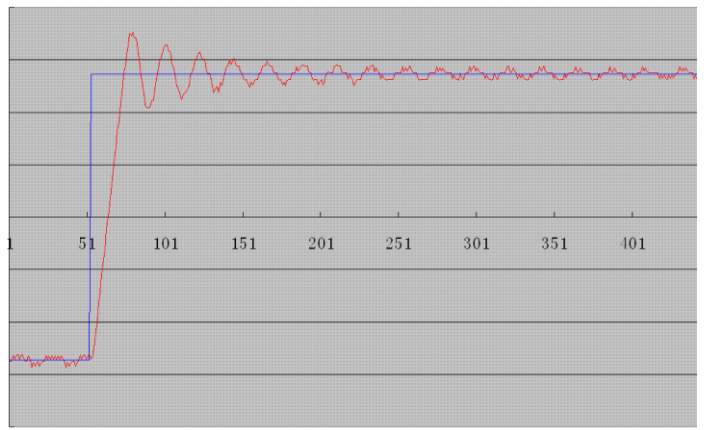
Left 3



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 $F = \text{Speed_Fb_N} * 20 + 100$ (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 255 indicates 100% feedforward	255	0~255
d2.09	K_Acc_FF	The value is inversely proportional to the feedforward	32767 (7FF.F)	32767~10
d0.05	Pc_Loop_BW	Sets the bandwidth of the position loops in Hz	10	0~100
d2.26	Pos_Filter_N	Average filter parameter	N=1	1~255

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.
$$K_Acc_FF = \frac{I_p * K_t * Encoder_R}{250000 * \sqrt{2} * J_t * \pi}$$
 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: $f = 1000/(2\pi * PD_Filter)$ 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.

8.2 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	0~1

8.3 Auto reverse

In this mode, motor will run forward and reverse continuously according to the setting mode. User can set parameters in velocity loop and position loop in this mode. Please make sure auto forward/reverse is allowed in the machine before using this mode and make sure the power of driver can be cut off anytime to avoid accident.

Operation procedure for auto reverse:

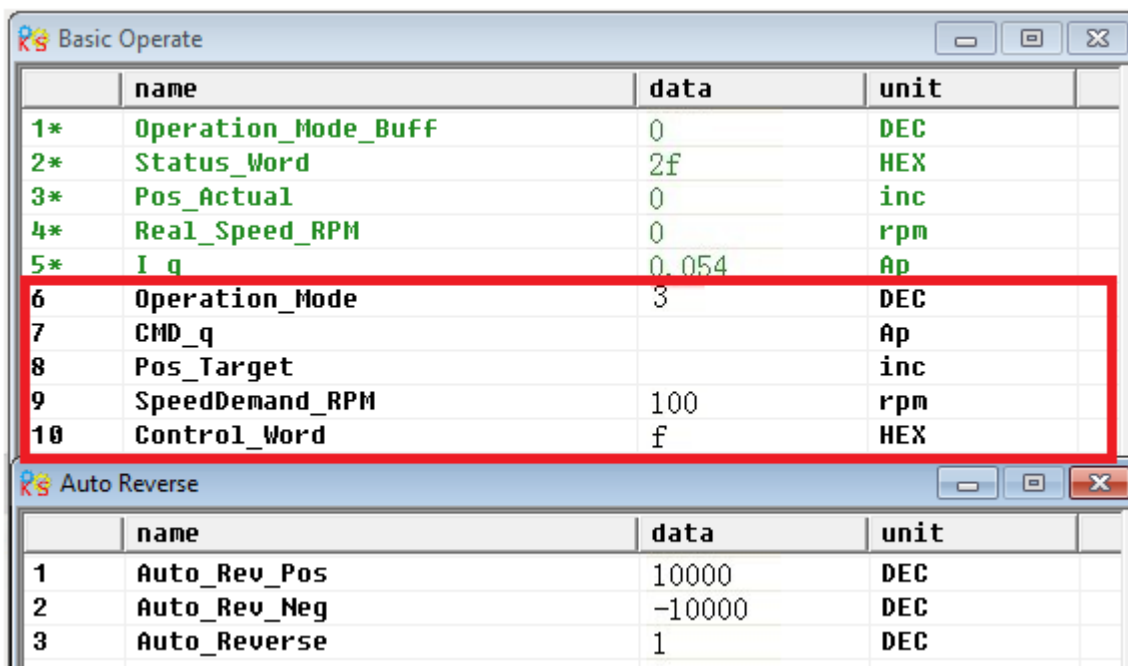
- 1: Use KincoServo software to online according to chapter 7.
- 2: Set speed mode control according to 7.2.
- 3: Click the menu “Driver-Operation mode-Auto Reverse” and set the parameter for auto reverse.

Set “Auto_Reverse” as 0 for no control.

Set “Auto_Reverse” as 1 for position control. The motor will run between the position “Auto_Rev_Pos” and “Auto_Rev_Neg”. The unit is inc. The speed depends on target velocity.

Set “Auto_Reverse” as 3 for time control. The motor will run between time “Auto_Rev_Pos” and “Auto_Rev_Neg”. The unit is ms. The speed depends on target velocity.

Following figure shows the parameters need to set. In this figure, the servo will run between -10000 inc and 10000 at speed 100RPM.



The image shows two windows from the KincoServo software. The top window, titled 'Basic Operate', contains a table of parameters. The bottom window, titled 'Auto Reverse', contains a table of parameters. A red box highlights the 'Operation_Mode' parameter in the 'Basic Operate' table, which is set to 3.

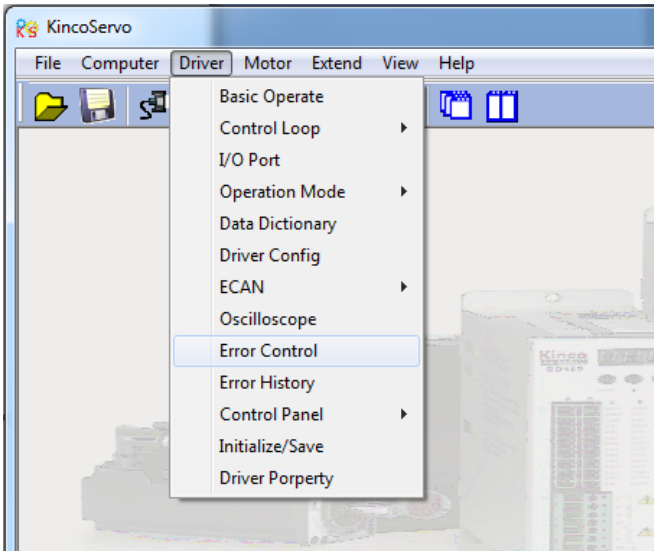
	name	data	unit
1*	Operation_Mode_Buff	0	DEC
2*	Status_Word	2f	HEX
3*	Pos_Actual	0	inc
4*	Real_Speed_RPM	0	rpm
5*	I q	0.054	Ap
6	Operation_Mode	3	DEC
7	CMD_q		Ap
8	Pos_Target		inc
9	SpeedDemand_RPM	100	rpm
10	Control_Word	f	HEX

	name	data	unit
1	Auto_Rev_Pos	10000	DEC
2	Auto_Rev_Neg	-10000	DEC
3	Auto_Reverse	1	DEC

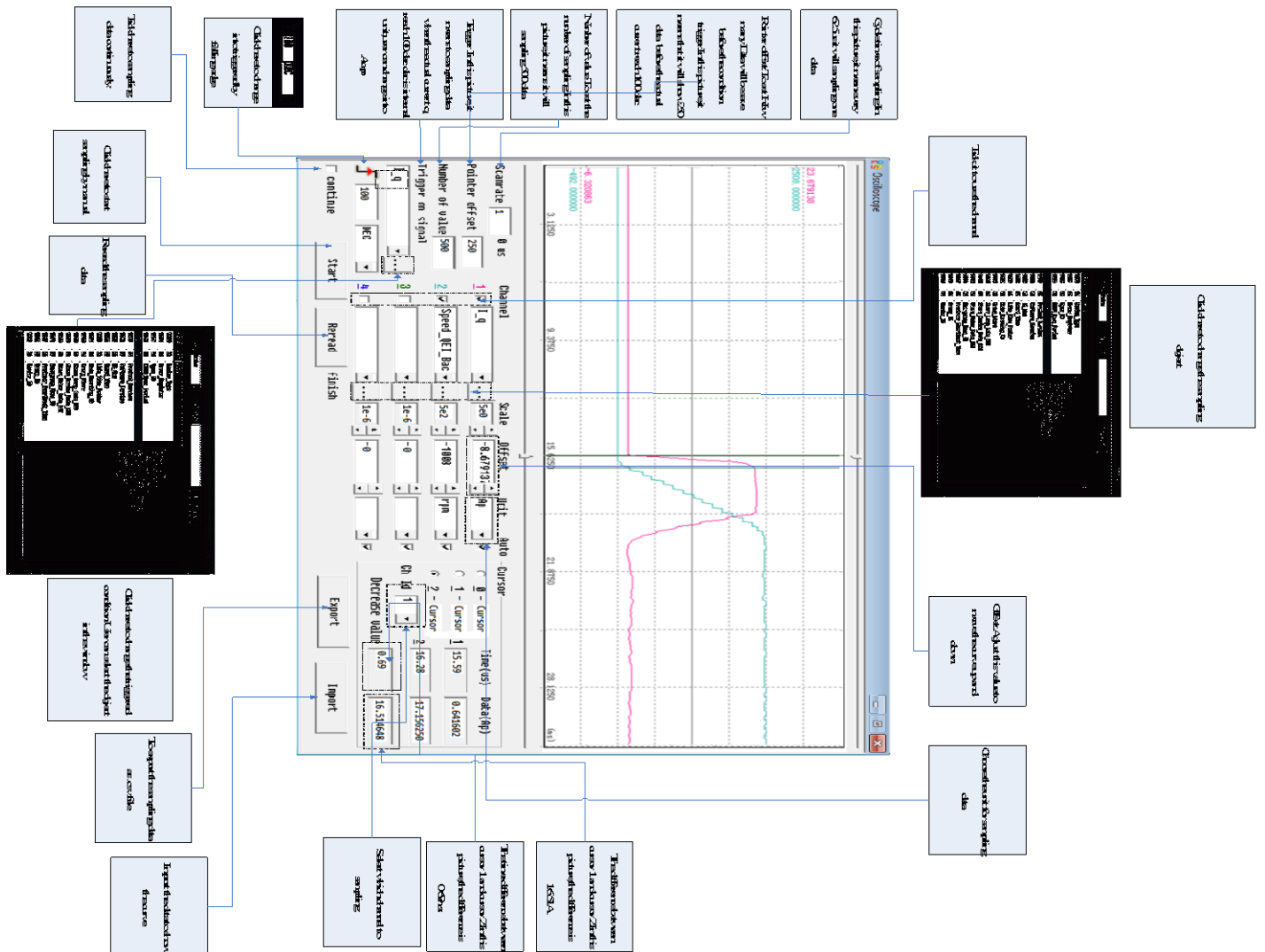
8.4 Debugging example

8.4.1 Oscilloscope

1. Enter oscilloscope



2. Parameters for Oscilloscope



8.4.2 Procedure for Parameter Adjustment

1. Velocity Loop Adjustment

(1) Adjust Kvp according to the load.

① Set motor running at Auto Reverse mode by position (Operation mode -3), then open oscilloscope and set the parameters to observe the curve. As shown in following figures.

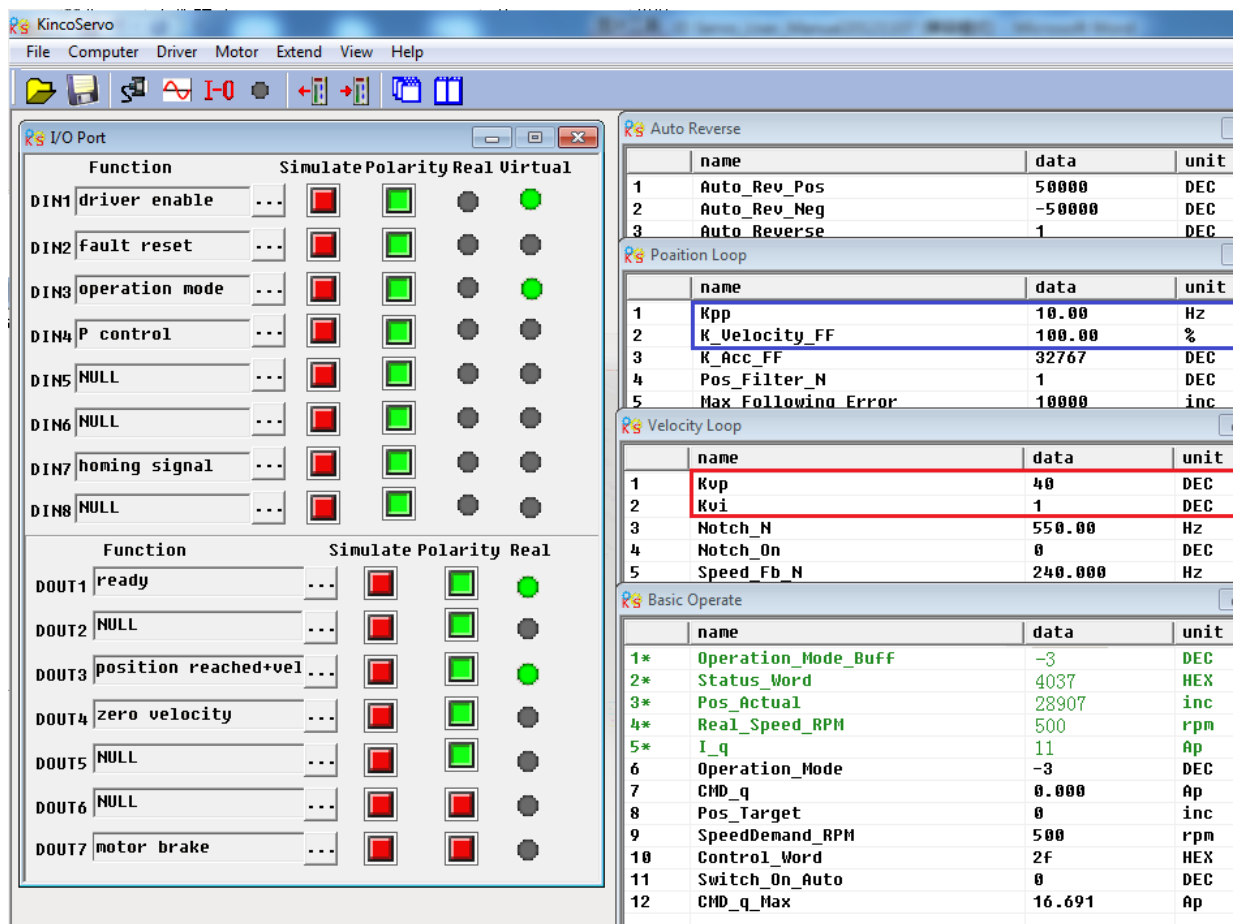
② Adjust Kvp and observe the speed curve. Following figures show the different curve in different Kvp. According to the curve, it shows that the bigger value of Kvp, the faster response of speed.

(2) Adjust Kvi according to load.

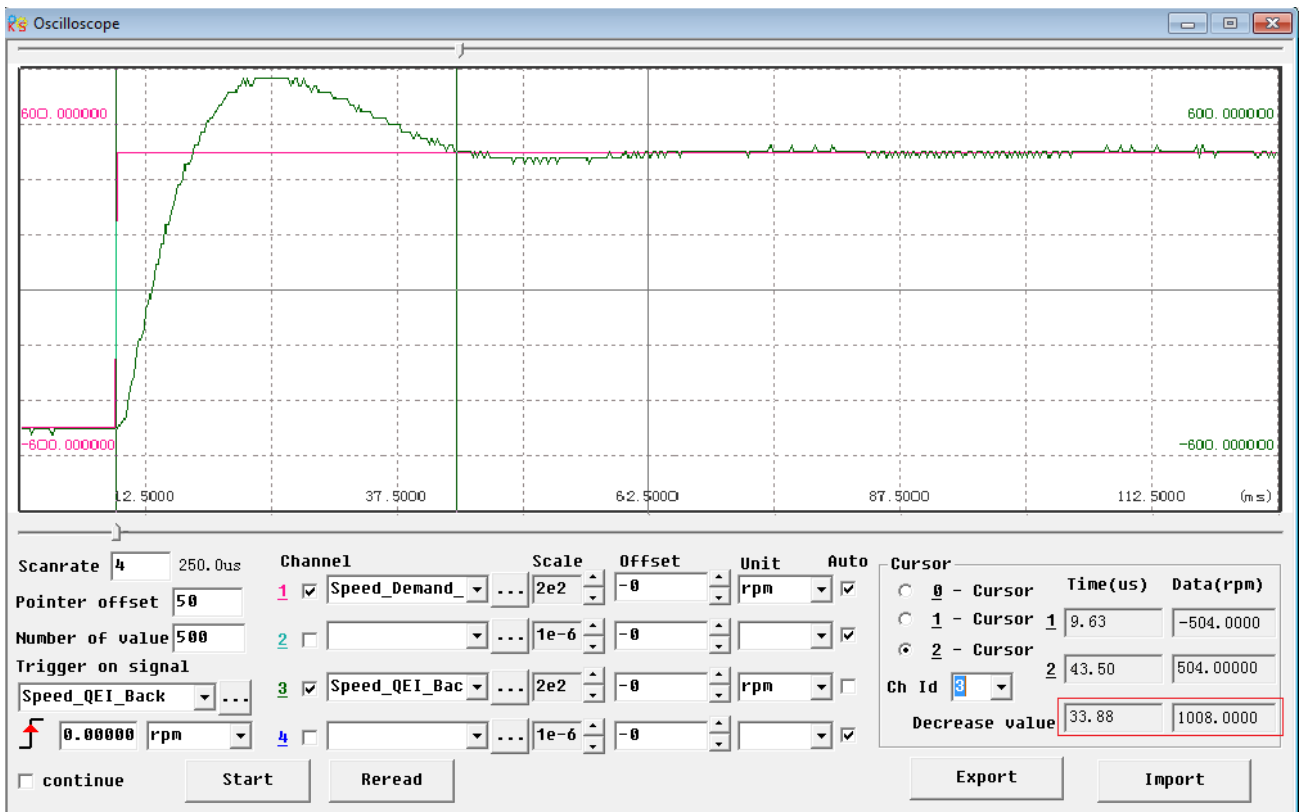
(3) Adjust Speed_Fb_N to reduce system noise.

Speed_Fb_N: This parameter is used to reduce system noise. But the bigger value of this parameter, the slower response of system.

In Auto Reverse mode, Kvp=40



The oscilloscope is shown as follows: actual speed response is 33.88ms



In Auto Reverse mode, $K_{vp}=110$

I/O Port

Function	Simulate	Polarity	Real	Virtual
DIN1 driver enable	Red	Green	Grey	Green
DIN2 fault reset	Red	Green	Grey	Grey
DIN3 operation mode	Red	Green	Grey	Green
DIN4 P control	Red	Green	Grey	Grey
DIN5 NULL	Red	Green	Grey	Grey
DIN6 NULL	Red	Green	Grey	Grey
DIN7 homing signal	Red	Green	Grey	Grey
DIN8 NULL	Red	Green	Grey	Grey

Function	Simulate	Polarity	Real	Virtual
DOUT1 ready	Red	Green	Green	Green
DOUT2 NULL	Red	Green	Grey	Grey
DOUT3 position reached+vel	Red	Green	Green	Green
DOUT4 zero velocity	Red	Green	Grey	Grey
DOUT5 NULL	Red	Green	Grey	Grey
DOUT6 NULL	Red	Green	Grey	Grey
DOUT7 motor brake	Red	Red	Grey	Grey

Auto Reverse

name	data	unit
1 Auto_Rev_Pos	50000	DEC
2 Auto_Rev_Neg	-50000	DEC
3 Auto Reverse	1	DEC

Position Loop

name	data	unit
1 Kpp	10.00	Hz
2 K_Velocity_FF	100.00	%
3 K_Acc_FF	32767	DEC
4 Pos_Filter_N	1	DEC
5 Max Following Error	10000	inc

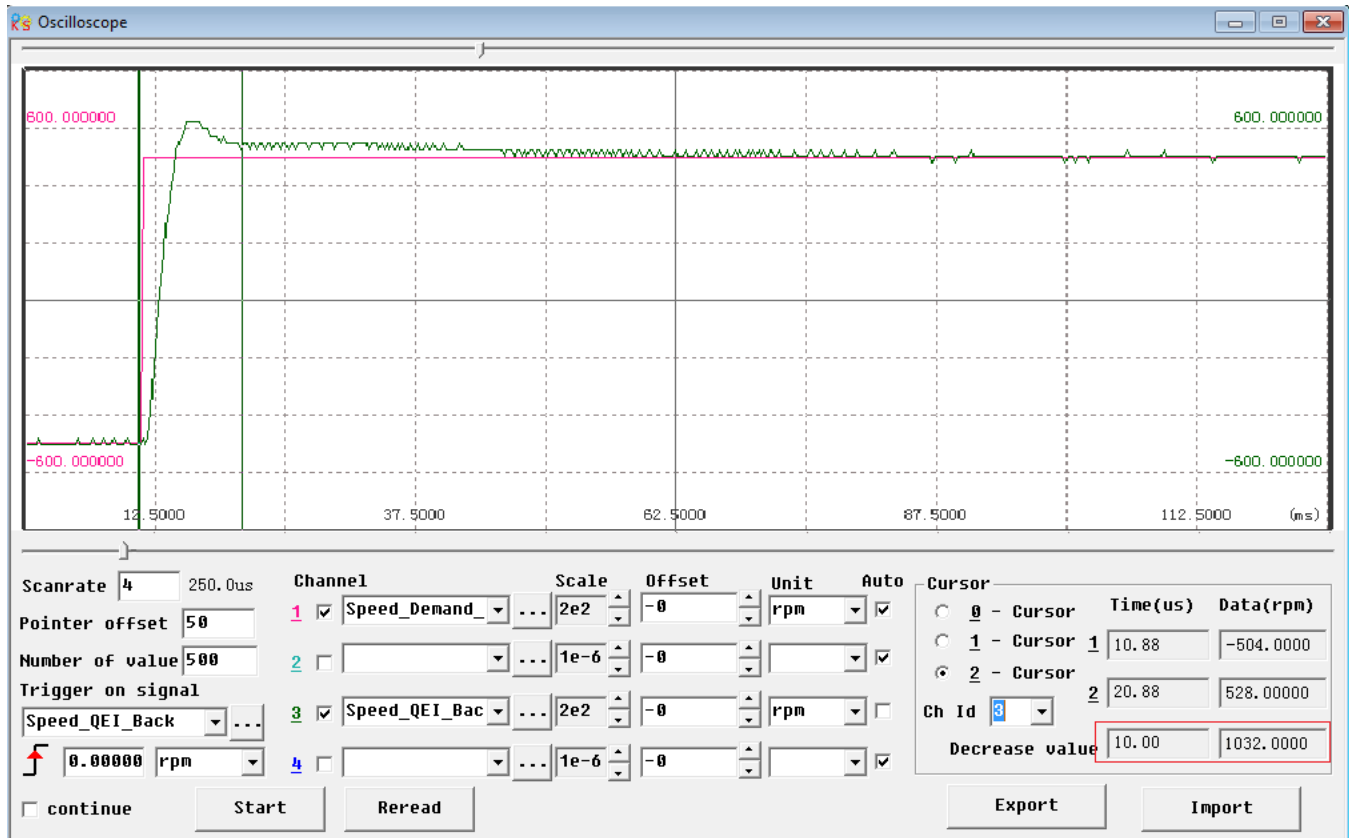
Velocity Loop

name	data	unit
1 Kvp	110	DEC
2 Kvi	1	DEC
3 Notch_N	550.00	Hz
4 Notch_On	0	DEC
5 Speed_Fb_N	240.000	Hz

Basic Operate

name	data	unit
1* Operation_Mode_Buff	-3	DEC
2* Status_Word	4437	HEX
3* Pos_Actual	4510	inc
4* Real_Speed_RPM	500	rpm
5* I_q	4	Ap
6 Operation_Mode	-3	DEC
7 CMD_q	0.000	Ap
8 Pos_Target	0	inc
9 SpeedDemand_RPM	500	rpm
10 Control_Word	2f	HEX
11 Switch_On_Auto	0	DEC
12 CMD_q_Max	16.691	Ap

The oscilloscope is shown as follows: actual speed response is 10.00ms



2. Position Loop Adjustment

(1) Adjust Kpp.

(2) Adjust Vff (K_Velocity_FF)

Adjust Vff parameter according to the allowable position error and coupling performance of machine. Normally Vff is 100%. If system doesn't need high response for position, then this parameter can be decreased to reduce overshoot.

(3) Use oscilloscope to observe curve.

Set motor running at Auto Reverse mode by time (Operation mode 3), set parameters of oscilloscope as following figure.

In Fig.(1) and Fig.(2), Vff is 100%. When Kpp is 30, the response of position loop is faster than the one when Kpp is 10. Meanwhile the following error is also less, but overshoot is bigger.

Fig.(3), Kpp is 30, Vff is 50%. Compare with Fig.(2), the following error is bigger, but response becomes slower and there is almost no overshoot.

Internal position mode, target position is 50000 inc.

Fig.(1) Kpp=10, Vff=100%

The screenshot shows the KincoServo software interface with several panels:

- I/O Port:** A table of digital inputs (DIN) and outputs (DOUT) with buttons for Simulate, Polarity, Real, and Virtual.
- Position Loop:**

name	data	unit
1 Kpp	10.000	Hz
2 K_Velocity_FF	100.000	%
3 K_Acc_FF	32767	DEC
4 Pos_Filter_N	1	DEC
5 Max_Following_Error	10000	inc
- Velocity Loop:**

name	data	unit
1 Kvp	150	DEC
2 Kvi	4	DEC
3 Notch_N	550.000	Hz
4 Notch_On	0	DEC
5 Speed_Fb_N	240.000	Hz
6 Speed_Mode	0	DEC
- Basic Operate:**

name	data	unit
1* Operation_Mode_Buff	1	DEC
2* Status_Word	5037	HEX
3* Pos_Actual	14224	inc
4* Real_Speed_RPM	474	rpm
5* I_q	0.134	Ap
6 Operation_Mode	1	DEC
7 CMD_q	0.000	Ap
8 Pos_Target	50000	inc
9 SpeedDemand_RPM	0	rpm
10 Control_Word	3F	HEX
11 Switch_On_Auto	0	DEC
12 CMD_q_Max	16.691	Ap
13 Profile_Speed	500.000	rpm

The oscilloscope is as following: max. following error is 69 inc.

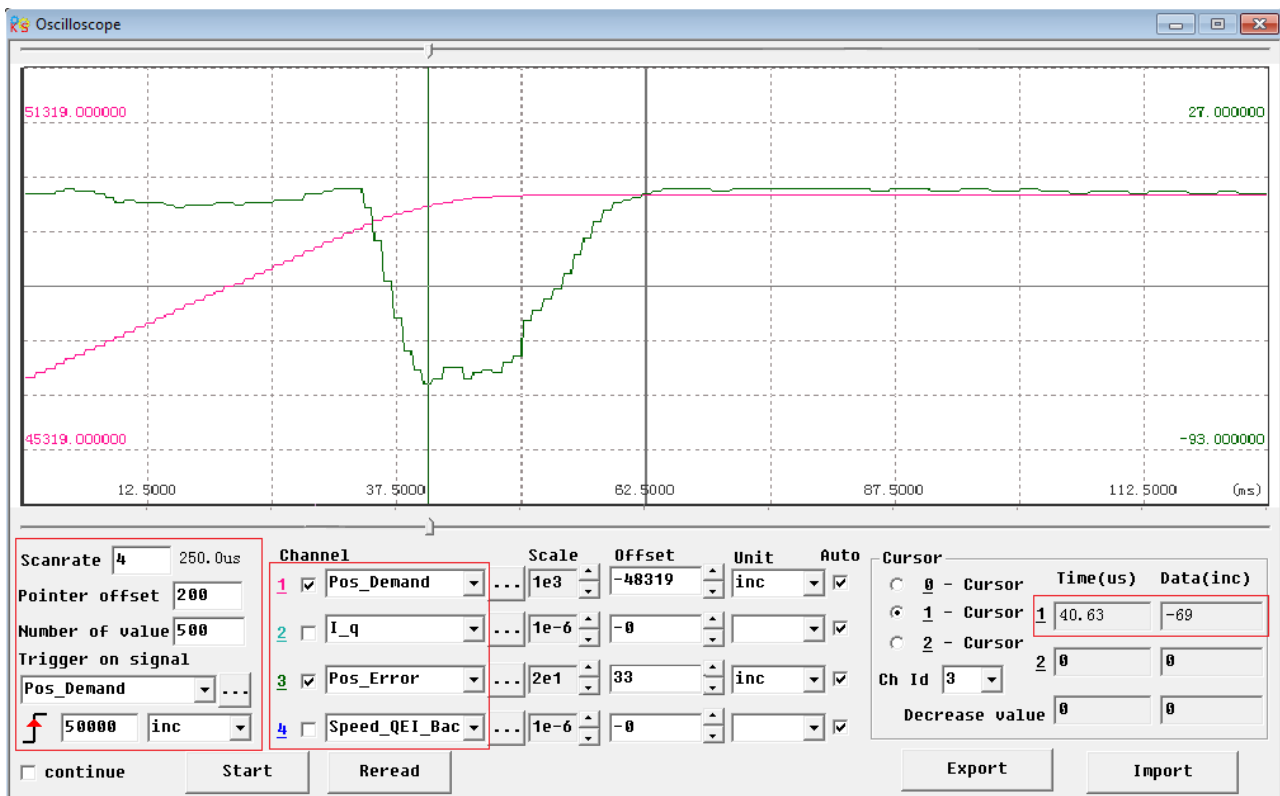
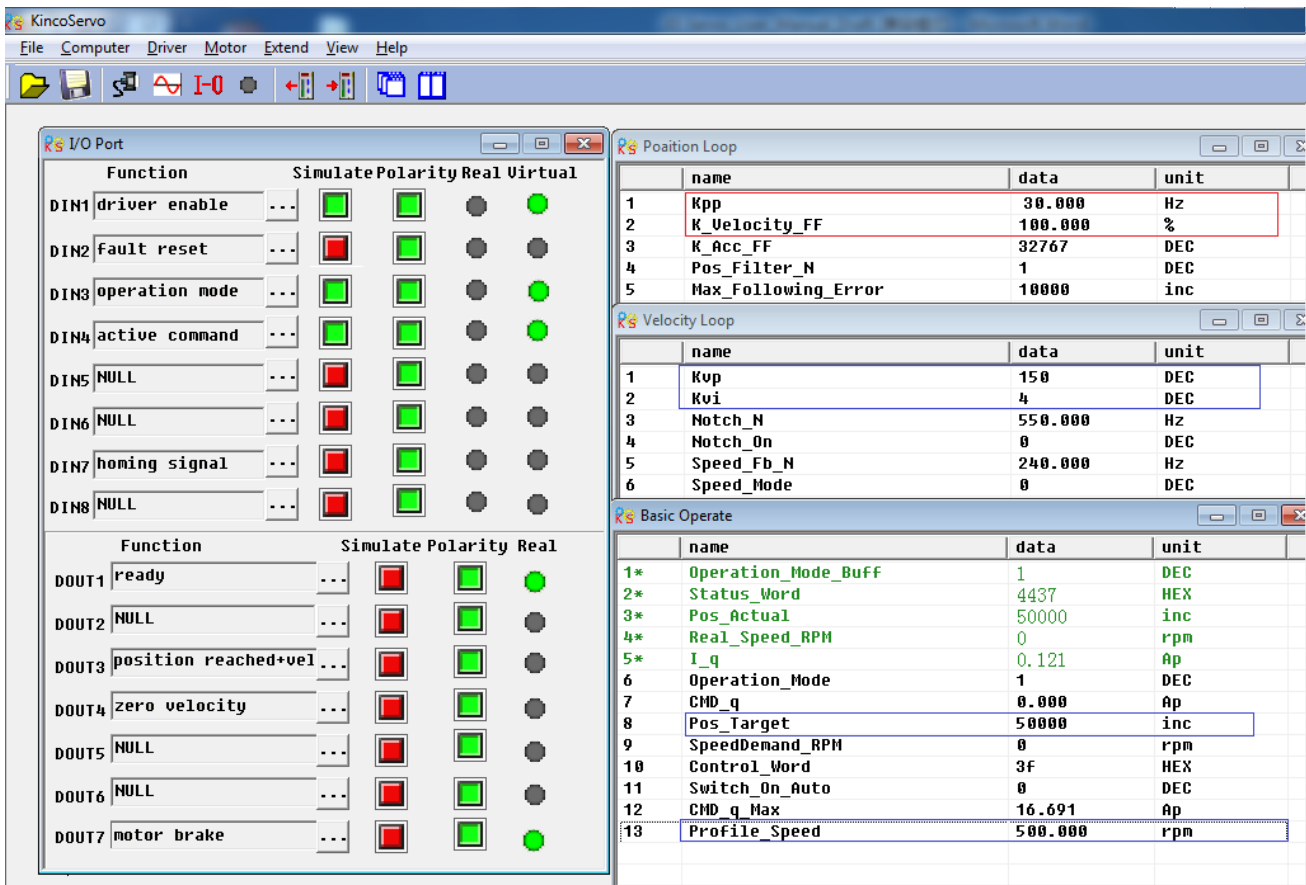


Fig.(2) Kpp=30,Vff=100%



The oscilloscope is as following: max. following error is 53 inc.

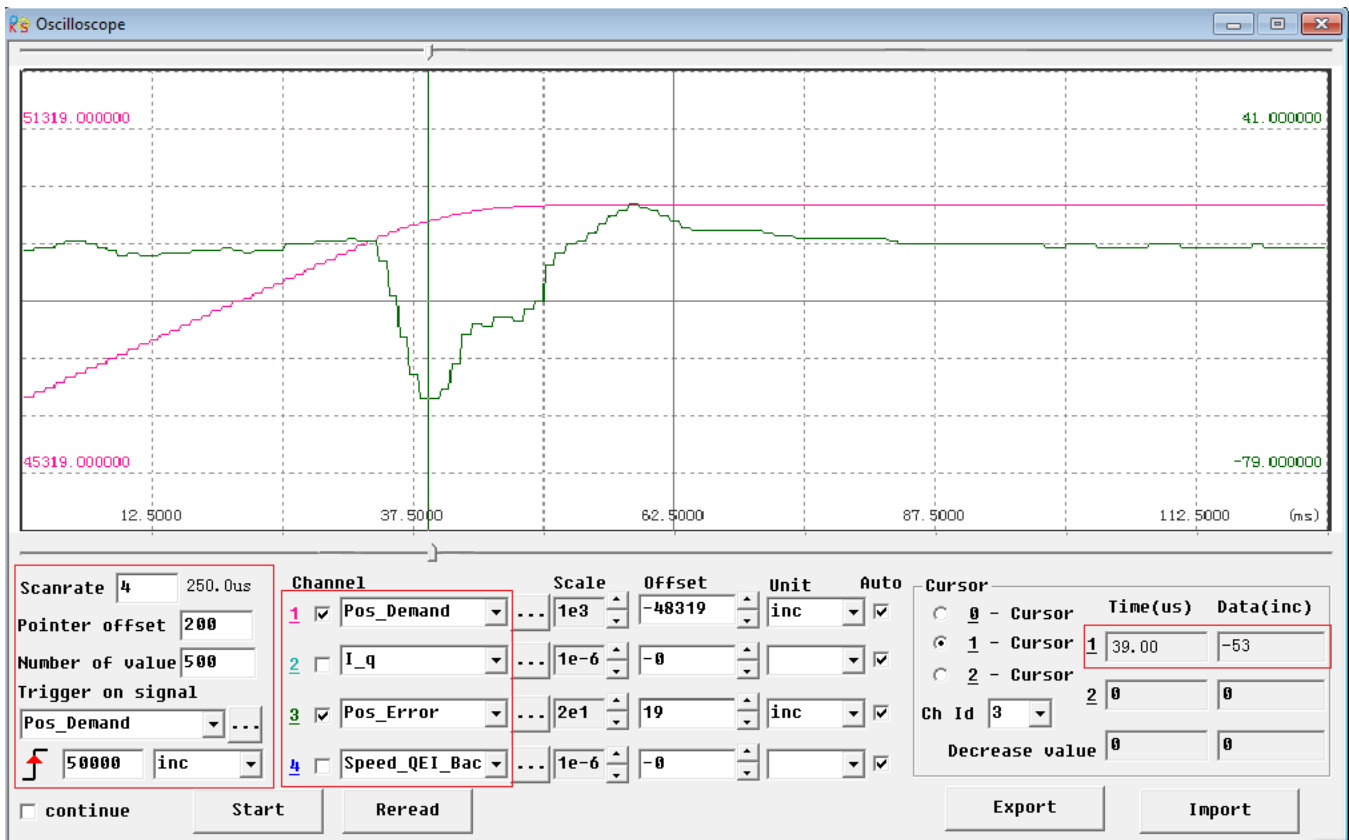


Fig.(3) Kpp=30,Vff=50%

KincoServo

File Computer Driver Motor Extend View Help

I/O Port

Function	Simulate	Polarity	Real	Virtual
DIN1 driver enable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN2 fault reset	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN3 operation mode	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN4 active command	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN5 NULL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN6 NULL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN7 homing signal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
DIN8 NULL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

DOUT1 ready

DOUT2 NULL

DOUT3 position reached+vel...

DOUT4 zero velocity

DOUT5 NULL

DOUT6 NULL

DOUT7 motor brake

Position Loop

name	data	unit
1 Kpp	30.000	Hz
2 K_Velocity_FF	50	%
3 K_Acc_FF	32767	DEC
4 Pos_Filter_N	1	DEC
5 Max_Following_Error	10000	inc

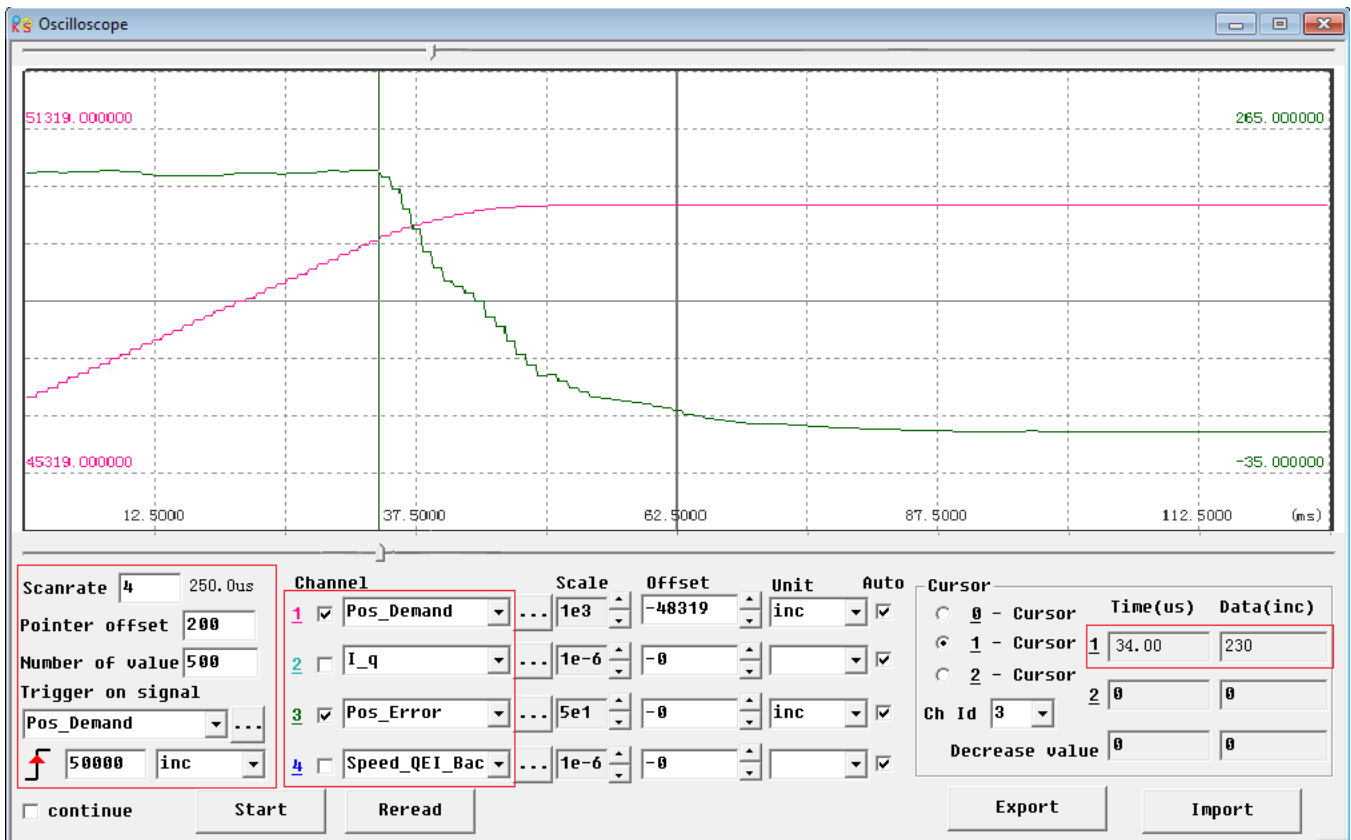
Velocity Loop

name	data	unit
1 Kvp	150	DEC
2 Kvi	4	DEC
3 Notch_N	550.000	Hz
4 Notch_On	0	DEC
5 Speed_Fb_N	240.000	Hz
6 Speed_Mode	0	DEC

Basic Operate

name	data	unit
1* Operation_Mode_Buff	1	DEC
2* Status_Word	5037	HEX
3* Pos_Actual	8826	inc
4* Real_Speed_RPM	2	rpm
5* I_q	0.000	Ap
6 Operation_Mode	1	DEC
7 CMD_q	0.000	Ap
8 Pos_Target	50000	inc
9 SpeedDemand_RPM	0	rpm
10 Control_Word	3f	HEX
11 Switch_On_Auto	0	DEC
12 CMD_q_Max	16.691	Ap
13 Profile_Speed	500.000	rpm

The oscilloscope is as following: max. following error is 230 inc.



Chapter 9 Communication

A **CD2S** 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.

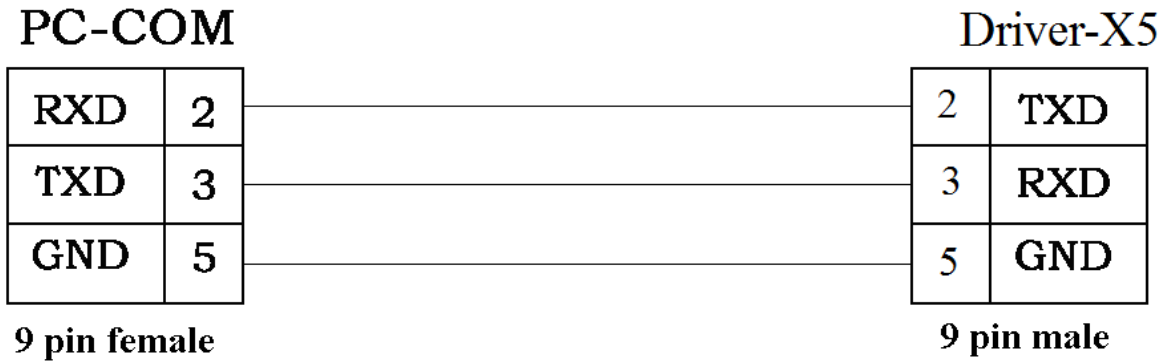


Fig. 9-1 Communication cables between a PC and a **CD2S** servo driver

9.1 Transport Protocol

The RS-232C communication of the **CD2S** servo driver strictly follows a master/slave protocol. The host computer can send any data to **CD2S** driver. The driver configured with ID No. will calculate such data and return a reply. Default communication settings for the **CD2S** servo driver are as follows:

Baud rate = 38400 bps

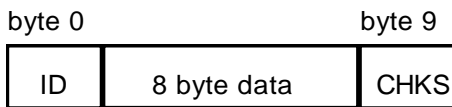
Data bits = 8

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.

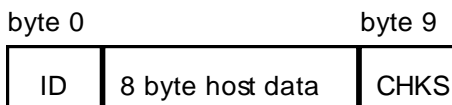
The transport protocol used by the RS-232 uses a data packet with fixed length of 10 bytes.



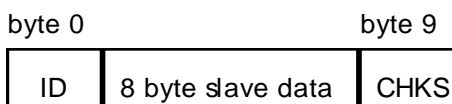
ID is the ID No. of the slave

CHKS = -SUM(byte0,...,byte8), CHKS is the last two digits of the calculation result.

The host sends:



The slave sends/The host receives:



Note: Each 10-byte packet has its own CHKS.

If the host sends an ID not existed in the network to the **CD2S** servo driver, no **CD2S** 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 **CD2S** 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:

byte 0 byte 1 byte 2 byte 3 byte 4 byte 5 byte 6 byte 7

CMD	INDEX	SUB INDEX		RESERVED			
-----	-------	--------------	--	----------	--	--	--

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:

byte 0 byte 1 byte 2 byte 3 byte 4 byte 5 byte 6 byte 7

RES	INDEX	SUB INDEX		DATA			
-----	-------	--------------	--	------	--	--	--

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

Example 9-1: Use home mode/position mode/speed mode by communication

Home mode (Controlword F to 1F)				
CANOpen	Name	Value	Message (ID=1)	Meaning
60400010	Controlword	F	01 2B 40 60 00 0F 00 00 00 25	Homing_Speed_Swit
60600008	Operation_mode	6	01 2F 60 60 00 06 00 00 00 0A	ch and

60980008	Homing_Method	33	01 2F 98 60 00 21 00 00 00 B7	Homing_Speed_Zero fault unit is DEC , DEC=[(RPM*512*Encoder resolution)/1875]
60990120	Homing_Speed_Switch	200RPM	01 23 99 60 01 55 55 08 00 30	
60990220	Homing_Speed_Zero	150RPM	01 23 99 60 02 00 40 06 00 9B	
60400010	Controlword	1F	01 2B 40 60 00 1F 00 00 00 15	
01 40 41 60 00 00 00 00 00 1E Read state word , C037 means home found				
Position mode (Controlword Absolute positioning 2F to 3F Relative positioning 4F to 5F , 103F Start absolute positioning)				
CANOpen	Name	Value	Message (ID=1)	Meaning
60400010	Controlword	F	01 2B 40 60 00 0F 00 00 00 25	DEC=[(RPM*512*Encoder resolution)/1875]
60600008	Operation_mode	1	01 2F 60 60 00 01 00 00 00 0F	
607A0020	Target_Position	50000inc	01 23 7A 60 00 50 C3 00 00 EF	
60810020	Profile_Speed	200RPM	01 23 81 60 00 55 55 08 00 49	
60830020	Profile_Acc	610.352rps/s	Default	DEC=[(RPS/S*65536*Encoder resolution)/1000/4000]
60840020	Profile_Dec	610.352rps/s	Default	
60400010	Controlword	2F	01 2B 40 60 00 2F 00 00 00 05	
		3F(Absolute positioning)	01 2B 40 60 00 3F 00 00 00 F5	
		4F	01 2B 40 60 00 4F 00 00 00 E5	
		5F(Relative positioning)	01 2B 40 60 00 5F 00 00 00 D5	
01 40 41 60 00 00 00 00 00 1E Read state word , D437 means position to				

Speed mode				
CANOpen	Name	Value	Message (ID=1)	Meaning
60600008	Operation_Mode	3	01 2F 60 60 00 03 00 00 00 0D	Default unit of Target speed
60FF0020	Target_Speed	150RPM	01 23 FF 60 00 00 40 06 00 37	
60400010	Controlword	F	01 2B 40 60 00 0F 00 00 00 25	
60830020	Profile_Acc	610.352 rps/s	Default	DEC DEC=[(RPM*512*Enc

60840020	Profile_Dex	610.352 rps/s	Default	oder Resolution)/1875] Default unit of Profile acc/dec DEC DEC=[(RPS/S*65536* Encoder Resolution)/1000/ 4000]
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Note: Under communication mode, data are transmitted in HEX.

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

1 st bit in numeric display (left)				2 nd bit in numeric display				3 rd bit in numeric display				4 th 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°C.	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	Ilt 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.

Chapter11 Appendix

Appendix 1: 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	200	800
	1.57KW						
	1.88KW						
	2.1kw						

	2.3kw						
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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 2: 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	