# Operation Manual

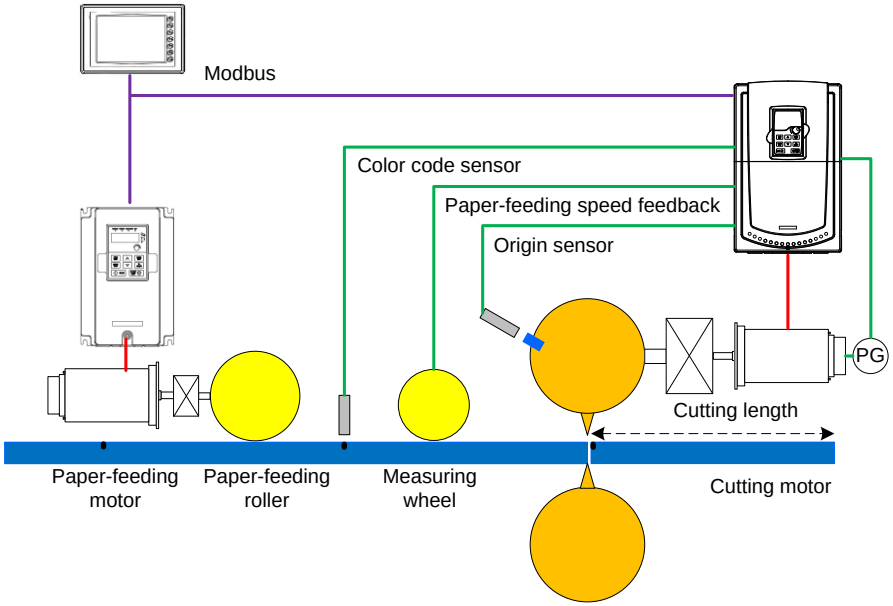
## DSV110 Servo Drive for Flying Shears

SHENZHEN INVT ELECTRIC CO., LTD.

# Preface

Thanks for choosing DSV110 servo drives for flying shears.

As high-performance servo drives designed for flying shears, DSV110 servo drives can be used to drive asynchronous motors and permanent-magnet synchronous motors (PMSMs). They support multiple types of encoders, and their torque is highly and dynamically responsive. DSV110 servo drives for flying shears are equipped with built-in flying cutting cam profiles, support cutting based on fixed lengths and color codes, provide cam profiles with smooth Sine curves, and thus can implement smooth cutting on materials. The mechanical impact and vibration are small. For equipment in good mechanical conditions, the cutting accuracy can reach ±0.5 mm. DSV110 servo drives support dual-motor driving for cutters and 1:1 direct driving of motors for cutter shafts. When direct driving is adopted, the Z-pulse signals of the motor encoder serve as the cutting point signals for the flying shear. The cutting accuracy is high.



# Contents

# Chapter 1 Safety precautions

## 1.1 Safety definition

| | |
|---|---|
| Danger: | Serious physical injury or even death may occur if related requirements are not followed. |
| Warning: | Physical injury or damage to the devices may occur if related requirements are not followed. |
| Note: | Steps to take for ensuring the proper running of the servo drive. |
| Trained and qualified electricians: | People working on the device must have taken part in professional electrical and safety training, obtained the certification, and been familiar with all steps and requirements of installing, commissioning, operating and maintaining the device, and are capable of preventing or dealing with all kinds of emergencies. |

## 1.2 Warning signs

Warning signs are used to warn you about the conditions that may cause severe injury or damage to the device. They instruct you to exercise caution to prevent danger. The following table describes the warning signs used in this manual.

| Sign | Name | Description | Abbreviation |
|---|---|---|---|
|  Danger | Danger | Serious physical injury or even death may be caused if related requirements are not followed. |  |
|  Warning | Warning | Physical injury or damage to the devices may be caused if related requirements are not followed. |  |
|  Electrostatic discharge | Electrostatic discharge | Damage to the PCBA board may be caused if related requirements are not followed. |  |
|  Hot sides | Hot sides | Sides of the device may become hot. Do not touch. |  |
| **Note** | Note | Steps to take for ensuring the proper running of the device. | **Note** |

## 1.3 Safety guide

| | |
|---|---|
|  | ✧ Only qualified electricians are allowed to operate the device.<br>✧ Do not perform any wiring, inspection, or component replacement |

operations when power is applied. Before wiring or inspection, ensure all input power supplies are disconnected and wait for at least the waiting time designated on the servo drive, or ensure that the DC bus voltage is lower than 36 V. The following table describes the waiting time.

| Servo drive model | | Min. waiting time |
|---|---|---|
| 380 V | 1.5 kW–110kW | 5 min |
| 380 V | 132 kW–315 kW | 15 min |

✧ Do not refit the product unauthorizedly; otherwise fire, electric shock or other injury may occur.

✧ High-temperature components or parts may become hot when the device is running. Do not touch them. Otherwise, you may get burnt.

✧ The electrical parts and components inside the product are electrostatic sensitive parts. Take measurements to prevent electrostatic discharge when performing operations involved with them.

## 1.4 Scrap disposition

✧ There is heavy metal in the product. Deal with it as industrial waste.

✧ When the life cycle ends, the product should enter the recycling system. Dispose of it separately at an appropriate collection point instead of placing it in the normal waste stream.

# Chapter 2 Product overview

## 2.1 Product specifications

| Function | | Specification |
|---|---|---|
| Power input | Input voltage (V) | AC 3PH 380V (-15%)–440V (+10%) |
| | Input current (A) | Refer to section 2.4 "Rated specifications". |
| | Input frequency (Hz) | 50 Hz or 60 Hz; allowable range: 47 Hz to 63 Hz |
| Power output | Output voltage (V) | 0–input voltage |
| | Output current (A) | Refer to section 2.4 "Rated specifications". |
| | Output power (kW) | Refer to section 2.4 "Rated specifications". |
| | Output frequency (Hz) | 0–400Hz |
| Technical control performance | Control mode | Space Vector Pulse Width Modulation (SVPWM), vector control with PG |
| | Motor type | Asynchronous motor, permanent-magnet synchronous motor (PMSM) |
| | Speed control accuracy | ±0.02% |
| | Speed fluctuation | ±0.1% |
| | Torque responsiveness | < 5ms |
| | Torque control accuracy | 5% |
| | Start torque | 0 Hz/200% |
| | Overload capacity | 150% of the rated current: 60s<br>180% of the rated current: 10s<br>200% of the rated current: 1s |
| Peripheral interface | Terminal analog input resolution | ≤ 20 mV |
| | Terminal digital input resolution | ≤ 2 ms |
| | Analog input | 3 inputs:<br>AI1 and AI2: 0–10 V/0–20 mA<br>AI3: -10–+10 V |

| Function | | Specification |
|---|---|---|
| | Analog output | 2 inputs:<br>AO1 and AO2: 0–10 V/0–20 mA |
| | Digital input | 9 inputs:<br>8 common inputs with a maximum frequency of 1 kHz and internal impedance of 3.3 kΩ<br>1 high-speed input with a maximum frequency of 50 kHz |
| | Digital output | 2 outputs:<br>1 high-speed pulse output with a maximum frequency of 50 kHz<br>1 Y terminal open collector output |
| | Relay output | 2 programmable relay outputs<br>RO1A is in the normally open (NO) state, RO1B is in the normally closed (NC) state, and RO1C is the common terminal.<br>RO2A is in the NO state, RO1B is in the NC state, and RO1C is the common terminal.<br>Contact capacity: 3 A/AC 250 V, 1 A/DC 30 V |
| Flying shear-dedicated function | Cam profile | Supporting the sine flying cutting cam profile |
| | Signals of color code sensor | Supporting high-speed capture through hardware IO ports |
| | cutting point photoelectric sensor | For direct-driven flying shears, Z pulses of the motor can be used as cutting point signals. |
| | Speed of cutter | Supporting a maximum speed of 600 m/min; supporting cutter inertia autotuning and auto compensation, which improve the accuracy of the high-speed cutting |
| | Cutting accuracy | Max. accuracy: ±0.5 mm |
| | Dual-drive cutting | Supporting dual-motor driving for double cutters |
| | Other function | Supporting the changing of the cutting length and synchronization area angle during the running, the increasing of the speed at the synchronization area, the cutting profile, and pre-alarm for cutting quantity |

| Function | | Specification |
|---|---|---|
| Others | Installation mode | Supporting three installation modes, including the wall-mounting, floor installation, and flange installation modes |
| | Ambient temperature during running | -10–+50°C, derating at temperature higher than 40°C |
| | Ingress Protection (IP) rating | IP20 |
| | Class of pollution | Class 2 |
| | Cooling mode | Forced-air cooling |
| | Brake unit | Built-in brake units are equipped for servo drives of 380 V, 30 kW or lower.<br>External brake units are optional for servo drives of 380 V, 37 kW or higher and 660 V. |
| | EMC filter | All products of the 380 V series can meet the C3 requirements stipulated in IEC61800-3.<br>External filters that meet the C2 requirements stipulated in IEC61800-3 are optional. |

## 2.2 Name plate

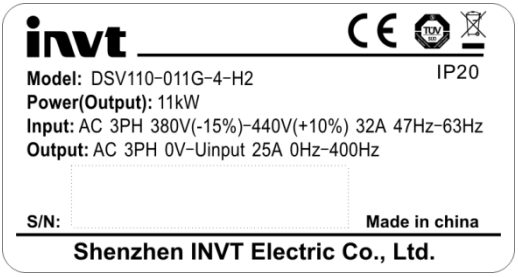



Figure 2-1 Name plate

## 2.3 Model code

The model code contains product information about the servo drive. You can find the model code from the name plate on the servo drive or the simplified name plate.

**DSV110 – 5R5G – 4 – H2**
① ② ③ ④

Figure 2-2 Model description

| Field | Identifier | Field description | Detailed description |
|---|---|---|---|
| Product series abbreviation | ① | Product series abbreviation | DSV110: Servo drive for flying shears |
| Rated power | ② | Power range+load type | 5R5: 5.5 kW<br>G: Heavy load |
| Voltage class | ③ | Voltage class | 4: AC 3PH 380 V (-15%)–440 V (+10%)<br>Rated voltage: 380 V |
| Management No. | ④ | Market management No. | H2: Supporting 5 V high-speed differential signal input of an incremental encode, orthogonal pulse input, and magnetic pole detection UVW signal input<br>S1: Supporting sin/cos encoders (1Vpp) such as Heidenhain ERN 1387, and orthogonal pulse input |

## 2.4 Rated specifications

| Product model | Output power (kW) | Input current (A) | Output current (A) | Carrier frequency (kHz) |
|---|---|---|---|---|
| DSV110-004G-4-H2/S1 | 4 | 13.5 | 9.5 | 1–15(8) |
| DSV110-5R5G-4-H2/S1 | 5.5 | 19.5 | 14 | 1–15(8) |
| DSV110-7R5G-4-H2/S1 | 7.5 | 25 | 18.5 | 1–15(8) |
| DSV110-011G-4-H2/S1 | 11 | 32 | 25 | 1–15(8) |
| DSV110-015G-4-H2/S1 | 15 | 40 | 32 | 1–15(4) |
| DSV110-018G-4-H2/S1 | 18.5 | 47 | 38 | 1–15(4) |
| DSV110-022G-4-H2/S1 | 22 | 56 | 45 | 1–15(4) |
| DSV110-030G-4-H2/S1 | 30 | 70 | 60 | 1–15(4) |
| DSV110-037G-4-H2/S1 | 37 | 80 | 75 | 1–15(4) |
| DSV110-045G-4-H2/S1 | 45 | 94 | 92 | 1–15(4) |
| DSV110-055G-4-H2/S1 | 55 | 128 | 115 | 1–15(4) |
| DSV110-075G-4-H2/S1 | 75 | 160 | 150 | 1–15(2) |
| DSV110-090G-4-H2/S1 | 90 | 190 | 180 | 1–15(2) |
| DSV110-110G-4-H2/S1 | 110 | 225 | 215 | 1–15(2) |
| DSV110-132G-4-H2/S1 | 132 | 265 | 260 | 1–15(2) |
| DSV110-160G-4-H2/S1 | 160 | 310 | 305 | 1–15(2) |
| DSV110-185G-4-H2/S1 | 185 | 345 | 340 | 1–15(2) |
| DSV110-200G-4-H2/S1 | 200 | 385 | 380 | 1–15(2) |
| DSV110-220G-4-H2/S1 | 220 | 430 | 425 | 1–15(2) |
| DSV110-250G-4-H2/S1 | 250 | 460 | 480 | 1–15(2) |
| DSV110-280G-4-H2/S1 | 280 | 500 | 530 | 1–15(2) |
| DSV110-315G-4-H2/S1 | 315 | 580 | 600 | 1–15(2) |

**Note:**

1. The input currents of the servo drives of 4 to 315 kW are measured at the input voltage of 380 V, without DC reactors or input/output reactors.
2. The rated output current is defined as the output current measured at the output voltage of 380 V.

# Chapter 3 Installation guide

## 3.1 Standard wiring of the main circuit

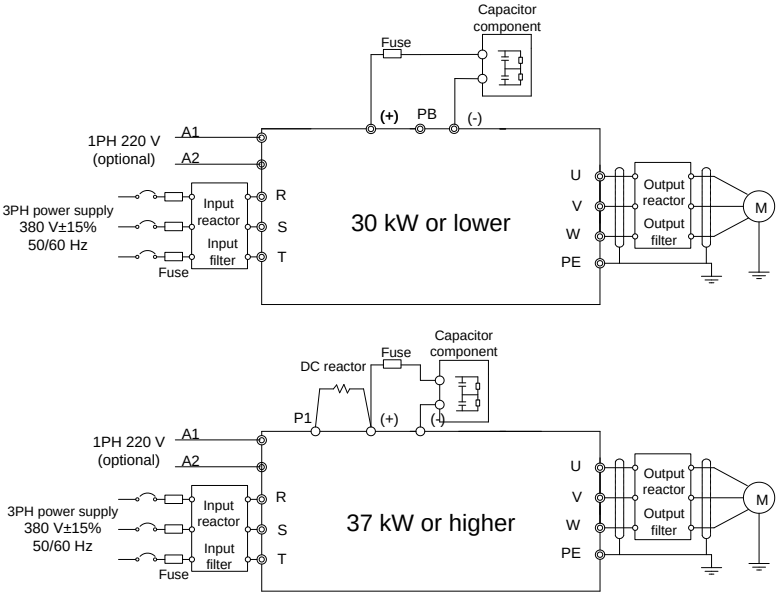



Figure 3-1 Standard wiring of the main circuit

**Note:**

1. The fuse, DC reactor, brake unit, brake resistor, input reactor, input filter, output reactor, and output filter are all optional accessories.
2. A1 and A2 are optional accessories.
3. For servo drives of 380 V, 37 kW or higher, the P1 and (+) terminals are shorted in factory. If you need to connect an external DC reactor, remove the short-circuit connector between the P1 and (+) terminals.
4. Before connecting a brake resistor, remove the yellow warning labels PB, (+), and (-) from the terminal block. Otherwise, poor contact may be caused.
5. You can also select optional capacitor components for servo drives of 380 V, 30 kW or lower.

## 3.2 Standard wiring of the control circuit

### 3.2.1 Wiring diagram of the control circuit

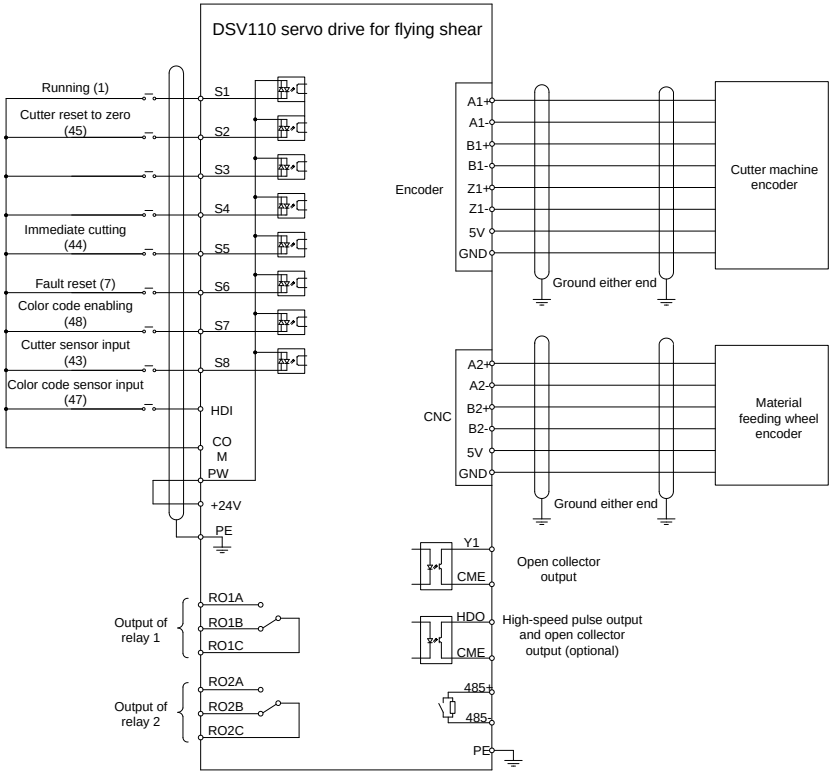


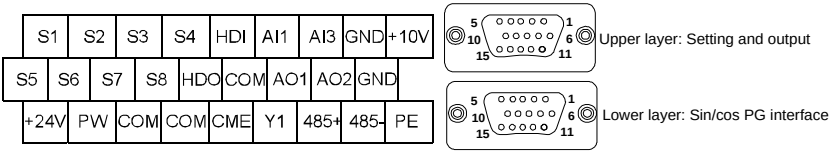

Figure 3-2 Wiring diagram of the control circuit

| Terminal name | Description |
|---|---|
| +10V | Used by the servo drive to provide power of +10 V |
| AI1<br>AI2<br>AI3 | 1. Input range:<br>For AI1 and AI2, the voltage and current ranges are 0 V to 10 V and 0 mA to 20 mA, respectively. AI1 is switched between voltage and current outputs through J3, and AI2 through J4.<br>For AI3, the voltage range is -10 V to +10 V.<br>2. Input impedance: 20 kΩ for voltage input, and 500 Ω for current input<br>3. Resolution: The minimum resolution is 5 mV when 10 V corresponds to 50 Hz.<br>4. Deviation: ±1% at the temperature of 25°C |
| GND | Zero potential reference of +10 V |

<table>
<tr><th>Terminal name</th><th colspan="3">Description</th></tr>
<tr><td>AO1</td><td colspan="3" rowspan="2">1. Output range: Output voltage of 0–10 V or output current of 0–20 mA; voltage and current outputs are switched through jumpers; AO1 is switched through J1, and AO2 is switched through J2.<br>2. Deviation: ±1% at the temperature of 25°C</td></tr>
<tr><td>AO2</td></tr>
<tr><td>RO1A</td><td colspan="3" rowspan="3">RO1 is relay output. RO1A is normally open (NO), RO1B is normally closed (NC), and RO1C is a common terminal.<br>Contact capacity: 3 A/AC 250 V, 1 A/ DC 30 V</td></tr>
<tr><td>RO1B</td></tr>
<tr><td>RO1C</td></tr>
<tr><td>RO2A</td><td colspan="3" rowspan="3">RO2 is relay output. RO2A is NO, RO2B is NC, and RO2C is a common terminal.<br>Contact capacity: 3 A/ AC 250 V, 1 A/ DC 30 V</td></tr>
<tr><td>RO2B</td></tr>
<tr><td>RO2C</td></tr>
<tr><td>HDO</td><td colspan="3">1. Switch capacity: 200 mA/30 V<br>2. Output frequency range: 0–50 kHz</td></tr>
<tr><td>COM</td><td colspan="3">Common terminal of +24 V</td></tr>
<tr><td>CME</td><td colspan="3">Common terminal of the open collector output</td></tr>
<tr><td>Y</td><td colspan="3">1. Switch capacity: 200 mA/30 V<br>2. Ouput frequency range: 0–1 kHz</td></tr>
<tr><td>485+</td><td colspan="3" rowspan="2">485 communication port and 485 differential signal port<br>For standard 485 communication ports, use twisted pairs or shielded cables.</td></tr>
<tr><td>485-</td></tr>
<tr><td>PE</td><td colspan="3">Ground terminal</td></tr>
<tr><td>PW</td><td colspan="3">Used by an external source to provide the working power of digital input<br>Voltage range: 12–24 V</td></tr>
<tr><td>24V</td><td colspan="3">Used by the servo drive to provide power for users<br>Max. output current: 200 mA</td></tr>
<tr><td>COM</td><td colspan="3">Common terminal of +24 V</td></tr>
<tr><td>S1</td><td>Digital input 1</td><td rowspan="8">1. Internal impedance: 3.3 kΩ<br>2. Allowable voltage input: 12–30 V<br>3. Bidirectional input terminal, supporting both the NPN and PNP connection modes<br>4. Max. input frequency: 1 kHz<br>5. All these terminals are programmable digital input terminals, and you can set the function of each terminal through corresponding function codes.</td></tr>
<tr><td>S2</td><td>Digital input 2</td></tr>
<tr><td>S3</td><td>Digital input 3</td></tr>
<tr><td>S4</td><td>Digital input 4</td></tr>
<tr><td>S5</td><td>Digital input 5</td></tr>
<tr><td>S6</td><td>Digital input 6</td></tr>
<tr><td>S7</td><td>Digital input 7</td></tr>
<tr><td>S8</td><td>Digital input 8</td></tr>
<tr><td>HDI</td><td colspan="3">Except the functions of S1 to S8, this terminal can also function as a high-frequency pulse input channel.<br>Max. input frequency: 50 kHz</td></tr>
</table>

### 3.2.2 Description of S1-type terminals (EC-PG302-05)

1. S1 terminal block arrangement




2. Definition of S1 terminal DB15 pins

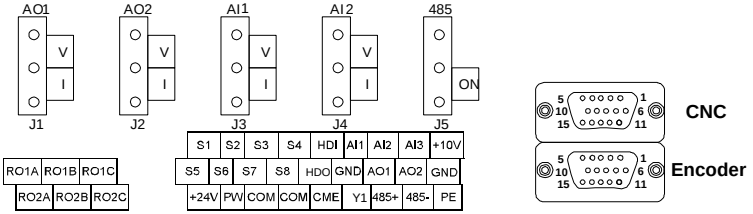
| DB15 (upper layer) | Pulse setting and output interface signal | DB15 (lower layer) | Sin/cos PG interface signal |
|---|---|---|---|
| 1 | AO+ | 1 | B- |
| 2 | AO- | 2 | Null |
| 3 | BO+ | 3 | R+ |
| 4 | BO- | 4 | R- |
| 5 | ZO+ | 5 | A+ |
| 6 | ZO- | 6 | A- |
| 7 | / | 7 | 0V |
| 8 | 0V | 8 | B+ |
| 9 | / | 9 | 5V |
| 10 | +5V | 10 | C- |
| 11 | A2+ | 11 | C+ |
| 12 | A2- | 12 | D+ |
| 13 | B2+ | 13 | D- |
| 14 | B2- | 14 | Null |
| 15 | / | 15 | Null |

3. Description of functions of S1 terminal DB15 pins

| Upper-layer terminal name (pulse setting interface) | Description |
|---|---|
| A2+, A2-, B2+, B2- | 5 V differential orthogonal pulse setting signal, supporting a maximum of 400 kHz |
| AO+, AO-, BO+, BO-, ZO+, ZO- | Frequency-divided output of encoder pulse signals at the division ratio of 1:1 |
| **Upper-layer terminal name (sin/cos encoder interface)** | **Description** |
| +5V, 0V | Used to supply power for the encoder<br>Allowed range: 5 V±5%, 200 mA |
| A+, A-, B+, B-, C+, C-, D+, D-, R+, R- | Sin/cos encoder signal input, supporting SINA/SINB/SINC/SIND 0.8–1.2Vpp, SINR 0.2–0.85Vpp, and a maximum of 200 kHz |

### 3.2.3 Description of H2-type terminals

1. H2 terminal block arrangement




2. Definition of H2 terminal DB15 pins

| DB15 (CNC) | Numerical control system interface signal | DB15 (Encoder) | Encoder interface signal |
|---|---|---|---|
| 1 | AO+ | 1 | +5V |
| 2 | AO- | 2 | A1+ |
| 3 | BO+ | 3 | B1+ |
| 4 | BO- | 4 | Z1+ |
| 5 | ZO+ | 5 | U+ |
| 6 | ZO- | 6 | U- |
| 7 | CME | 7 | V+ |
| 8 | GND | 8 | V- |
| 9 | S7 | 9 | GND |
| 10 | +5V | 10 | A1- |
| 11 | A2+ | 11 | B1- |
| 12 | A2- | 12 | Z1- |
| 13 | B2+ | 13 | W+ |
| 14 | B2- | 14 | W- |
| 15 | COM | 15 | |

3. Description of functions of H2 terminal DB15 pins

| Terminal name (CNC) | Description |
|---|---|
| A2+, A2-, B2+, B2- | 5 V differential orthogonal pulse setting signal, supporting a maximum of 400 kHz |
| AO+, AO-, BO+, BO-, ZO+, ZO- | Frequency-divided output of encoder pulse signals at the division ratio of 1:1 |
| CME, COM | Alarm output (to use this function, you need to short the Y terminal to +24V and remove the short-circuit connector between CME and COM) |
| S7 | Common digital input |
| **Terminal name (encoder)** | **Description** |
| +5V, GND | Used to supply power for the encoder |

| | |
|---|---|
| | Allowed range: 5 V±5%, 200 mA |
| A1+, A1-, B1+, B1-, Z1+, Z1- | Differential input signals of encoders, supporting a maximum of 400 kHz |
| U+, U-, V+, V-, W+, W- | Differential angle signal input of UVW-type encoders (incremental encoders do not have to be connected to them) |

### 3.2.4 Input/output signal connection diagrams

Use U-shaped short-circuit connectors to set the NPN or PNP mode and internal or external power supply. The NPN mode and internal power supply are set in factory.

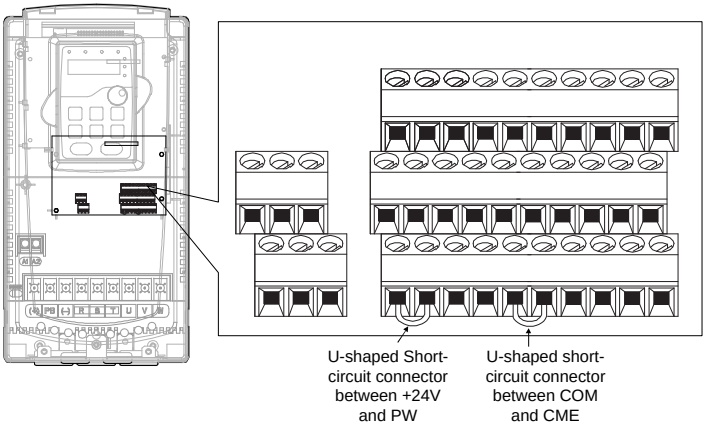



Figure 3-3 Positions of U-shaped short-circuit connectors

If input signals are transmitted by an NPN transistor, set the U-shaped short-circuit connector between +24V and PW as follows according to the power supply used.

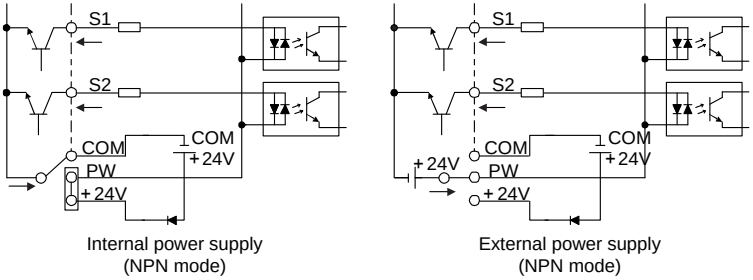



Figure 3-4 NPN modes

If input signals are transmitted by a PNP transistor, set the U-shaped short-circuit connector as follows according to the power supply used.

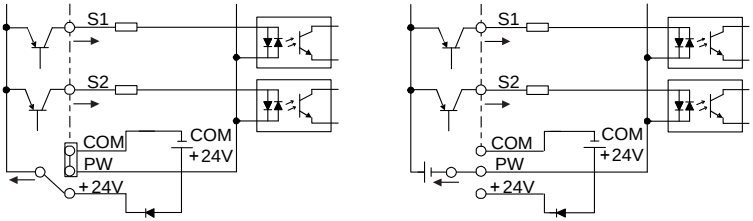



Figure 3-5 PNP modes

# Chapter 4 Keypad operation

## 4.1 Keypad introduction

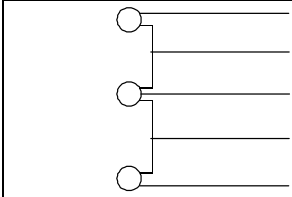
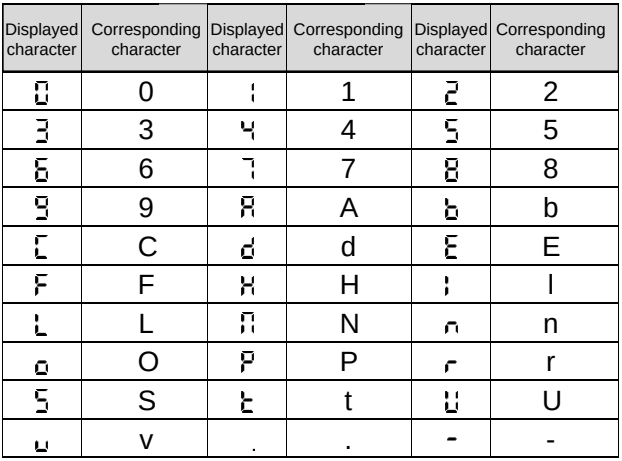
The keypad is used to control the DSV110 flying shear-dedicated servo drive, read the state data, and modify parameters.


Figure 4-1 Keypad diagram

**Note:**

1. The standard configuration is LED keypad, but you can choose an optional LCD keypad. The LED keypad supports the display in multiple languages, provides the parameter copying function, and supports 10-line high-definition display. The installation dimensions of the LCD keypad are the same as that of the LED keypad.
2. When installing a keypad externally, you can directly use M3 thread screws to fix it or use a keypad mounting bracket. Standard keypad mounting brackets are provided for servo drives of 380 V, 37 to 500 kW and 660 V. For those of 380 V, 1.5 to 30 kW, keypad mounting brackets are optional, and you need to purchase them if required.

| SN | Name | Description | |
|---|---|---|---|
| 1 | State indicator | RUN/TUNE | If the indicator is off, the servo drive is in the stop state; if the indicator blinks, parameter autotuning is being performed; and if the indicator is on, the servo drive is in the running state. |
| | | FWD/REV | Forward/reverse running indicator<br>If the indicator is off, the servo drive is in the forward running state; and if the indicator is on, the servo drive is in the reverse running state. |
| | | LOCAL/REMOT | Keypad-, terminal-, and remote |

<table>
<tr><th>SN</th><th>Name</th><th colspan="3">Description</th></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td></td><td colspan="2">communication-based control indicator<br>If the indicator is off, the control is based on keypad; if the indicator blinks, the control is based on terminals; and if the indicator is on, the control is based on remote communication.</td></tr>
<tr><td>TRIP</td><td colspan="2">Fault indicator<br>If the indicator is on, the servo drive is in the faulty state; if the indicator is off, the servo drive runs properly; and if the indicator blinks, the servo drive is in the pre-alarm state.</td></tr>
<tr><td>2</td><td>Unit indicator</td><td colspan="3">Indicates the unit displayed on the keypad.<br>  <br>Hz — Frequency unit<br>RPM — Rotating speed unit<br>A — Current unit<br>% — Percentage<br>V — Voltage unit</td></tr>
<tr><td>3</td><td>Digital display</td><td colspan="3">Five-digit LED display, displaying various monitored data such as the set frequency and output frequency, and alarm codes.<br>  <br>Displayed character / Corresponding character / Displayed character / Corresponding character / Displayed character / Corresponding character<br>0 / 0 / 1 / 1 / 2 / 2<br>3 / 3 / 4 / 4 / 5 / 5<br>6 / 6 / 7 / 7 / 8 / 8<br>9 / 9 / A / A / b / b<br>C / C / d / d / E / E<br>F / F / H / H / I / I<br>L / L / N / N / n / n<br>O / O / P / P / r / r<br>S / S / t / t / U / U<br>v / v / . / . / - / -</td></tr>
<tr><td>4</td><td>Digital</td><td colspan="3">Used to adjust the frequency. For details, see the description of the function</td></tr>
</table>

| SN | Name | Description | | |
|---|---|---|---|---|
| | potentiometer | code P08.42. | | |
| 5 | Buttons |  | Programming key | Enter or exit from the Level-1 menus; or delete a parameter. |
| | |  | Enter key | Enter menus in cascading mode; or confirm the setting of a parameter. |
| | |  | UP key | Increase data or the function code progressively. |
| | |  | DOWN key | Decrease data or the function code progressively. |
| | |  | Right-shifting key | On the interface displayed when the machine is stopped or running, press this key to select, from left to right, the parameter to be displayed; or press this key to select the digit of a parameter during parameter modification. |
| | |  | Run key | In the keypad-based operation mode, press this key to run the machine. |
| | |  | Stop/Reset key | In running state, press this key to stop the machine. This function is restricted by P07.04. In the fault alarm state, this key can be used to reset the machine in all control modes. |
| | |  | Functional shortcut key | The function of this key is determined by P07.02. |

## 4.2 Keypad display

The keypad of the DSV110 flying shear-dedicated servo drive may display the stop state parameters, running state parameters, function code parameter editing states, and fault alarm states.

### 4.2.1 Parameters displayed in the stop state

When the servo drive is in the stop state, the keypad displays a parameter, as shown in Figure 4-2.

Multiple state parameters can be displayed in the stop state. You can set a parameter to be displayed by setting the binary bits of P07.07. For definitions of the bits, see the description of P07.07.

Parameters that can be selected to be displayed in the stop state include the set frequency, bus voltage, input terminal state, output terminal state, set torque, AI1, AI2, and AI3. Whether a parameter

is to be displayed is set through the bits (transformed into binary bits) of P07.07.

Press >>/SHIFT to shift the display of the selected parameters from left to right, and press QUICK/JOG (P07.02=2) to shift from right to left.

#### 4.2.2 Parameters displayed in the running state

After receiving a valid running command, the servo drive enters the running state, and a parameter is displayed on the keypad. The RUN/TUNE indicator is on, and the on/off state of the FWD/REV indicator is determined by the running direction of the servo drive, as shown in Figure 4-2.

Parameters that can be selected to be displayed in the running state include the running frequency, set frequency, bus voltage, output voltage, output current, running speed, output power, output torque, input terminal state, output terminal state, set torque, AI1, AI2, AI3, high-speed pulse HDI frequency, motor overload percentage, servo drive overload percentage, and ramp frequency reference. Whether a parameter is to be displayed is set through the bits (transformed into binary bits) of P07.05 and P07.06.

Press >>/SHIFT to shift the display of the selected parameters from left to right, and press QUICK/JOG (P07.02=2) to shift from right to left.

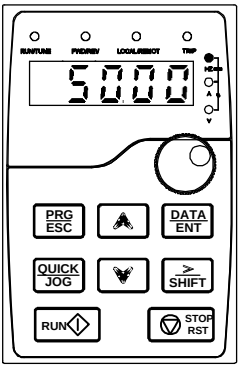
#### 4.2.3 Information displayed in the faulty state

After detecting a fault signal, the servo drive enters the fault alarm state immediately, and the fault code blinks on the keypad. The TRIP indicator is on, and you can perform fault reset by using the STOP/RST key, control terminals, or communication commands.

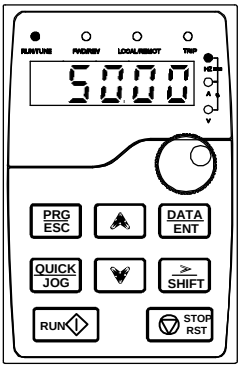
If the fault still persists, the fault code is continuously displayed.

#### 4.2.4 Function code editing

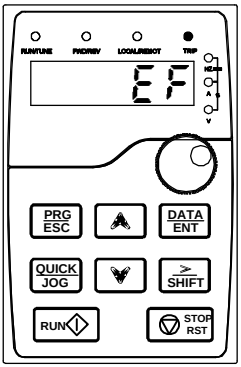
You can press the PRG/ESC key to enter the editing state in the stop, running, or fault alarm state (if a user password is used, see the description of P07.00). Editing states are displayed through two levels of menus in the following sequence: function code group or function code number → function code parameter. Press the DATA/ENT key to enter the function parameter display interface. On the function parameter display interface, press the DATA/ENT key to save the parameter settings, and the PRG/ESC key to exit from the parameter display interface.




Parameters displayed in the stop state




Parameters displayed in the running state




Information displayed in the faulty state

Figure 4-2 Keypad display

## 4.3 Keypad operation

You can perform various operations on the servo drive by using a keypad. For details about the structure of the function codes, see the function code table.

### 4.3.1 Function code modification

The servo drive provides three levels of menus, including:

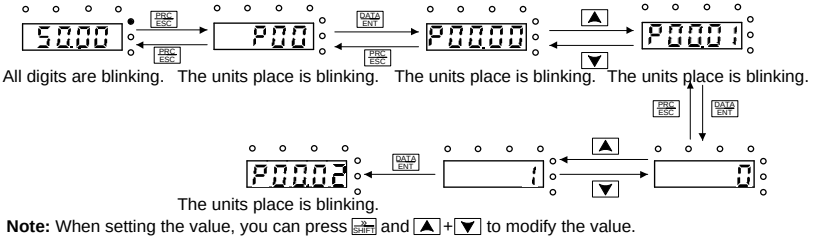
- Function code group number (Level-1 menu)
- Function code number (Level-2 menu)
- Function code set value (Level-3 menu)

**Description:** When performing operations on the Level-3 menus, you can press the PRG/ESC or DATA/ENT key to return to the Level-2 menu. If you press the DATA/ENT key, the set value of the parameter is saved to the control board before you return to the Level-2 menu, and then the next function code is displayed. If you press the PRG/ESC key, you return to the Level-2 menu directly, the set value of the parameter is not saved, and the current function code is displayed.

On Level-3 menus, if no digit of the parameter blinks, it indicates that the function code cannot be modified due to the following possible reasons:

1. The function code is an unmodifiable parameter, for example, a detected parameter or running recording parameter.
2. The function code cannot be modified in the running state, and can be modified after the machine is stopped.

Example: Change the value of P00.00 from **0** to **1**.




**Note:** When setting the value, you can press SHIFT and ▲+▼ to modify the value.

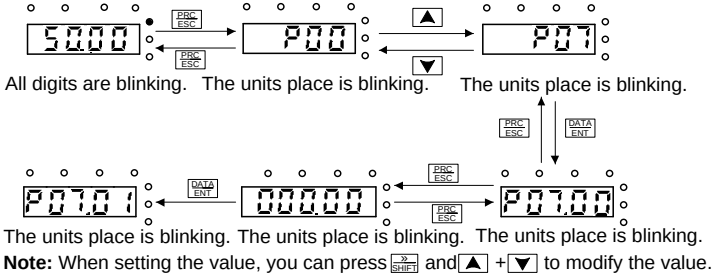
Figure 4-3 Parameter modification diagram

### 4.3.2 Servo drive password setting

DSV110 flying shear-dedicated servo drives provide the user password protection function. When P07.00 is set to a non-zero value, the value is the user password. The password protection is immediately enabled after you exit from the function code editing interface, and "0.0.0.0.0" is displayed when you press the PRG/ESC key again to enter the function code editing interface. You need to enter the correct user password before entering the interface.

To disable the password protection function, you need only to set P07.00 to 0.

The password protection takes effect one minute after you exit from the function code editing interface. After the password protection function takes effect, "0.0.0.0.0" is displayed when you press the PRG/ESC key to enter the function code editing interface. You need to enter the correct user password to enter the interface.

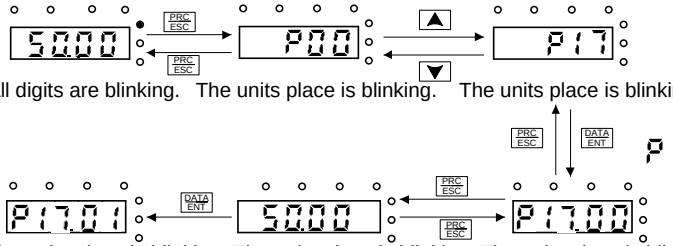



**Note:** When setting the value, you can press SHIFT and ▲ +▼ to modify the value.

Figure 4-4 Password setting diagram

### 4.3.3 Servo drive state viewing

DSV110 flying shear-dedicated servo drives provide the function code group P17 for state viewing. You can enter P17 to view the state of the servo drive.




**Note:** When setting the value, you can press SHIFT and ▲ + ▼ to modify the value.

Figure 4-5 Parameter viewing diagram

# Chapter 5 Function parameters

The function parameters of DSV110 flying shear-dedicated servo drives are divided by function into 30 groups, P00 to P29. Each function group includes several function codes. Three levels of menus are applied for function codes. For example, "P08.08" indicates the 8th function code in the P08 group. The P29 group indicates factory functions, and you have no access to it.

To facilitate the settings of function codes, the function group numbers correspond to the Level-1 menus, the function codes correspond to the Level-2 menus, and the function code parameters correspond to the Level-3 menus.

1. The content of the function table is as follows:

   Column 1 "Function code ": Code of the function group and parameter

   Column 2 "Name": Full name of the function parameter

   Column 3 "Detailed description": Detailed description of the function parameter

   Column 4 "Default value": Initial value set in factory

   Column 5 "Modify": Whether the function parameter can be modified, and conditions for the modification

   "○" indicates that the value of the parameter can be modified when the servo drive is in the stop or running state.

   "◎" indicates that the value of the parameter cannot be modified when the servo drive is in the running state.

   "●" indicates that the value of the parameter is detected and recorded, and cannot be modified.

   (The servo drive automatically checks and constrains the modification of parameters, which helps prevent incorrect modifications.)

2. The parameters adopt the decimal system (DEC). If the hexadecimal system is adopted, the data in each digit is independent from each other during parameter editing. The values of some of the digits can be hexadecimal (0–F).

3. "Default value" indicates the factory setting of the function parameter. If the value of the parameter is detected or recorded, the value cannot be restored to the factory setting.

4. To better protect the parameters, the servo drive provides the password protection function. After a password is set (that is, P07.00 is set to a non-zero value), "0.0.0.0.0" is displayed when you press the PRG/ESC key to enter the function code editing interface. You need to enter the correct user password to enter the interface. For the factory parameters, you need to enter the correct factory password to enter the interface. (You are advised not to modify the factory parameters. Incorrect parameter setting may cause operation exceptions or even damage to the servo drive.). When the system is not locked due to password protection, you can modify the password, and the last value entered is the user password. If P07.00 is set to 0, the user

password is canceled. If P07.00 is set to a non-zero value, the parameters are protected by the user password during servo drive power-on.

5. When you modify function parameters through serial communication, the user password provides the same functions.

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| **P00 group** | **Basic functions** | | | |
| P00.00 | Speed control mode | 0–1: Reserved<br>2: Space voltage vector control mode<br>3: Closed-loop vector control mode | 3 | ◎ |
| P00.01 | Channel of running commands | Used to select the channel of control commands of the servo drive.<br>The control commands of the servo drive include start, stop, forward running, reverse running, jogging, and fault reset.<br>0: Keypad ("LOCAL/REMOT" off)<br>The running commands are controlled through the RUN and STOP/RST keys on the keypad. In the running state, if you press the RUN and STOP/RST keys at the same time, the servo drive coasts to stop.<br>1: Terminals ("LOCAL/REMOT" blinks)<br>The running commands are controlled through the forward running, reverse running, forward jogging, reverse jogging functions of the multi-function input terminals.<br>2: Communication ("LOCAL/REMOT" on)<br>The running commands are controlled by the upper computer in the communication mode. | 0 | ○ |
| P00.03 | Max. output frequency | Used to set the maximum output frequency of the servo drive. Pay attention to this parameter. It determines the setting of the frequency and the speed of acceleration and deceleration.<br>Setting range: P00.04–400.00 Hz | 50.00 Hz | ◎ |
| P00.04 | Upper limit of running frequency | Indicates the output frequency upper limit of the servo drive. The value cannot be greater than the value of P00.03 (Max. output frequency).<br>When the set frequency is higher than this upper limit, the servo drive runs at this frequency upper limit. | 50.00 Hz | ◎ |

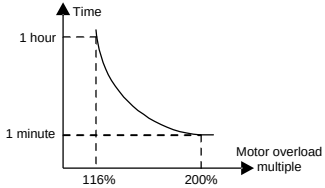
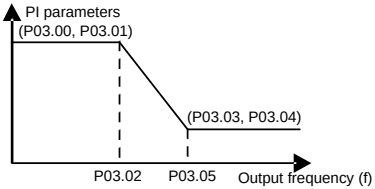
| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | Setting range: P00.05–P00.03 (Max. output frequency) | | |
| P00.06 | Frequency A setting mode | 0: Keypad<br>After this parameter is set to 0, you can set the frequency by modifying the value of P00.10 (Frequency set through keypad).<br>1: Analog input AI1<br>2: Analog input AI2<br>3: Analog input AI3<br>4: High-speed pulse HDI<br>5–11: Reserved<br>12: Pulse strings A and B | 0 | ○ |
| P00.10 | Frequency set through keypad | If Frequency A setting mode is set to 0 (Keypad), the value of this parameter is the initial digital setting of the frequency of the servo drive.<br>Setting range: 0.00 Hz–P00.03 (Max. output frequency) | 10.00 Hz | ○ |
| P00.11 | ACC time 1 | Indicates the time the servo drive takes to accelerate from 0 Hz to P00.03 (Max. output frequency).<br>Setting range: 0.0–3600.0s | Depend on model | ○ |
| P00.12 | DEC time 1 | Indicates the time the servo drive takes to decelerate from P00.03 (Max. output frequency) to 0 Hz.<br>Setting range: 0.0–3600.0s | Depend on model | ○ |
| P00.13 | Running direction | 0: Run in the default direction; the servo drive runs forward, and the FWD/REV indicator is off.<br>1: Run in the reverse direction; the servo drive runs reversely, and the FWD/REV indicator is on.<br>You can change the rotating direction of the motor by modifying this parameter. The modification equals adjusting any two lines of the motor lines (U, V, W) to change the rotating direction of the motor. You can also change the rotating direction of the motor through the QUICK/JOG key on the keypad. For details, see the description of P07.02.<br>**Note:**<br>After the function parameters are restored to the default values, the running direction of the motor is restored to the default value. Exercise caution | 2 | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | in scenarios where commissioning has been performed on the system and the rotating direction of the motor cannot be changed.<br>2: No reverse running; the servo drive cannot run in the reverse direction. This value is applicable to some special scenarios where reverse running is forbidden. | | |
| P00.14 | Carrier frequency | The carrier frequency of the servo drive is set properly in factory. Generally, you do not need to modify this parameter. If the carrier frequency you set exceeds the default value, the servo drive needs to be derated by 10% for each increased 1 kHz.<br>Setting range: 1.2–15.0 kHz | Depend on model | ○ |
| P00.15 | Motor parameter autotuning | 0: No operation<br>1: Reserved<br>2: Static autotuning (comprehensive autotuning); applicable to scenarios where the motor cannot be disconnected from the load. | 0 | ◎ |
| P00.18 | Function parameter restoration | 0: No operation<br>1: Restore to the default values<br>2: Delete fault files<br>**Note:**<br>After a selected operation is performed, this parameter is automatically restored to 0. Restoring to the default values may delete the user password. Exercise caution when using this function. | 0 | ◎ |
| **P01 group Start and stop control** | | | | |
| P01.08 | Stop mode | 0: Decelerate to stop. After receiving a valid stop command, the servo drive stops in deceleration mode. It reduces the output frequency to 0 Hz in the defined DEC time and stops.<br>1: Coast to stop. After receiving a valid stop command, the servo drive stops the output immediately, and the load coasts to stop based on the mechanical inertia. | 0 | ○ |
| P01.25 | Emergency stop DEC time | Indicates the deceleration time in emergency stop (the terminal function is set to 56)<br>Setting range: 0.0–60.0s | 2.0s | ○ |

| Function code | Name | Detailed description | | Default value | Modify |
|---|---|---|---|---|---|
| **P02 group** | **Parameters of motor 1** | | | | |
| P02.00 | Type of motor 1 | 0: Asynchronous motor<br>1: Synchronous motor | | 0 | ◎ |
| P02.01 | Rated power of asynchronous motor 1 | 0.1–3000.0 kW | Parameters of the controlled asynchronous motor.<br>To ensure the control performance, set P02.01–P02.05 correctly according to the information on the name plate of the asynchronous motor.<br>The DSV110 flying shear-dedicated servo drive provides the parameter autotuning function. Whether parameter autotuning can be performed properly depends on the settings of the motor name plate parameters.<br>In addition, you need to configure a motor based on the standard motor configuration of the servo drive. If the power of the motor is greatly different from that of the standard motor configuration, the control performance of the servo drive degrades significantly.<br>**Note:**<br>Resetting the rated power of the motor (P02.01) can initialize the parameters of P02.02 to P02.10. | Depend on model | ◎ |
| P02.02 | Rated frequency of asynchronous motor 1 | 0.01 Hz–P00.03 (Max. output frequency) | | 50.00Hz | ◎ |
| P02.03 | Rated rotating speed of asynchronous motor 1 | 1–36000rpm | | Depend on model | ◎ |
| P02.04 | Rated voltage of asynchronous motor 1 | 0–1200V | | Depend on model | ◎ |
| P02.05 | Rated current of asynchronous motor 1 | 0.8–6000.0A | | Depend on model | ◎ |
| P02.06 | Stator resistance of asynchronous motor 1 | 0.001–65.535Ω | After motor parameter autotuning is properly performed, the values of P02.06 to P02.10 are automatically updated. These parameters are the reference parameters for high-performance vector control, directly affecting the control performance of the servo drive.<br>**Note:**<br>Do not modify these parameters | Depend on model | ○ |
| P02.07 | Rotor resistance of asynchronous motor 1 | 0.001–65.535Ω | | Depend on model | ○ |
| P02.08 | Leakage inductance of asynchronous motor 1 | 0.1–6553.5mH | | Depend on model | ○ |

| Function code | Name | Detailed description | | Default value | Modify |
|---|---|---|---|---|---|
| P02.09 | Mutual inductance of asynchronous motor 1 | 0.1–6553.5mH | unless it is necessary. | Depend on model | ○ |
| P02.10 | Current of asynchronous motor 1 without load | 0.1–6553.5A | | Depend on model | ○ |
| P02.15 | Rated power of synchronous motor 1 | 0.1–3000.0kW | Parameters of the controlled synchronous motor.<br>To ensure the control performance, set P02.15–P02.19 correctly according to the information on the name plate of the synchronous motor.<br>The DSV110 flying shear-dedicated servo drive provides the parameter autotuning function. Whether parameter autotuning can be performed properly depends on the settings of the motor name plate parameters.<br>In addition, you need to configure a motor based on the standard motor configuration of the servo drive. If the power of the motor is greatly different from that of the standard motor configuration, the control performance of the servo drive degrades significantly.<br>**Note:**<br>Resetting the rated power of the motor (P02.15) can initialize the parameters of P02.16 to P02.19. | Depend on model | ◎ |
| P02.16 | Rated frequency of synchronous motor 1 | 0.01Hz–P00.03 (Max. output frequency) | | 50.00Hz | ◎ |
| P02.17 | Number of pole pairs of synchronous motor 1 | 1–128 | | 2 | ◎ |
| P02.18 | Rated voltage of synchronous motor 1 | 0–1200V | | Depend on model | ◎ |
| P02.19 | Rated current of synchronous motor 1 | 0.8–6000.0A | | Depend on model | ◎ |
| P02.20 | Stator resistance of synchronous motor 1 | 0.001–65.535Ω | After motor parameter autotuning is properly performed, the values of P02.20 to P02.22 are automatically updated. These parameters are the reference parameters for high-performance vector control, | Depend on model | ○ |
| P02.21 | D-axis inductance of synchronous | 0.01–655.35mH | | Depend on model | ○ |

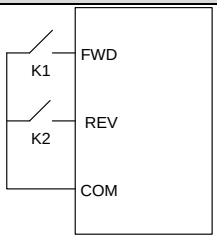
| Function code | Name | Detailed description | | Default value | Modify |
|---|---|---|---|---|---|
| | motor 1 | | directly affecting the control | | |
| P02.22 | Q-axis inductance of synchronous motor 1 | 0.01–655.35mH | performance of the servo drive.<br>When P00.15 is set 1 (rotating autotuning), the value of P02.23 can be automatically updated through autotuning. In this case, you do not need to modify it.<br>When P00.15 is set 2 (static autotuning), the value of P02.23 cannot be automatically updated through autotuning. In this case, you need to calculate its value and manually modify it. | Depend on model | ○ |
| P02.26 | Overload protection of motor 1 | 0: No protection<br>1: Common motor (equipped with low-speed compensation)<br>The heat dissipation performance of a common motor degrades when it runs at a low speed, and so the corresponding electronic thermal protection values need to be adjusted. The low-speed compensation described here is to reduce the overload protection threshold of the motor when it runs at a frequency lower than 30 Hz.<br>2: Variable-frequency motor (without low-speed compensation)<br>The heat dissipation performance of a variable-frequency motor is not affected by the rotating speed, and so the protection threshold does not need to be adjusted when the motor runs at a low frequency. | | 2 | ◎ |
| P02.27 | Overload protection coefficient of motor 1 | Motor overload multiple M = Iout/(In × K)<br>In is the rated current of the motor, Iout is the output current of the servo drive, and K is the motor overload protection coefficient.<br>The smaller K is, the greater M is, and the more likely protection is implemented.<br>When M is 116%, protection is implemented after the motor is overloaded for 1 hour; when M is 200%, | | 100.0% | ○ |

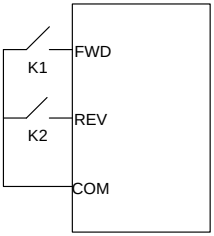
| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | protection is implemented after overload of 60s; and when M is equal to or higher than 400%, protection is implemented immediately.<br>  <br><br>Setting range: 20.0%–120.0% | | |
| **P03 group** | **Vector control** | | | |
| P03.00 | ASR proportional gain 1 | The parameters of P03.00 to P03.05 are applicable only to the vector control mode. When the frequency is lower than P03.02 (Low-point frequency for switching), the ASR PI parameters are P03.00 and P03.01. When the frequency is higher than P03.05 (High-point frequency for switching), the ASR PI parameters are P03.03 and P03.04. When the frequency is between P03.02 and P03.05, the PI parameters are obtained based on the linear change of these two parameters, as shown in the following figure.<br>  <br><br>You can adjust the dynamic response characteristics of the speed loop in vector control by setting the proportional gain and integral time of the automatic speed regulator (ASR). Both increasing the proportional gain and decreasing the integral time can accelerate the dynamic response of the speed loop. However, if the proportional gain is too large or the integral time is too short, oscillation to the system or overadjustment may be caused. If the proportional gain is too small, steady-state oscillation may be | 20.0 | ○ |
| P03.01 | ASR integral time 1 | | 0.200s | ○ |
| P03.02 | Low-point frequency for switching | | 5.00Hz | ○ |
| P03.03 | ASR proportional gain 2 | | 20.0 | ○ |
| P03.04 | ASR integral time 2 | | 0.200s | ○ |
| P03.05 | High-point frequency for switching | | 10.00Hz | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | easily caused to the system, and static speed error may also occur.<br>The ASR PI parameters are closely related to the inertia of the system. The default PI parameters need to be modified based on the characteristics of loads to meet requirements of various scenarios.<br>Setting range of P03.00: 0.0–200.0<br>Setting range of P03.01: 0.000–10.000s<br>Setting range of P03.02: 0.00 Hz–P03.05<br>Setting range of P03.03: 0.0–200.0<br>Setting range of P03.04: 0.000–10.000s<br>Setting range of P03.05: P03.02–P00.03(Max. output frequency) | | |
| P03.06 | ASR output filter | 0–8 (corresponding to 0–$2^8$/10 ms) | 0 | ○ |
| P03.09 | ACR proportional coefficient P | **Note:**<br>These two parameters are the PI regulation parameters of the automatic current regulator (ACR). They directly affect the dynamic responding speed and control accuracy of the system. Generally for asynchronous machines, you do not need to modify their default values; and for synchronous machines, you can modify the default values as required.<br>Setting range: 0–20000 | 1000 | ○ |
| P03.10 | ACR integral coefficient I | | 1000 | ○ |
| P03.11 | Torque setting mode | Used to enable the torque control mode and select the torque setting mode.<br>0: Torque control disabled<br>1: Keypad (P03.12)<br>2: Analog input AI1<br>3: Analog input AI2<br>4: Analog input AI3<br>5: Pulse frequency HDI<br>6–10: Reserved | 0 | ○ |
| P03.12 | Torque set through keypad | Setting range: -300.0%–+300.0% (of the rated current of the motor) | 10.0% | ○ |
| P03.16 | Forward running frequency upper limit set through keypad in torque control | Setting range: 0.00 Hz–P00.03 (Max. output frequency) | 100.00Hz | ○ |

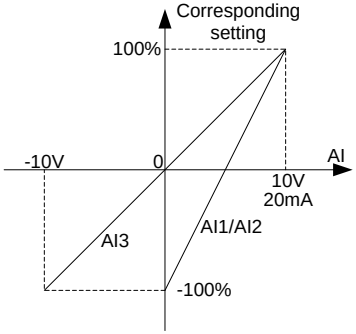
| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P03.17 | Reverse running frequency upper limit set through keypad in torque control | | 100.00 Hz | ○ |
| P03.20 | Electromotion torque upper limit set through keypad | These two parameters are used to set the torque limits.<br>Setting range: 0.0–300.0% (of the rated current of the motor) | 180.0% | ○ |
| P03.21 | Brake torque upper limit set through keypad | | 180.0% | ○ |
| **P05 group** | **Input terminals** | | | |
| P05.01 | S1 terminal function | 0: No function<br>1: Forward running (FWD)<br>4: Forward jogging<br>6: Coast to stop<br>7: Fault reset<br>31: Reset the total cutting amount<br>32: Reset the cutting count value<br>43: Cutting reference point input (only valid for S6 to S8)<br>44: Immediate cutting command input terminal<br>45: Cutter reset to zero<br>46: Re-enable color code (If a color code error occurs in running, you can select a correct color code again. When this function is selected, the first color code must be correct.)<br>47: Color reference point input (valid only for S6 to S8 and HDI)<br>48: Enable the color code function (stop running when switching to this function)<br>49: Enable the rotary cutting function (stop running when switching to this function)<br>50: Paper-fed signal (S3–S7) (If the paper-fed signal is missed, the cutter stops at the 180° position.)<br>55: Cutting length selection (P23.24 is used as the cutting length when this function is valid, and P23.15 is used as the cutting length when this function is | 1 | ◎ |
| P05.02 | S2 terminal function | | 45 | ◎ |
| P05.03 | S3 terminal function | | 31 | ◎ |
| P05.04 | S4 terminal function | | 32 | ◎ |
| P05.05 | S5 terminal function | | 44 | ◎ |
| P05.06 | S6 terminal function | | 7 | ◎ |
| P05.07 | S7 terminal function | | 48 | ◎ |
| P05.08 | S8 terminal function | | 43 | ◎ |
| P05.09 | HDI terminal function | | 47 | ◎ |

<table>
<tr><th>Function code</th><th>Name</th><th>Detailed description</th><th>Default value</th><th>Modify</th></tr>
<tr><td></td><td></td><td>invalid.)<br>56: Emergency stop<br>57: Motor overtemperature fault input</td><td></td><td></td></tr>
<tr><td>P05.10</td><td>Input terminal polarity</td><td>Used to set the input terminal polarity.<br>When the corresponding bit is set to 0, the polarity of the input terminal is positive.<br>When the corresponding bit is set to 1, the polarity of the input terminal is negative.
<table>
<tr><td></td><td>BIT8</td><td>BIT7</td><td>BIT6</td><td>BIT5</td></tr>
<tr><td></td><td>HDI</td><td>S8</td><td>S7</td><td>S6</td></tr>
<tr><td>BIT4</td><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr>
<tr><td>S5</td><td>S4</td><td>S3</td><td>S2</td><td>S1</td></tr>
</table>
Setting range: 0x000–0x1FF</td><td>0x000</td><td>○</td></tr>
<tr><td>P05.11</td><td>Digital filtering time</td><td>Set the sample filtering time of S1 to S8 and HDI. In scenarios where there is strong interference, you need to increase this parameter to prevent misoperation.<br>Setting range: 0.000–1.000s</td><td>0.010s</td><td>○</td></tr>
<tr><td>P05.12</td><td>Virtual terminal setting</td><td>0x000–0x1FF (0: Disabled; 1: Enabled）<br>BIT0: S1 virtual terminal<br>BIT1: S2 virtual terminal<br>BIT2: S3 virtual terminal<br>BIT3: S4 virtual terminal<br>BIT4: S5 virtual terminal<br>BIT5: S6 virtual terminal<br>BIT6: S7 virtual terminal<br>BIT7: S8 virtual terminal<br>BIT8: HDI virtual terminal</td><td>0x000</td><td>◎</td></tr>
<tr><td>P05.13</td><td>Running control mode of terminal</td><td>Used to set the running control mode of a terminal.<br>0: Two-wire control 1<br>The enabling and direction determination functions are integrated. This is the commonest two-wire mode, determining the forward and reverse running of the motor through the defined FWD and REV terminal commands.</td><td>0</td><td>◎</td></tr>
</table>

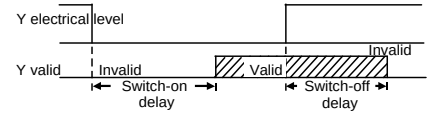
<table>
<tr><th>Function code</th><th>Name</th><th>Detailed description</th><th>Default value</th><th>Modify</th></tr>
<tr><td></td><td></td><td>


<table>
<tr><th>FWD</th><th>REV</th><th>Running command</th></tr>
<tr><td>OFF</td><td>OFF</td><td>Stop</td></tr>
<tr><td>ON</td><td>OFF</td><td>Forward running</td></tr>
<tr><td>OFF</td><td>ON</td><td>Reverse running</td></tr>
<tr><td>ON</td><td>ON</td><td>Holding on</td></tr>
</table>
1: Two-wire control 2<br>
The enabling and direction determination functions are separated. In this mode, FWD is defined as the enabling terminal, and REV is defined as the direction determination terminal.


<table>
<tr><th>FWD</th><th>REV</th><th>Running command</th></tr>
<tr><td>OFF</td><td>OFF</td><td>Stop</td></tr>
<tr><td>ON</td><td>OFF</td><td>Forward running</td></tr>
<tr><td>OFF</td><td>ON</td><td>Stop</td></tr>
<tr><td>ON</td><td>ON</td><td>Reverse running</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>P05. 32</td><td>Lower limit of AI1</td><td rowspan="11">These function codes define the correspondence between the analog input voltage and the settings corresponding to the analog input. If an analog input voltage exceeds the set maximum value or is smaller than the set minimum value, the maximum or minimum value is used for calculation.<br>When the analog input is current input, the current of 0 to 20 mA corresponds to the voltage of 0 to 10 V.<br>The nominal value corresponding to the 100% of the analog setting varies according to application scenarios. For details, see the description of different application scenarios. The following figure shows several application scenarios.</td><td>0.00 V</td><td>○</td></tr>
<tr><td>P05.33</td><td>Setting corresponding to lower limit of AI1</td><td>0.0%</td><td>○</td></tr>
<tr><td>P05.34</td><td>Upper limit of AI1</td><td>10.00 V</td><td>○</td></tr>
<tr><td>P05.35</td><td>Setting corresponding to upper limit of AI1</td><td>100.0%</td><td>○</td></tr>
<tr><td>P05.36</td><td>AI1 filtering time</td><td>0.030s</td><td>○</td></tr>
<tr><td>P05.37</td><td>Lower limit of AI2</td><td>0.00 V</td><td>○</td></tr>
<tr><td>P05.38</td><td>Setting corresponding to lower limit of AI2</td><td>0.0%</td><td>○</td></tr>
<tr><td>P05.39</td><td>Upper limit of AI2</td><td>10.00 V</td><td>○</td></tr>
<tr><td>P05.40</td><td>Setting corresponding to upper limit of AI2</td><td>100.0%</td><td>○</td></tr>
<tr><td>P05.41</td><td>AI2 filtering time</td><td>0.030s</td><td>○</td></tr>
<tr><td>P05.42</td><td>Lower limit of AI3</td><td>-10.00 V</td><td>○</td></tr>
</table>

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P05.43 | Setting corresponding to lower limit of AI3 |  | -100.0% | ○ |
| P05.44 | Zero-drift value of AI3 | | 0.00 V | ○ |
| P05.45 | Zero dead-zone value of AI3 | | 0.02 V | ○ |
| P05.46 | Upper limit of AI3 | | 10.00 V | ○ |
| P05.47 | Setting corresponding to upper limit of AI3 | | 100.0% | ○ |
| P05.48 | AI3 filtering time | Input filtering time: used to adjust the sensitivity of analog input. Increasing this value can enhance the anti-interference capability of the analog input but may also reduce the sensitivity of the analog input.<br>**Note:**<br>AI1 and AI2 can support the input of 0 to 10 V/0 to 20 mA. When AI1 and AI2 are 0 to 20 mA, the voltage corresponding to 20 mA is 10 V. AI3 supports the input of -10 to +10 V.<br>Setting range of P05.32: 0.00V–P05.34<br>Setting range of P05.33: -300.0%–300.0%<br>Setting range of P05.34: P05.32–10.00V<br>Setting range of P05.35: -300.0%–300.0%<br>Setting range of P05.36: 0.000s–10.000s<br>Setting range of P05.37: 0.00V–P05.39<br>Setting range of P05.38: -300.0%–300.0%<br>Setting range of P05.39: P05.37–10.00V<br>Setting range of P05.40: -300.0%–300.0%<br>Setting range of P05.41: 0.000s–10.000s<br>Setting range of P05.42: -10.00V–P05.44<br>Setting range of P05.43: -300.0%–300.0%<br>Setting range of P05.44: P05.42–P05.46<br>Setting range of P05.45: 0.00–10.00V<br>Setting range of P05.46: P05.44–10.00V<br>Setting range of P05.47: -300.0%–300.0%<br>Setting range of P05.48: 0.000s–10.000s | 0.030s | ○ |
| P05.50 | Lower limit of HDI frequency | 0.000 kHz–P05.52 | 10.000 kHz | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P05.51 | Setting corresponding to lower limit of HDI frequency | -300.0%–300.0% | -200.0% | ○ |
| P05.52 | Upper limit of HDI frequency | P05.50–50.000 kHz | 50.000 kHz | ○ |
| P05.53 | Setting corresponding to upper limit of HDI frequency | -300.0%–300.0% | 200.0% | ○ |
| P05.54 | HDI frequency input filtering time | 0.000s–10.000s | 0.000s | ○ |
| **P06 group Output terminals** | | | | |
| P06.00 | HDO output type | Used to set the function of a high-speed pulse output terminal.<br>0: Open collector high-speed pulse output with a maximum pulse frequency of 50.0 kHz. For related functions, see the description of P06.27 to P06.31.<br>1: Open collector output. For the related function, see the description of P06.02. | 0 | ◎ |
| P06.01 | Y output | 0: Invalid<br>1: In running<br>5: Servo drive fault<br>26: DC bus voltage established<br>27: Cutting point output (20 ms)<br>28: Output of alarms generated when the set cutting amount is reached<br>30: Output of alarms generated when color codes are missed<br>32: Cutter reference point detection completed<br>33: Output of alarms generated when the set cutting amount is reached in a batch (refer to the description of P21.24 and P21.25) | 0 | ○ |
| P06.02 | HDO output | | 0 | ○ |
| P06.03 | Relay output RO1 | | 0 | ○ |
| P06.04 | Relay output RO2 | | 0 | ○ |
| P06.05 | Polarity of output terminal | Used to set the polarities of output terminals.<br>When the corresponding bit is set to 0, the polarity of the output terminal is positive.<br>When the corresponding bit is set to 1, the polarity of | 0x0 | ○ |

<table>
<tr><th>Function code</th><th>Name</th><th>Detailed description</th><th>Default value</th><th>Modify</th></tr>
<tr><td></td><td></td><td>the output terminal is negative.<br><table><tr><td>BIT3</td><td>BIT2</td><td>BIT1</td><td>BIT0</td></tr><tr><td>RO2</td><td>RO1</td><td>HDO</td><td>Y</td></tr></table>Setting range: 0x0–0xF</td><td></td><td></td></tr>
<tr><td>P06.06</td><td>Y switch-on delay time</td><td rowspan="8">Used to define the delay time of electrical level change when a programmable output terminal is switched on or off.<br>  <br>Setting range: 0.000–50.000s<br>Note:<br>P06.08 and P06.09 are valid only when P06.00 is set to 1.</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.07</td><td>Y switch-off delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.08</td><td>HDO switch-on delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.09</td><td>HDO switch-off delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.10</td><td>RO1 switch-on delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.11</td><td>RO1 switch-off delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.12</td><td>RO2 switch-on delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.13</td><td>RO2 switch-off delay time</td><td>0.000s</td><td>○</td></tr>
<tr><td>P06.16</td><td>HDO high-speed pulse output</td><td>0: Running frequency<br>22: Torque current (corresponding to the rated current of the motor)<br>25: Ramp frequency reference (dual-polarity)</td><td>0</td><td>○</td></tr>
<tr><td>P06.27</td><td>Lower limit of HDO output</td><td rowspan="5">Setting range of P06.27: -300.0%–P06.29<br>Setting range of P06.28: 0.00–50.00kHz<br>Setting range of P06.29: P06.27–300.0%<br>Setting range of P06.30: 0.00–50.00kHz<br>Setting range of P06.31: 0.000–10.000s</td><td>-200.0%</td><td>○</td></tr>
<tr><td>P06.28</td><td>Setting corresponding to lower limit of HDO output</td><td>10.00 kHz</td><td>○</td></tr>
<tr><td>P06.29</td><td>Upper limit of HDO output</td><td>200.0%</td><td>○</td></tr>
<tr><td>P06.30</td><td>Setting corresponding to upper limit of HDO output</td><td>50.00 kHz</td><td>○</td></tr>
<tr><td>P06.31</td><td>HDO filtering time</td><td>0.000s</td><td>○</td></tr>
</table>

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| **P07 group** | **Human-machine interface (HMI)** | | | |
| P07.00 | User password | 0–65535<br>If you set this parameter to a non-zero value, the password protection function is enabled.<br>If you set this parameter to 00000, the user password set before is deleted, and the password protection function is disabled.<br>After a user password is set and takes effect, you need to enter the correct password to enter the parameter menus before you can view or modify parameters. Remember the user password you set.<br>The password protection takes effect one minute after you exit from the function code editing interface.<br>After the password protection takes effect, "0.0.0.0.0" is displayed when you press the PRG/ESC key to enter the function code editing interface. You need to enter the correct password to enter the interface.<br>**Note:**<br>Restoring the default values may delete user passwords. Use this function with caution. | 0 | ○ |
| P07.01 | Function parameter copy | Used to set the parameter copying mode.<br>0: No operation<br>1: Upload function parameters from the machine to keypad<br>2: Download function parameters (including the motor parameters) from the keypad to machine<br>3: Download function parameters (excluding motor parameters of the P02 and P12 groups) from the keypad to machine<br>4: Download function parameters (only motor parameters of the P02 and P12 groups) from the keypad to machine<br>**Note:**<br>After the parameter is set to 1, 2, 3 or 4, and the operation is executed, the parameter is automatically restored to 0. The parameters uploaded or downloaded do not include those of the P29 group (factory function parameters). | 0 | ◎ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P07.05 | Selection 1 of parameters to be displayed in the running state | 0x0000–0xFFFF<br>BIT0: Running frequency (Hz on)<br>BIT1: Set frequency (Hz blinks)<br>BIT2: Bus voltage (V on)<br>BIT3: Output voltage (V on)<br>BIT4: Output current (A)<br>BIT5: Rotating speed (rpm on)<br>BIT6: Output power (% on)<br>BIT7: Output torque (% on)<br>BIT8– BIT9: Reserved<br>BIT10: Input terminal state<br>BIT11: Output terminal state<br>BIT12: Set torque (% on)<br>BIT13– BIT15: Reserved | 0x03FF | ○ |
| P07.06 | Selection 2 of parameters to be displayed in the running state | 0x0000–0xFFFF<br>BIT0: AI1 (V on)<br>BIT1: AI2 (V on)<br>BIT2: AI3 (V on)<br>BIT3: High-speed pulse HDI frequency<br>BIT4: Motor overload percentage (% on)<br>BIT5: Servo drive overload percentage (% on)<br>BIT6: Ramp frequency reference (Hz on)<br>BIT7–15: Reserved | 0x0000 | ○ |
| P07.07 | Selection of parameters to be displayed in the stop state | 0x0000–0xFFFF<br>BIT0: Set frequency (Hz on, frequency blinks slowly)<br>BIT1: Bus voltage (V on)<br>BIT2: Input terminal state<br>BIT3: Output terminal state<br>BIT4– BIT5: Reserved<br>BIT6: Set torque (% on)<br>BIT7: AI1 (V on)<br>BIT8: AI2 (V on)<br>BIT9: AI3 (V on)<br>BIT10–BIT15: Reserved | 0x00FF | ○ |
| P07.11 | Temperature of bridge rectifier module | -20.0–120.0°C | | ● |
| P07.12 | Temperature of the inverter | -20.0–120.0°C | | ● |

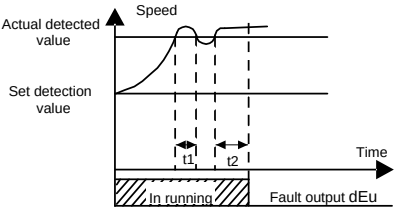
| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | module | | | |
| P07.13 | Control board software version | 1.00–655.35 | | ● |
| P07.14 | Accumulated running time | 0–65535h | | ● |
| P07.15 | Most significant digit of power consumption of servo drive | Displayed power consumption of the servo drive<br>Power consumption of the servo drive = P07.15×1000+P07.16<br>Setting range of P07.15: 0–65535 kWh (×1000)<br>Setting range of P07.16: 0.0–999.9 kWh | | ● |
| P07.16 | Least significant digit of power consumption of servo drive | | | ● |
| P07.18 | Rated power of servo drive | 0.4–3000.0 kW | | ● |
| P07.19 | Rated voltage of servo drive | 50–1200 V | | ● |
| P07.20 | Rated current of servo drive | 0.1–6000.0 A | | ● |
| P07.21 | Factory bar code 1 | 0x0000–0xFFFF | | ● |
| P07.22 | Factory bar code 2 | 0x0000–0xFFFF | | ● |
| P07.23 | Factory bar code 3 | 0x0000–0xFFFF | | ● |
| P07.24 | Factory bar code 4 | 0x0000–0xFFFF | | ● |
| P07.25 | Factory bar code 5 | 0x0000–0xFFFF | | ● |
| P07.26 | Factory bar code 6 | 0x0000–0xFFFF | | ● |
| P07.27 | Type of current fault | 0: No fault<br>1: Inverter unit U phase protection (OUt1)<br>2: Inverter unit V phase protection (OUt2)<br>3: Inverter unit W phase protection (OUt3) | | ● |
| P07.28 | Type of last fault | | | ● |
| P07.29 | Type of last but | | | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | one fault | 4: ACC overcurrent (OC1)<br>5: DEC overcurrent (OC2)<br>6: Constant-speed overcurrent (OC3)<br>7: ACC overvoltage (OV1)<br>8: DEC overvoltage (OV2)<br>9: Constant-speed overvoltage (OV3)<br>10: Bus undervoltage fault (UV)<br>11: Motor overload (OL1)<br>12: Servo drive overload (OL2)<br>13: Phase loss on the input side (SPI)<br>14: Phase loss on the output side (SPO)<br>15: Rectifier module overheat (OH1)<br>16: Inverter module overheat (OH2)<br>17: External fault (EF)<br>18: 485 communication fault (CE)<br>19: Current detection fault (ItE)<br>20: Motor autotuning fault (tE)<br>21: EEPROM operation fault (EEP)<br>22: PID feedback disconnection fault (PIDE)<br>23: Brake unit fault (bCE)<br>24: Running time ends (END)<br>25: Electronic overload (OL3)<br>26: Panel communication error (PCE)<br>27: Parameter upload error (UPE)<br>28: Parameter download error (DNE)<br>29: PROFIBUS communication fault (E-DP)<br>30: Ethernet communication fault (E-NET)<br>31: CANopen communication fault (E-CAN)<br>32: Short-to-ground fault 1 (ETH1)<br>33: Short-to-ground fault 2 (ETH2)<br>34: Speed deviation fault (dEu)<br>35: Misadjustment fault (STo)<br>36: Underload fault (LL)<br>37: Encoder disconnection fault (ENC1O)<br>38: Encoder reverse running fault (ENC1D)<br>39: Encoder Z pulse disconnection fault (ENC1Z)<br>43: Motor overtemperature fault (OT)<br>44: Fault specific to flying shears (ECUT1–ECUT7) | | |
| P07.30 | Type of last but two fault | | | ● |
| P07.31 | Type of last but three fault | | | ● |
| P07.32 | Type of last but four fault | | | ● |
| P07.33 | Running | | 0.00 Hz | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | frequency at current fault | | | |
| P07.34 | Ramp frequency reference at current fault | | 0.00 Hz | ● |
| P07.35 | Output voltage at current fault | | 0 V | ● |
| P07.36 | Output current at current fault | | 0.0 A | ● |
| P07.37 | Bus voltage at current fault | | 0.0 V | ● |
| P07.38 | Highest temperature at current fault | | 0.0°C | ● |
| P07.39 | Input terminal state at current fault | | 0 | ● |
| P07.40 | Output terminal state at current fault | | 0 | ● |
| P07.41 | Running frequency at last fault | | 0.00 Hz | ● |
| P07.42 | Ramp frequency reference at last fault | | 0.00 Hz | ● |
| P07.43 | Output voltage at last fault | | 0 V | ● |
| P07.44 | Output current at last fault | | 0.0 A | ● |
| P07.45 | Bus voltage at last fault | | 0.0 V | ● |
| P07.46 | Highest temperature at last fault | | 0.0°C | ● |
| P07.47 | Input terminal state at last fault | | 0 | ● |
| P07.48 | Output terminal | | 0 | ● |

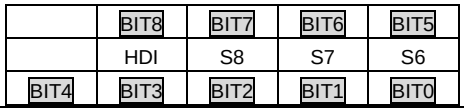
| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | state at last fault | | | |
| P07.49 | Running frequency at last but one fault | | 0.00 Hz | ● |
| P07.50 | Ramp frequency reference at last but one fault | | 0.00 Hz | ● |
| P07.51 | Output voltage at last but one fault | | 0V | ● |
| P07.52 | Output current at last but one fault | | 0.0 A | ● |
| P07.53 | Bus voltage at last but one fault | | 0.0 V | ● |
| P07.54 | Highest temperature at last but one fault | | 0.0°C | ● |
| P07.55 | Input terminal state at last but one fault | | 0 | ● |
| P07.56 | Output terminal state at last but one fault | | 0 | ● |
| **P08 group** | **Enhanced functions** | | | |
| P08.06 | Jogging frequency | Used to set the frequency reference of the servo drive for jogging operation.<br>Setting range: 0.00Hz–P00.03 (Max. output frequency) | 5.00 Hz | ○ |
| P08.07 | Jogging ACC time | Time the servo drive takes to accelerate from 0 Hz to P00.03 (Max. output frequency)<br>Setting range: 0.0–3600.0s | Depend on model | ○ |
| P08.08 | Jogging DEC time | Time the servo drive takes to decelerate from P00.03 (Max. output frequency) to 0 Hz.<br>Setting range: 0.0–3600.0s | Depend on model | ○ |
| P08.22 | Torque for inertia identification | 0.0–100.0% (of the rated torque of the motor)<br>**Note:**<br>If the torque is too large, the inertia autotuning speed may be too fast; and if the torque is too small, the inertial autotuning may fail. | 10.0% | ○ |
| P08.23 | Inertia | 0: No operation | 0 | ◎ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | autotuning | 1: Autotuning enabled<br>Note:<br>After this parameter is set to 1, the motor accelerates and decelerated repeatedly to perform inertial autotuning. The maximum speed is 3/4 of the rated speed. After the autotuning is complete, the keypad displays "-END-", and the autotuning result is stored in P21.28. | | |
| **P11 group** | **Protection parameters** | | | |
| P11.00 | Phase loss protection | 0x00–0x11<br>LED ones place (reserved):<br>0: Input phase loss protection disabled<br>1: Input phase loss protection enabled<br>LED tens place:<br>0: Output phase loss protection disabled<br>1: Output phase loss protection enabled<br>LED hundreds place:<br>0: Input phase loss protection disabled<br>1: Input phase loss protection enabled | 0x110 | ○ |
| P11.06 | Max. output current | Setting range: 50.0–200.0% (of the rated current of the servo drive) | 160.0% | ◎ |
| P11.13 | Fault output terminal action at fault | Used to set the action of the fault output terminal during undervoltage and auto fault reset<br>0x00–0x11<br>LED ones place:<br>0: Perform an action at undervoltage fault<br>1: No action at undervoltage fault<br>LED tens place:<br>0: Perform an action during auto reset<br>1: No action during auto reset | 0x00 | ○ |
| P11.14 | Speed deviation detection value | Used to set the speed deviation detection value.<br>0.0–50.0% | 10.0% | ○ |
| P11.15 | Speed deviation detection time | Used to set the time for detecting speed deviation.<br>**Note:**<br>No speed deviation protection is performed when P11.15 is set to 0.0. | 1.0s | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | |  <br>t1<t2, so the inverter continues to work<br>t2=P11.15<br>Setting range: 0.0–10.0s | | |
| **P13 group Synchronous motor control parameters** | | | | |
| P13.01 | Initial magnetic pole detection mode | If you use an ABZ encoder to drive a synchronous motor, angle autotuning needs to be performed at the first time of power-on.<br>0: Pulse superposition<br>1: Reserved<br>2: DC brake | 0 | ◎ |
| P13.06 | Pulse superposition voltage | 0.0–300.0% (of the rated voltage of the motor) | 100.0% | ◎ |
| **P14 group Serial communication functions** | | | | |
| P14.00 | Communication address | Setting range: 1–247<br>When the master is writing a frame in which the slave communication address is set to 0, that is, a broadcast address, all the salves on the Modbus receive the frame but do not respond to it.<br>The communication addresses on the communication network are unique, which is the basis of the point-to-point communication between the upper computer and servo drive.<br>**Note:**<br>The communication address of a slave cannot be set to 0. | 1 | ○ |
| P14.01 | Communication baud rate | Used to set the rate of data transmission between the upper computer and servo drive.<br>0: 1200BPS<br>1: 2400BPS<br>2: 4800BPS<br>3: 9600BPS | 4 | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | 4: 19200BPS<br>5: 38400BPS<br>6: 57600BPS<br>7: 115200BPS<br>**Note:**<br>The baud rate set on the servo drive must be consistent with that on the upper computer. Otherwise, the communication fails. The greater the baud rate, the faster the communication. | | |
| P14.02 | Data bit check | The data format set on the servo drive must be consistent with that on the upper computer. Otherwise, the communication fails.<br>0: No check (N, 8, 1) for RTU<br>1: Even check (E, 8, 1) for RTU<br>2: Odd check (O, 8, 1) for RTU<br>3: No check (N, 8, 2) for RTU<br>4: Even check (E, 8, 2) for RTU<br>5: Odd check (O, 8, 2) for RTU | 1 | ○ |
| P14.03 | Communication response delay | 0–200 ms<br>Indicates the period from the time the servo drive completes the receiving of data to the time it transmits response data to the upper computer. If the response delay set is shorter than the system processing time, the servo drive transmits the response data to the upper computer after the data is processed by the system; if the delay set is longer than the system processing time, the servo drive waits, after the data is processed by the system, until the delay time ends, and then transmits data to the upper computer. | 5ms | ○ |
| P14.04 | Communication timeout time | 0.0 (invalid); 0.1–60.0s<br>When this parameter is set to 0.0, the communication timeout time is invalid.<br>When this parameter is set a non-zero value, the system reports the "485 communication fault" (CE) if the communication interval exceeds the value of this parameter.<br>In general, this parameter is set to 0.0. In systems where continuous communication is performed, you | 0.0s | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | can set this parameter to monitor the communication state. | | |
| P14.05 | Transmission error handling | 0: Generate an alarm and coast to stop<br>1: No alarm and continue to run<br>2: No alarm and stop according to the stop mode (only in the communication-based control mode)<br>3: No alarm and stop according to the stop mode (in all control modes) | 0 | ○ |
| P14.06 | Communication handling action | 0x000–0x111<br>LED ones place:<br>0: Responding to write operations. The servo drive responds to read and write commands of the upper computer.<br>1: No response to write operations. The servo drive does not respond to the write commands, but responds only to the read commands of the upper computer. Setting the parameter to this value can improve the communication efficiency.<br>LED tens place:<br>0: Communication encryption is invalid.<br>1: Communication encryption is valid.<br>LED hundreds place:<br>0: Function parameters modified through communication are stored during PoFF.<br>1: Function parameters modified are stored based on the most significant bit (MSB) of the communication address. If the MSB is 1, they are stored during PoFF; and if it is 0, they are stored immediately. | 0x000 | ○ |
| **P17 group** | **State viewing 1** | | | |
| P17.00 | Set frequency | Displays the current set frequency for the servo drive.<br>Range: 0.00 Hz–P00.03 | 0.00 Hz | ● |
| P17.01 | Output frequency | Displays the current output frequency of the servo drive.<br>Range: 0.00 Hz–P00.03 | 0.00 Hz | ● |
| P17.02 | Ramp frequency reference | Displays the current ramp frequency reference of the servo drive.<br>Range: 0.00 Hz–P00.03 | 0.00 Hz | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P17.03 | Output voltage | Displays the current output voltage of the servo drive.<br>Range: 0–1200V | 0 V | ● |
| P17.04 | Output current | Displays the current output current of the servo drive.<br>Range: 0.0–5000.0 A | 0.0 A | ● |
| P17.05 | Motor rotating speed | Displays the current rotating speed of the motor.<br>Range: 0–65535 RPM | 0 RPM | ● |
| P17.06 | Torque current | Displays the current torque current of the servo drive.<br>Range: -3000.0–3000.0 A | 0.0 A | ● |
| P17.07 | Exciting current | Displays the current exciting current of the servo drive.<br>Range: -3000.0–3000.0 A | 0.0 A | ● |
| P17.08 | Motor power | Displays the current power of the motor. 100.0% corresponds to the rated power of the motor. A positive value indicates that the motor is in the electromotion state, and a negative value indicates that it is in the power generation state.<br>Range: -300.0–+300.0% (of the rated power of the motor) | 0.0% | ● |
| P17.09 | Output torque | Displays the current output torque of the servo drive. 100.0% corresponds to the rated torque of the motor. In forward running, a positive value indicates that the motor is in the electromotion state, and a negative value indicates that it is in the power generation state. In reverse running, a positive value indicates that the motor is in the power generation state, and a negative value indicates that it is in the electromotion state.<br>Range: -250.0–+250.0% | 0.0% | ● |
| P17.11 | DC bus voltage | Displays the current DC bus voltage of the servo drive.<br>Range: 0.0–2000.0 V | 0.0 V | ● |
| P17.12 | Digital input terminal state | Displays the current digital input terminal state of the servo drive.<br>  | 0 | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | S5 S4 S3 S2 S1<br>Range: 0000–01FF | | |
| P17.13 | Digital output terminal state | Displays the current digital output terminal state of the servo drive.<br>BIT3 BIT2 BIT1 BIT0<br>RO2 RO1 HDO Y<br>Range: 0000–000F | 0 | ● |
| P17.15 | Torque reference | Displays the torque reference, a percentage relative to the rated torque of the motor.<br>Range: -300.0%–+300.0% (of the rated current of the motor) | 0.0% | ● |
| P17.16 | AI1 adjustment voltage | Displays the adjustment voltage of AI1.<br>0.00–10.00 V | 0.00 V | ● |
| P17.17 | AI2 adjustment voltage | Displays the adjustment voltage of AI2.<br>0.00–10.00 V | 0.00 V | ● |
| P17.18 | AI3 adjustment voltage | Displays the adjustment voltage of AI3.<br>0.00–10.00 V | 0.00 V | ● |
| P17.19 | AI1 input voltage | Displays the input signal of AI1.<br>Range: 0.00–10.00 V | 0.00 V | ● |
| P17.20 | AI2 input voltage | Displays the input signal of AI2.<br>Range: 0.00–10.00 V | 0.00 V | ● |
| P17.21 | AI3 input voltage | Displays the input signal of AI3.<br>Range: -10.00–+10.00 V | 0.00V | ● |
| P17.22 | HDI input frequency | Displays the HDI input frequency.<br>Range: 0.000–50.000 kHz | 0.000 kHz | ● |
| P17.23 | Detected color code deviation | Range: -10.000–+10.000 mm<br>Note:<br>It is the deviation relative to P23.15 (Cutting length) or the internal correction value. | 0.000mm | ● |
| P17.24 | Number of consecutive missed color codes | Range: 0–65535 | 0 | ● |
| P17.28 | Detected color code correction length | Range: 0.0–6000.0mm | 0.0 mm | ● |
| P17.31 | Position deviation in the | -32767–+32767<br>Short-board cutting: A positive value indicates that | 0 | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | synchronization area | the cutter lags, that is, overcompensation for P21.28 (Torque feedforward gain); and a negative value indicates that the cutter overshoots, that is, undercompensation for P21.28.<br>Long-board cutting: A positive value indicates that the cutter lags, that is, undercompensation for P21.28 (Torque feedforward gain); and a negative value indicates that the cutter overshoots, that is, overcompensation for P21.28. | | |
| P17.32 | Cutting point pulse deviation | Range: -32767–+32767 | 0 | ● |
| P17.33 | Exciting current reference | Displays the exciting current reference in the vector control mode.<br>Range: -3000.0–+3000.0 A | 0.0 A | ● |
| P17.34 | Torque current reference | Displays the torque current reference in the vector control mode.<br>Range: -3000.0–+3000.0 A | 0.0 A | ● |
| P17.35 | UVW encoder state | Range: 0–7 | 0 | ● |
| P17.37 | Torque feedforward percentage | Range: -300.0%–+300.0% | 0.0% | ● |
| P17.38 | Torque percentage reference | Range: -300.0%–+300.0% | 0.0% | ● |
| P17.39 | Parameter download error function code | Range: 0.00–29.00 | 0.00 | ● |
| **P18 group** | **State viewing 2** | | | |
| P18.00 | Detected encoder frequency | Detected encoder frequency. A positive value indicates that the motor is running forward, and a negative value indicates that the motor is running reversely.<br>Range: -3276.8–+3276.7 Hz | 0.0 Hz | ● |
| P18.01 | Encoder position count value | Encoder count value, quadruplicated frequency.<br>Range: 0–65535 | 0 | ● |
| P18.02 | Encoder Z pulse position value | Count value corresponding to the encoder Z pulse<br>Range: 0–65535 | 0 | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P18.03 | Max. value of the UVW encoder state | Range: 0–7 | 0 | ● |
| P18.04 | Min. value of the UVW encoder state | Range: 0–7 | 0 | ● |
| P18.05 | Cutting amount in the current batch | 0–60000<br>**Note:**<br>Refer to P21.24 and P21.25. | 0 | ● |
| P18.06 | Color code width | 0–6553.5mm<br>**Note:**<br>It is the actual color code width detected. | 0 | ● |
| P18.07 | Position deviation | Pulse deviation between the current position reference and the actual running position.<br>Range: -32768–+32767 | 0 | ● |
| P18.09 | Cutter perimeter | 0–6553.5 mm<br>**Note:**<br>The cutter perimeter is calculated based on the diameter of the cutter. | 0.0 mm | ● |
| P18.10–P18.11 | Actual number of cutter motor pulses per revolution (detected by a sensor) | 0–65535000<br>**Note:**<br>Number of pulses per revolution of the cutter = P20.01×4×P23.04/P23.05; P18.10 is the most significant digit (MSD), and P18.11 is the least significant digit (LSD). | 0 | ● |
| P18.12 | Set length for the current cutting | 0–65535 | 0 | ● |
| P18.13 | Number of Z pulse errors | Range: 0–65535 | 0 | ● |
| P18.14 | MSD of Pg1 pulse count | Encoder pulse count value. The counting continues once the servo drive is powered on.<br>Range: 0–65535 | 0 | ● |
| P18.15 | LSD of Pg1 pulse count | Encoder pulse count value. The counting continues once the servo drive is powered on.<br>Range: 0–65535 | 0 | ● |
| P18.16 | Cutting fault code | 0–9 | 0 | ● |
| P18.17 | Total cutting | 0–65535 | 0 | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | amount (MSD) | | | |
| P18.18 | Total cutting amount (LSD) | 0–65535 | 0 | ● |
| P18.19 | Position regulator output | Output frequency of the position regulator during position control.<br>Range: 0.00–400.00 Hz | 0.00 Hz | ● |
| P18.20 | Actual cutting length | 0–6553.5 mm | 0.0 mm | ● |
| P18.22 | Magnetic pole angle | Current magnetic pole position.<br>Range: 0.00–359.99 | 0.00 | ● |
| P18.24 | Number of material feeding pulses (MSD) | 0–65535 | 0 | ● |
| P18.25 | Number of material feeding pulses (LSD) | 0–65535 | 0 | ● |
| P18.26 | Cutting error (detected by sensor) | -32.000–+32.000 mm<br>Including cutting error and detected optoelectronic switch error | 0.000 mm | ● |
| P18.27 | Cutting error (detected by software) | -32.000–+32.000 mm | 0.000 mm | ● |
| P18.28 | Detected pulse deviation at the proximity switch | -1000–+1000<br>**Note:**<br>If the value of this parameter is greater than P23.21, ECUT6 (rotary cutter sensor detection error) is reported. The value cannot be accumulated. Otherwise, the rotary cutter deceleration ratio (P23.04/P23.05) is set incorrectly. You can also prevent deviation accumulation by increasing P23.20. Moreover, the smaller fluctuation of the value, the better. | 0 | ● |
| P18.29 | Cutting amount | 0–65535<br>The value of this parameter is automatically reset to 0 after P23.15 (cutting length) is modified. | 0 | ● |
| P18.30 | Cutter position | 0.0°–359.9° (referring to the cutting point as 0°) | 0.0 | ● |
| P18.31 | Material feeding linear speed | -600.0–+600.0 m/min | 0.0 m/min | ● |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | (detected value) | | | |
| P18.32 | Cutter linear speed (detected value | -600.0–+600.0 m/min | 0.0 m/min | ● |
| **P20 group Encoder** | | | | |
| P20.00 | Encoder type | 0: Incremental encoder<br>1: ABZ UVW encoder<br>2: Resolver encoder<br>3: Sin/cos encoder without CD signals<br>4: Sin/cos encoder with CD signals | 0 | ◎ |
| P20.01 | Number of encoder pulses | Number of pulses the encoder generates after rotating one circle.<br>Setting range: 0–60000 | 1024 | ◎ |
| P20.02 | Encoder direction | Ones place: AB direction<br>0: Forward; 1: Reverse<br>Tens place: Z pulse direction<br>0: Forward; 1: Reverse<br>Hundreds place: Magnetic pole detection signal direction<br>0: Forward; 1: Reverse | 0x000 | ◎ |
| P20.03 | Encoder disconnection fault detection time | Time for detecting encoder disconnection faults.<br>Setting range: 0.0–100.0s | 1.0s | ○ |
| P20.04 | Encoder reversing running fault detection time | Time for detecting encoder reverse running faults.<br>Setting range: 0.0–100.0s | 0.8s | ○ |
| P20.05 | Number of encoder detection filtering times | Setting range: 0x00–0x99<br>Ones place: Number of low-speed filtering times; corresponding to 2^(0–9)×125 μs<br>Tens place: Number of high-speed filtering times; corresponding to 2^(0–9)×125 μs | 0x33 | ○ |
| P20.07 | Synchronous machine control parameter | Setting range: 0x0000–0xFFFF<br>Generally, you do not need to modify this parameter.<br>Bit0: Z pulse correction enabling<br>Bit1: Encoder angle correction enabling | 0x0003 | ○ |
| P20.09 | Initial angle of Z | Electrical degree between the Z pulse of the encoder | 0.00 | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | pulse | and the magnetic pole position of the motor. Setting range: 0.00–359.99 | | |
| P20.10 | Initial magnetic pole angle | Electrical degree between the position of the encoder and the magnetic pole position of the motor. Setting range: 0.00–359.99 | 0.00 | ○ |
| P20.11 | Initial magnetic pole angle autotuning | Setting range: 0–3<br>0: No operation<br>1: Rotating autotuning (without load)<br>2: Static autotuning (applicable to resolvers and sin/cos encoders)<br>3: Rotating autotuning (with load)<br>After you set this parameter to 1 or 2 and confirm the setting, the keypad displays "-RUN-". Press the "RUN" key, and the autotuning of the initial magnetic pole angle is performed. The autotuning ends when the keypad displays "-END-", and the identified initial magnetic pole angle is stored in P20.09 and P20.10. The initial magnetic pole angle obtained through autotuning of 1 (Rotating autotuning) is more accurate, so this parameter is commonly set to 1. In such cases, you need to disconnect the load from the motor, or ensure that the load of the motor is light. | 0 | ◎ |
| P20.12 | Encoder detection filtering time | 0–200.0 μs<br>**Note:**<br>To prevent encoder interference, you need to set the encoder signal filtering width properly. Generally, the filtering width cannot exceed half of the minimum width of the encoder. For example, if the maximum pulse frequency of the encoder is 100 kHz, its minimum width is 5 μs (calculated based on the duty ratio of 50%), and so the value of this parameter needs to be less than 2.5 μs. | 3.0 μs | ○ |
| P20.13 | Speed measuring method | 0: Common mode<br>1: Optimized mode | 0 | ◎ |
| **P21 group** | **Position control and flying shear parameters** | | | |
| P21.01 | Material feeding pulse command | LED ones place: Pulse mode<br>0: A / B orthogonal pulse; A leads B | 0x0000 | ◎ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | mode | 1: A: Clock; B: Direction<br>2: A: Count in ascending order<br>3: A: Count in descending order<br>LED tens place: Pulse direction<br>Bit0: Pulse forward direction setting<br>0: Forward<br>1: Reverse | | |
| P21.02 | APR reset-to-zero gain | Setting range: 0.0–400.0 | 20.0 | ○ |
| P21.03 | APR cutting gain | Setting range: 0.0–400.0<br>**Note:**<br>Increasing the value of this parameter can improve the cutting accuracy. Try to increase the value while ensuring that the motor does not oscillate. | 60.0 | ○ |
| P21.08 | APR output amplitude limit | Setting range: 0.0–100.0% of P00.03 (Max. output frequency) | 5.0% | ○ |
| P21.11 | Numerator of the material feeding pulse gear ratio | Setting range: 1–1000 | 100 | ○ |
| P21.12 | Denominator of the material feeding pulse gear ratio | Setting range: 1–1000<br>**Note:**<br>Number of pulses generated when the material feeding roller rotates one circle = P23.07×4×P21.11/P21.12 | 100 | ○ |
| P21.20 | ACC time of cutting proximity switch searching | Setting range of P21.20: 0.01–300.00s<br>Setting range of P21.21: 0.01–300.00s | 3.00s | ○ |
| P21.21 | DEC time of cutting proximity switch searching | | 3.00s | ○ |
| P21.23 | Speed of proximity switch searching | Setting range: 0.00–50.00 Hz | 2.00 Hz | ○ |
| P21.24 | Single-batch cutting amount setting for alarm generation | Setting range: 0–60000 | 50 | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| P21.25 | Single-batch cutting amount setting for advanced alarm generation | Setting range: 0–600<br>For example, if P21.24 is set to 50, and this parameter is set to 3, an alarm is generated when the cutting amount in a batch is 47 (P21.24- P21.25). | 3 | ○ |
| P21.27 | Min. material feeding linear speed | Setting range: 0.0–5.0 m/min | 0.2 m/min | ○ |
| P21.28 | Torque feedforward gain | Setting range: 0%–300.0%<br>1. P21.28 × Rated torque of the motor, allowing the motor to accelerate from 0 to P00.03 (Max. output frequency) in 1s.<br>2. Set this parameter to 0 for low-speed cutting.<br>3. The value of this parameter can be obtained through inertial autotuning parameters. Refer to P08.22 and P08.23. | 0.0% | ○ |
| P21.29 | Material feeding speed filtering time | Setting range: 0–3200.0 ms<br>**Note:**<br>If the acceleration or deceleration of the material feeding speed is fast, you need to set this parameter to a short time. Otherwise, the cutting deviation increases during the acceleration or deceleration. | 10.0 ms | ○ |
| P21.30 | High-speed analog | Setting range: 0–0x21<br>Ones place: Enabling option<br>0: Terminal enabling (terminal function #58)<br>1: Enabling (internal enabling)<br>Tens place: Analog port option<br>0: AI3<br>1: AI1<br>2: AI2 | 0x00 | ◎ |
| P21.31 | High-speed analog filtering time | Setting range: 0.1–10.0 ms | 1.0 ms | ○ |
| P21.33 | Reset-to-zero signal type | Setting range: 0–1<br>0: Electrical level signal<br>1: Pulse signal | 0 | ○ |
| P21.34 | Material feeding encoder detection filtering | Setting range: 0–20.0 μs<br>**Note:**<br>To prevent encoder interference, you need to set the | 3.0 μs | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | time | encoder signal filtering width properly. Generally, the filtering width cannot exceed half of the minimum width of the encoder. For example, if the maximum pulse frequency of the encoder is 50 kHz, its minimum width is 10 μs (calculated based on the duty ratio of 50%), and so the value of this parameter needs to be less than 5.0 μs. | | |
| **P22 group** | **Color code and cutting** | | | |
| P22.00 | Color code cutting selection | Setting range: 0–0x111<br>Ones place: Color code enabling option<br>0: Disabled<br>1: Enabled<br>Tens place: Color code installation distance setting<br>Bit0: P22.01 direction setting<br>0: Set P22.01 to forward<br>1: Set P22.01 to reverse<br>Bit1: P22.01 magnification option<br>0: ×1<br>1: ×10 (for example, if P22.01 is 1000.0 mm, the actual installation distance is 10000 mm)<br>Hundreds place: Color code detection filtering compensation<br>0: Compensated<br>1: No compensation | 0 | ○ |
| P22.01 | Color code sensor installation distance | Setting range: 0.0–6500.0 mm<br>**Note:**<br>1. Distance between the color code detection point and the cutting point of the rotary cutter. If the cutting point is behind the color code, you need to reduce the value; and if the cutting point is before the color code, you need to increase the value.<br>2. The color code sensor can be installed at any position. You just need to set the installation distance properly. | 1000.0 mm | ○ |
| P22.02 | Color code sensor offset | Setting range: -999.9–2000.0 mm<br>**Note:**<br>Used to set the offset distance between the cutting position of the fed material and the color code. A negative value indicates that the cutting position is | 0.0mm | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | before the color code. | | |
| P22.03 | Color code signal detection window | Setting range: 0–3000.0mm<br>**Note:**<br>If a color code appears within the window scope of P23.15 (Cutting length), it is identified as a correct color code. Otherwise, it is identified as a wrong color code and discarded. | 50.0mm | ○ |
| P22.04 | Number of color codes in each cutting | Setting range: 1–100<br>**Note:**<br>Used to set the number of color codes included in one cutting length (P23.15). | 1 | ○ |
| P22.05 | Number of auto corrections of the color code cutting length | Setting range: 0–100<br>**Note:**<br>If it is continuously detected that the color code distance exceeds P22.06, the cutting length is automatically corrected. The cutting length is not corrected if this parameter is set to 0. | 10 | ○ |
| P22.06 | Deviation threshold for auto color code correction | Setting range: 0.0–1000.0 mm<br>**Note:**<br>Used in combination with P22.05 to automatically correct the cutting length. | 1.0 mm | ○ |
| P22.07 | Number of color code sensor detection filtering times | Setting range: 0–80 (×125 μs) | 0 | ○ |
| P22.08 | First color code alignment window | Setting range: 0–1000.0 mm<br>(0: Disabled) | 0.0 mm | ○ |
| P22.09 | Max. length of first color code alignment | Setting range: 0–1000.0mm (0: 20.0 mm)<br>(This parameter is invalid if P22.08 is set to 0.) | 0.0 mm | ○ |
| P22.10 | Threshold for number of consecutive missed color codes | Setting range: 0–1000 | 4 | ○ |
| P22.11 | Action at color code missing | Setting range: 0–3<br>When the number of color code missing times is greater than P22.10: | 0 | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | 0: Auto color code re-alignment; output only alarm signals (#30) but no fault signals.<br>1: No color code re-alignment; continue the cutting based on the set length; output only alarm signals (#30) but no fault signals.<br>2: No color code re-alignment; continue the cutting based on the set length; output both fault signals and alarm signals (#30).<br>3: No color code re-alignment; return to the zero point and then stop and report fault; output both fault signals and alarm signals (#30). | | |
| P22.12 | Color code sensor detection delay | 0.00–30.00 ms<br>**Note:**<br>Used to set the response delay of the color code sensor for compensating the actual position detected by the color code sensor. | 0.05 ms | ○ |
| P22.13 | Cutting amount | 0: Disabled<br>1–65535 | 0 | ○ |
| P22.14 | Cutting amount setting for alarm generation | 0–65535 | 0 | ○ |
| P22.15 | Alarm signal output selection | 0: Buzzer<br>1: Alarm indicator | 0 | ○ |
| P22.16 | High electrical level time of alarm signal output | 0–60.000s | 1.000s | ○ |
| P22.17 | Low electrical level time of alarm signal output | 0–60.000s | 1.000s | ○ |
| **P23 group** | **Cutting functions** | | | |
| P23.00 | Cutter mode | Setting range: 0–0x1101<br>LED ones place: Cutter enabling<br>0: Disabled<br>1: Enabled<br>LED tens place: Reserved | 0 | ○ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | LED hundreds place: Sensor setting<br>0: Proximity switch<br>1: Encoder Z pulse<br>LED thousands place: Cutter encoder reset selection<br>0: The cutter state is reset after the material is transmitted reversely for 5 cm.<br>1: The cutter state is not reset when the material is transmitted reversely. | | |
| P23.01 | Linear speed input | 0: Pulse terminal (A2, B2)<br>1: Digital setting | 0 | ◎ |
| P23.02 | Digital setting of linear speed | 0.0–600.0 m/min<br>**Note:**<br>The acceleration and deceleration time of the simulated speed depends on P00.11 and P00.12. The running of the simulated linear speed is independent of whether the cutter is enabled. The simulated linear speed runs even when the cutter stops. Do not set the simulated linear speed too high before the cutter is enabled. Otherwise, shock may be caused. | 20.0 m/min | ○ |
| P23.03 | Cutter diameter | 0.00–6553.5 mm | 200.0 mm | ○ |
| P23.04 | Numerator of the cutter reduction gearbox (number of gear teeth on the cutter side) | 1–60000 | 10 | ◎ |
| P23.05 | Denominator of the cutter reduction gearbox (number of gear teeth on the motor side) | 1–60000<br>**Note:**<br>Number of pulses per revolution of the cutter = P20.01×4×P23.04/P23.05 | 10 | ◎ |
| P23.06 | Diameter of the material feeding encoder roller | 0.00–655.35 mm | 50.00 mm | ○ |
| P23.07 | Number of pulses of the material feeding encoder | 1–30000<br>**Note:**<br>Number of pulses generated when the material feeding roller rotates one circle = | 1024 | ◎ |

| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | | P23.07×4×P21.11/P21.12 | | |
| P23.08 | Sensor installation angle | 0.0–359.9° (based on the position of the cutting point) | 0.0° | ◎ |
| P23.09 | Angle of the synchronization area | 0.0–300.0°<br>**Note:**<br>Angle of the synchronization area = Angle between a cutting point and its previous cutting point + Angle between the cutting point and its next cutting point.<br>If the angle of synchronization area is set to 30°, the angle between a cutting point and its previous cutting point is 15°, and that between it and its next cutting point is also 15°. You can increase the angle between two cutting points by modifying P23.17. | 30.0° | ○ |
| P23.10 | Angle increase in the ACC area | 0.0–50.0% | 0.0% | ○ |
| P23.11 | Cutting speed increase in the synchronization area | -10.0–100.0% | 0.0% | ○ |
| P23.12 | Number of cutters | 1–4 | 1 | ◎ |
| P23.13 | Reserved | 0–1 | 0 | ○ |
| P23.14 | Speed curve selection | 0: Straight line<br>1: S curve | 1 | ○ |
| P23.15 | Cutting length | 0–65535 | 10000 | ○ |
| P23.16 | Unit of cutting length | 0: 0.001 mm<br>1: 0.01 mm<br>2: 0.1 mm<br>3: 1 mm | 2 | ◎ |
| P23.17 | Angle of advanced entry into the synchronization area | 0.0–90.0° | 0° | ○ |
| P23.18 | Position for returning to zero point | 0–359.9° (take the position of the cutting point as 0°) | 180.0° | ○ |
| P23.19 | Pulse threshold | 0–1000 | 20 | ○ |

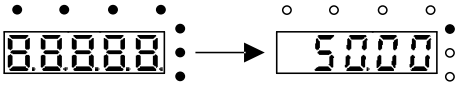
| Function code | Name | Detailed description | Default value | Modify |
|---|---|---|---|---|
| | for sensor correction | **Note:**<br>If the difference between the number of cutter pulses (detected by the sensor between two cuttings) and that of pulses per revolution of the cutter (P20.01×4×P23.04/P23.05) is greater than the value of this parameter, the current cutter position is corrected based on the step set in P23.20. If the difference is smaller than the value of this parameter, no correction is performed. The position of the cutter may be changed during the correction, which may affect the accuracy of the current cutting. | | |
| P23.20 | Max. pulse correction in each revolution | 0–1000<br>**Note:**<br>Refer to the description of P23.19. | 200 | ○ |
| P23.21 | Angle threshold for cutter position deviation alarm | 0–60.0°<br>**Note:**<br>If the difference between the number of cutter pulses (detected by the sensor between two cuttings) and that of pulses per revolution of the cutter (P20.01×4×P23.04/P23.05) is greater than the value of this parameter (P23.21/360×P20.01×4×P23.04/P23.05) for three consecutive times, the ECUT6 fault is reported. | 10.0° | ◎ |
| P23.22 | Start speed setting | Ones place: Start tracking option<br>0: Smooth tracking<br>1: Direct tracking<br>Tens place: Return-to-zero selection for the first start (in non-color code mode)<br>0: No auto return-to-zero for the first start<br>1: Auto return-to-zero for the first start | 0x00 | ○ |
| P23.23 | Number of sensor detection software filtering times | 0–20: (×125 μs) | 3 | ○ |
| P23.24 | Second cutting length | 0–65535 (set through terminal #55) | 10000 | ○ |

# Chapter 6 Basic operations

## 6.1 First power-on

**Operation during the first power-on**

After checking the wiring and power supply, switch on the air switch of the AC power supply on the input side of the servo drive. After being powered on, the keypad of the servo drive displays "8.8.8.8.8." first, and the contactor is closed properly. When the displayed characters change to the set frequency, the initialization of the servo drive is complete, and the servo drive is in the standby state.



"8.8.8.8.8." is displayed and all the seven indicators are on.

Standby state

## 6.2 Commissioning guide

### 6.2.1 Closed-loop vector control commissioning steps for asynchronous machines

1. Set P00.18 to 1 to restore the factory settings.
2. Set P00.03, P00.04, and motor name plate parameters in the P02 group.
3. Set P00.15 to 2 to perform static parameter autotuning. The obtained parameter values are stored in motor parameters of the P02 group.
4. Check and ensure that the encoder is installed and set properly.

   Encoder direction checking and parameter setting: Set the encoder resolution (P20.01), set P00.00 to 2, and set P00.10 to 20 Hz. Run the servo drive, and the motor rotates at 20 Hz. Check whether P18.00 (the speed detected) is correct. If the speed detected is negative, it indicates that the encoder runs reversely. In this case, you need just to set P20.02 to 1. If the deviation of the speed detected is large, it indicates that P20.01 is set incorrectly. Observe whether the value of P18.02 (Encoder Z pulse position value) fluctuates. If it does, it indicates that the encoder encounters interference or P20.01 is set incorrectly. In this case, check the wiring or shield layer.
5. Test the running in the closed-loop vector control mode.

   Set P00.00 to 3 to perform the closed-loop vector control. Modify P00.10 and the ASR and ACR PI parameters in the P03 group to ensure the smooth running.

### 6.2.2 Closed-loop vector control commissioning steps for synchronous machines

1. Set P00.18 to 1 to restore the factory settings.
2. Set P00.00 to 3 (Closed-loop vector control mode), and set P00.03, P00.04, and motor name plate parameters in the P02 group.
3. Set encoder parameters P20.00 and P20.01.
4. Perform initial magnetic pole angle autotuning.

   Set P20.11 to 1, 2, or 3 (1 and 3 indicate rotating autotuning, and 2 indicates static autotuning), and then press the RUN key to run the servo drive.

(1) Rotating autotuning 1 (P20.11 = 1)

The machine detects the magnetic pole position when the autotuning starts, and then it accelerates to 10 Hz to obtain the magnetic pole position corresponding to the Z pulse of the encoder, and then it decelerates to stop.

If the ENC1O or ENC1D fault occurs in the running, set P20.02 to 1 to perform autotuning again.

After the autotuning is complete, the angle obtained is automatically stored in P20.09 and P20.10.

(2) Static autotuning (P20.11 = 2)

In scenarios where loads can be disconnected, it is recommended that you set P20.11 to 1. In this mode, the angle obtained is more accurate. In scenarios where loads cannot be disconnected, you can set P20.11 to 2. The magnetic pole position obtained through autotuning is stored in P20.09 and P20.10

(3) Rotating autotuning 2 (P20.11 = 3)

The machine performs static autotuning first to obtain the initial magnetic pole angle, and then accelerated to 10 Hz to obtain the magnetic position corresponding to the Z pulse of the encoder and decelerates to stop.

**Note:**

- If the ENC1D fault (encoder runs reversely) occurs during the autotuning, set P20.02 to 1. If the ENC1O fault (encoder disconnection) occurs, try setting P20.02 to 1, and check and ensure that P20.01 (Encoder resolution) and P02.17 (Number of pole pairs of synchronous motor 1) are set properly. Then perform autotuning.
- After the autotuning is complete, the keypad displays "-END-". Perform autotuning for three consecutive times. If the up and down fluctuation of the initial angle stored in P20.09 and P20.10 is less than 15°, it indicates that the autotuning is properly performed.

5. Test the running in the closed-loop vector control mode.

Modify P00.10 and the ASR and ACR PI parameters in the P03 group to ensure the smooth running. If oscillation occurs, you can decrease the values of P03.00, P03.03, P03.09, and P03.10. If current oscillation occurs in low-speed running, you can modify the low-speed filtering parameter P20.05 (Number of encoder detection filtering times).

**Note:** After the motor or encoder cables are modified, the direction of the encoder (P20.02) needs to be identified again, and magnetic pole position autotuning needs to be performed again.

### 6.2.3 Flying cutting commissioning steps

1. Fixed-length cutting mode

(1) Enable the flying cutting function by setting P23.00 to 1.

(2) Set the mechanical parameters of the cutter, including P23.03 to P23.05, P23.08, P23.09, and P23.12.

You can adopt the jogging mode to observe the number (P18.10 is the MSD, and P18.11 is the LSD) of encoder feedback pulses per resolution of the cutter detected through sensor signals. The actual deceleration ratio = (P18.10–P18.11)/(4×P20.01). Fine-tune P23.04 and P23.05 according to the actual deceleration ratio. When P23.04 and P23.05 are set properly, P18.28 (pulse deviation corrected through the sensor) is not accumulated. The smaller the value fluctuation of P18.28, the better. If the fluctuation is large, perform mechanical check.

(3) Check the position of the photoelectric sensor.

Return to zero through the return-to-zero terminal, and observe P18.30 (Cutter position). If the value of P18.30 is the same as that of P23.18 (return-to-zero setting), it indicates that P23.08 is set correctly. Otherwise, reset P23.08. If P23.08 is set incorrectly, the cutting position will be out of the synchronization area.

When the cutter is located at the cutting point (middle point), the value of P18.30 is supposed to be 0. Otherwise, P23.08 is set incorrectly.

(4) Set the mechanical parameters for material feeding, including P23.06, P23.07, P21.11, and P21.12.

Run the material feeding motor to observe whether the value of P18.31 (Material feeding linear speed) is correct. If the value is incorrect, you need to set the material feeding parameters properly. The actual linear speed must be a positive value (instead of a negative value). Otherwise, set the tens place of P21.01 or re-connect the linear speed detection encoder.

(5) Handle the interference on the cutter encoder and material feeding encoder.

Check whether the shield layers of the encoders are wired properly. Observe P18.02 (Encoder Z pulse position value). If the value jumps more than 5 pulses, it indicates that there is interference. You need to handle the interference on the encoders. Otherwise, the cutting accuracy may be affected.

Narrow-pulse interference can also be eliminated through software. When you handle the interference through software, you need to set P20.12 and P21.34.

(6) Set the cutting length and unit through P23.15 and P23.16.

(7) Test material feeding without paper through simulation

Enable the simulated material feeding speed by setting P23.01 to 1, and set P23.02 (Digital setting of linear speed). Observe P18.26 (Cutting error). If the value meets the requirements, set P23.01 to 0, and you can perform a cutting test with materials.

2. Color code-based cutting mode

Set color code-related parameters, including P22.00 to P22.10.

Each time after receiving a running command signal, the cutter starts to detect color codes and runs at the same speed as the linear speed of the materials. The cutter starts the rotary cutting after detecting the first color code point, and all the subsequent color codes are aligned based on the first detected color code. When the number of missed color codes is greater than P22.10, the servo drive outputs color code missing alarm signals, and perform actions according to the setting of P22.11. Observe P17.23 to see whether the detected color code signal deviation is too large. If yes, adjust the color code sensor to ensure that the value of P17.23 is within a proper range.

3. Commissioning precautions

(1) Adjust the ASR gain (P03.00–P03.04) and increase the APR gain (P21.03) to reduce the cutting error.

(2) Set P21.29 (Material feeding speed filtering time) properly to ensure that the cutting accuracy in fast acceleration or deceleration meets requirements.

(3) When the cutter motor runs first, it automatically searches for reference points. If not reference point is detected, it reports the ECUT5 fault (no reference point found) after running two revolutions.

(4) After the cutting sensor is adjusted again, you need to set P23.08 (Sensor installation angle) properly again. Then set P23.00 to 0 first and then to 1 to perform the return-to-zero operation again. Otherwise, the ECUT6 fault may be reported.

(5) Alarm signal output

If (P22.13-P18.29) < P22.14, alarm signal output is enabled. You can set the output signal to be constantly high or pulse signal through P22.15 (setting P22.15 to 1 or 0). If the output signal is set to be pulse signal, you can set the high electrical level time through P22.16 and set the low electrical level time through P22.17. When P22.13 is set to 0, alarm signals are disabled.

# Chapter 7 Fault tracking

## 7.1 Alarm and fault indications

Faults are indicated by indicators. For details, see Chapter 4 "Keypad operation". When the TRIP indicator is on, the alarm or fault code displayed on the keypad indicates that the servo drive encounters an exception. You can find out causes and solutions for most of the alarms or faults based on the information provided in this chapter. If you cannot find out the causes of an alarm or fault, contact the local INVT office.

## 7.2 Fault reset

The servo drive can be reset in various ways, including pressing the STOP/RST key on the keypad, digital input, and disconnecting the power supply. After a fault is resolved, you can restart the motor.

## 7.3 Fault history

The function codes P07.27 to P07.32 record the types of the last six faults. The function codes P07.33 to P07.40, P07.41 to P07.48, and P07.49 to P07.56 record the running data of the servo drive at the last three faults, respectively.

## 7.4 Servo drive faults and solutions

Perform the following steps after a fault occurs:

1. After a fault occurs on the servo drive, check whether a display exception occurs on the keypad. If yes, contact the INVT office.
2. If no keypad exception occurs, view the corresponding fault recording parameters in the P07 group to understand the actual states at the current fault.
3. Check whether exceptions described in the table in section 7.4.1 occur.
4. Resolve the fault or ask for help.
5. After the fault is resolved, perform fault reset to run the servo drive.

### 7.4.1 Servo drive faults and solutions

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| OUt1 | Inverter unit U phase protection | • The acceleration is too fast.<br>• Internal damage is caused on the IGBT of the phase.<br>• The drive cable is not properly connected.<br>• Short-to-ground occurs. | • Increase the acceleration time.<br>• Replace the power unit.<br>• Check the drive cable.<br>• Check whether there are strong interference sources among the peripheral devices. |
| OUt2 | Inverter unit V phase protection | | |
| OUt3 | Inverter unit W phase protection | | |
| OV1 | ACC overvoltage | • Exceptions occur on | • Check the input power |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| OV2 | DEC overvoltage | the input voltage.<br>• There is a large amount of fed-back energy.<br>• There is a lack of brake components.<br>• The dynamic braking function is not enabled. | supply.<br>• Check whether the DEC time of the load is too short, or the servo drive is started when the motor is rotating.<br>• All a dynamic braking component.<br>• Check the settings of related function codes. |
| OV3 | Constant-speed overvoltage | | |
| OC1 | ACC overcurrent | • The ACC or DEC is too fast.<br>• The voltage of the grid is low.<br>• The power of the servo drive is low.<br>• The load changes suddenly or exceptions occur on the load.<br>• Short-to-ground occurs, or phase loss occurs on the output side.<br>• There are strong external interference sources.<br>• The overvoltage stall protection function is not enabled. | • Increase the ACC or DEC time.<br>• Check the input power supply.<br>• Use a servo drive with greater power.<br>• Check whether the load is short circuited (short to ground or wire-to-wire short circuit) or whether the rotation is blocked.<br>• Check the output wiring.<br>• Check there is strong interference.<br>• Check the settings of related function codes. |
| OC2 | DEC overcurrent | | |
| OC3 | Constant-speed overcurrent | | |
| UV | Bus undervoltage | • The voltage of the grid is low.<br>• The overvoltage stall protection function is not enabled. | • Check the input power supply of the grid.<br>• Check the settings of related function codes. |
| OL1 | Motor overload | • The voltage of the grid is too low.<br>• The rated current of the motor is not correctly set. | • Check the voltage of the grid.<br>• Set the rated current of the motor again.<br>• Check the load and |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| | | • The rotation of the motor is blocked or the load suddenly changes too much. | adjust the torque boost. |
| OL2 | Servo drive overload | • The ACC is too fast.<br>• The rotating motor is restarted.<br>• The voltage of the grid is too low.<br>• The load is too heavy.<br>• The motor power is too large, and the power of the servo drive is too small. | • Increase the ACC time.<br>• Avoid restarting the motor immediately after it stops.<br>• Check the voltage of the grid.<br>• Use a servo drive with greater power.<br>• Use a motor that meets the operation requirements. |
| SPI | Phase loss on the input side | The input R, S, or T phase is missed or the fluctuation is large. | • Check the input power supply.<br>• Check the installation wiring. |
| SPO | Phase loss on the output side | The U, V, or W phase is missed on the output side (or the three phases of the load are seriously asymmetrical). | • Check the output wiring.<br>• Check the motor and cables. |
| OH1 | Rectifier module overheat | • The vent duct is blocked or the fan is damaged.<br>• The ambient temperature is too high.<br>• The time of overload running is too long. | • Dredge the vent duct or replace the fan.<br>• Lower the ambient temperature. |
| OH2 | Inverter module overheat | | |
| EF | External fault | External fault caused by actions of input terminals. | Check the input of external devices. |
| CE | 485 communication fault | • The baud rate is improperly set.<br>• The communication line is faulty. | • Set the baud rate properly.<br>• Check the communication port |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| | | • The communication address is incorrect.<br>• There is strong interference on the communication. | wiring.<br>• Set the communication address correctly.<br>• Change or modify the wiring to improve the anti-interference capability. |
| ItE | Current detection fault | • The control panel connector is in poor contact.<br>• The Hall component is damaged.<br>• The magnifying circuit is abnormal. | • Check the connector and rewire it.<br>• Replace the Hall component.<br>• Replace the main control panel. |
| tE | Motor autotuning fault | • The motor capacity and the servo drive capacity do not match.<br>• The parameters of the motor are not properly set.<br>• The parameter values obtained through autotuning are significantly different from those standard ones.<br>• The autotuning times out. | • Replace the servo drive with one of another model.<br>• Set the model and nameplate parameters of the motor correctly.<br>• Disconnect the load of the motor and perform autotuning again.<br>• Check the cable connection and parameter settings of the motor.<br>• Check whether the upper frequency limit is higher than 2/3 of the rated frequency. |
| EEP | EEPROM operation fault | • Error occurs in writing or reading control parameters.<br>• EEPROM is damaged. | • Press the STOP/RST key to reset.<br>• Replace the main control board. |
| PIDE | PID feedback disconnection fault | • The PID feedback is disconnected.<br>• The PID feedback source cannot be | • Check the PID feedback signal line.<br>• Check the PID feedback source. |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| | | found. | |
| bCE | Brake unit fault | • The brake line is faulty or the brake pipe is damaged.<br>• The resistance of the external brake resistor is low. | • Check the brake unit and replace the brake pipe.<br>• Increase the brake resistance. |
| END | Running time arrival | The actual running time of the servo drive is longer than the preset running time. | Ask the supplier to adjust the preset running time. |
| OL3 | Electronic overload fault | The servo drive generates overload alarms based on the preset value. | Check the load and overload alarm generating threshold. |
| PCE | Panel communication error | • The keypad cable is in poor contact or disconnected.<br>• The keypad cable is too long and so encounters strong interference.<br>• Some of the keypad or mainboard communication circuits are faulty. | • Check the keypad cable to determine whether a fault occurs.<br>• Check the environment and remove interference sources.<br>• Replace hardware and seek maintenance services. |
| UPE | Parameter upload error | • The keypad cable is in poor contact or disconnected.<br>• The keypad cable is too long and so encounters strong interference.<br>• Some of the keypad or mainboard communication circuits are faulty. | • Check the keypad cable to determine whether a fault occurs.<br>• Replace hardware and seek maintenance services.<br>• Replace hardware and seek maintenance services. |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| DNE | Parameter download error | • The keypad cable is in poor contact or disconnected.<br>• The keypad cable is too long and so encounters strong interference.<br>• There are errors in the data stored on the keypad. | • Check the keypad cable to determine whether a fault occurs.<br>• Replace hardware and seek maintenance services.<br>• Re-back up the data on the keypad. |
| E-DP | PROFIBUS communication fault | • The communication address is incorrect or the build-out resistor is not removed.<br>• The GSD file of the main station is not properly configured.<br>• The surrounding interference is too strong. | • Check the related settings.<br>• Check the surrounding environment and eliminate interference. |
| E-NET | Ethernet communication fault | • The Ethernet address is incorrectly set.<br>• The Ethernet communication mode is selected incorrectly.<br>• The surrounding interference is too strong. | • Check the related settings.<br>• Check the selection of the communication mode.<br>• Check the surrounding environment and eliminate interference. |
| E-CAN | CANopen communication fault | • .The cables are in poor contact or the build-out resistor is not removed.<br>• The communication baud rates are different.<br>• The surrounding interference is too | • Check the cables and remove the build-out resistor.<br>• Set the same baud rate.<br>• Check the surrounding environment and eliminate interference. |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| | | strong. | |
| ETH1 | Short-to-ground fault 1 | • The servo drive is short to ground.<br>• The current detection circuit is faulty.<br>• The actual power setting of the motor is significantly different from the power of the servo drive. | • Check whether the motor is properly wired.<br>• Replace the Hall.<br>• Replace the main control board.<br>• Reset the parameters of the motor. |
| ETH2 | Short-to-ground fault 2 | • The servo drive output is short to ground.<br>• The current detection circuit is faulty.<br>• The actual power setting of the motor is significantly different from the power of the servo drive. | • Check whether the motor is properly wired.<br>• Replace the Hall.<br>• Replace the main control board.<br>• Reset the parameters of the motor. |
| dEu | Speed deviation fault | The load is too heavy or the rotation is blocked. | • Check the load. Ensure the load is normal.<br>• Increase the detection time.<br>• Check the control parameters. |
| STo | Misadjustment fault | • The control parameters of the synchronous motor are incorrectly set.<br>• The autotuning parameters are | • Check the load. Ensure the load is normal.<br>• Check the control parameters.<br>• Increase the |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| | | incorrectly set.<br>• The servo drive is not connected to the motor. | misadjustment detection time. |
| LL | Electronic underload fault | The servo drive generates underload alarms based on the preset value. | Check the load and underload alarm generating threshold. |
| ENC1O | Encoder disconnection fault | Errors occur in the line sequence of the encoder, or the signal cable is not properly connected. | Check the wiring of the encoder. |
| ENC1D | Encoder reverse running fault | The direction in the encoder speed signal is opposite to the running direction of the motor. | Reset the direction of the encoder. |
| ENC1Z | Encoder Z pulse disconnection fault | The Z signal line is disconnected. | Check the wiring of the Z signal. |
| OT | Motor overtemperature fault | • The motor overtemperature input terminal is enabled.<br>• Exceptions occur on the temperature detection resistor.<br>• The motor runs in the overload state for a long time, or exceptions occur on the motor. | • Check the wiring of the motor overtemperature input terminal (terminal function #57).<br>• Check whether the temperature sensor works properly.<br>• Check and maintain the motor. |
| ECUT 1 | Cutter linear speed too high | The linear speed of the cutter is too high (the linear speed corresponding to P00.03 is too high). | Check the diameter and deceleration ratio setting of the cutter, or reduce the value of P00.03 (Max. output frequency). |
| ECUT 3 | Error setting of the denominator of the material feeding pulse gear ratio | The value of P21.12 (Denominator of the material feeding pulse gear ratio) is set too | Reduce the value of P21.12. |

| Fault code | Fault type | Possible causes | Solution |
|---|---|---|---|
| | | large. | |
| ECUT 4 | Error setting of cutting length | The value of P23.15 (cutting length) is set too small. | Increase the value of P23.15. |
| ECUT 5 | Reference point not found | Reference points cannot be found. | Check whether the proximity switch (sensor) is properly wired. Check whether it is connected to the terminals S6 to S8. |
| ECUT 6 | Cutter reference point deviation | The position of the cutter exceeds the set value of P23.21 for three consecutive times. | Check whether the installation of the sensor causes large fluctuation of P18.28. Check whether the cutter deceleration ratio parameters P23.04 and P23.05 are set properly. Check whether the parameters P23.19 and P23.20 are set properly. |
| ECUT 7 | Color code signal missing fault | The color code signal missing fault occurs. See the parameters P22.10 and P22.11. | Check whether the color code sensor is installed properly. |

**7.4.2 Other state**

| Displayed code | State type | Possible cause | Solution |
|---|---|---|---|
| PoFF | System power failure | The system encounters a power outage or the bus voltage is too low. | Check the conditions of the grid. |

# Chapter 8 Communication protocol

## 8.1 Introduction to the Modbus protocol

Modbus is a software protocol, a common language used in electronic controllers. By using this protocol, a controller can communicate with other devices through transmission lines. It is a general industrial standard. With this standard, control devices produced by different manufacturers can be connected to form an industrial network and be monitored in a centralized way.

The Modbus protocol provides two transmission modes, namely American Standard Code for Information Interchange (ASCII) and remote terminal units (RTU). On one Modbus network, all the device transmission modes, baud rates, data bits, check bits, end bits, and other basic parameters must be set consistently.

A Modbus network is a control network with one master and multiple slaves, that is, on one Modbus network, there is only one device serving as the master, and other devices are the slaves. The master can communicate with one slave or broadcast messages to all the slaves. For separate access commands, a slave needs to return a response. For broadcasted information, slaves do not need to return responses.

## 8.2 Application of Modbus

DSV110 servo drives use the RTU mode provided by the Modbus protocol, and RS485 interfaces are used.

### 8.2.1 RS485

RS485 interfaces work in half-duplex mode and transmit data signals in the differential transmission way, which is also referred to as balanced transmission. An RS485 interface uses a twisted pair, where one wire is defined as A (+), and the other B (-). Generally, if the positive electrical level between the transmission drives A and B ranges from +2 V to +6 V, the logic is "1"; and if it ranges from -2 V to -6 V, the logic is "0".

The 485+ terminal on the terminal block of the servo drive corresponds to A, and 485- corresponds to B.

The communication baud rate (P14.01) indicates the number of bits transmitted in a second, and the unit is bit/s (bps). A higher baud rate indicates faster transmission and poorer anti-interference capability. When a twisted pair of 0.56 mm (24 AWG) is used, the maximum transmission distance varies according to the baud rate, as described in the following table.

| Baud rate (bps) | Max. transmission distance | Baud rate (bps) | Max. transmission distance |
|---|---|---|---|
| 2400 | 1800 m | 9600 | 800 m |
| 4800 | 1200 m | 19200 | 600 m |

When RS485 interfaces are used for long-distance communication, it is recommended that you use shielded cables, and use the shield layer as the ground wires.

When there are fewer devices and the transmission distance is short, the whole network works well without terminal load resistors. The performance, however, degrades as the distance increases.

Therefore, it is recommended that you use a 120 Ω terminal resistor when the transmission distance is long.

#### 8.2.1.1 Application to one servo drive

Figure 8-1 is the Modbus wiring diagram of one servo drive and a PC. Generally, PCs do not provide RS485 interfaces, so you need to convert an RS232 interface or USB port of a PC to an RS485 interface. Connect end A of the RS485 interface to the 485+ port on the terminal block of the servo drive, and connect end B to the 485- port. It is recommended that you use shielded twisted pairs. When an RS232-RS485 converter is used, the cable used to connect the RS232 interface of the PC and the converter cannot be longer than 15 m. Use a short cable when possible. It is recommended that you insert the converter directly into the PC. Similarly, when a USB-RS485 converter is used, use a short cable when possible.

After the wiring is complete, select the correct port (the one that connects to the RS232-RS485 converter, for example, COM1) for the upper computer, and set the communication baud rate, data bit check, and other basic parameters to be consistent with those of the servo drive.

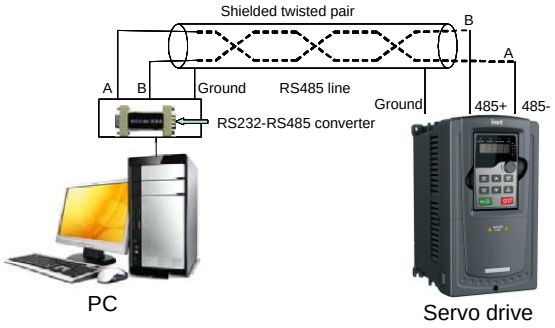



Figure 8-1 Wiring of RS485 applied to one servo drive

### 8.2.2 RTU mode

#### 8.2.2.1 RTU communication frame structure

When a controller is set to use the RTU communication mode on a Modbus network, every byte (8 bits) in the message includes 2 hexadecimal characters (each includes 4 bits). Compared with the ASCII mode, the RTU mode can transmit more data with the same baud rate.

**Code system**

- 1 start bit
- 7 or 8 data bits; the minimum valid bit is transmitted first. Each frame domain of 8 bits includes 2 hexadecimal characters (0–9, A–F).
- 1 odd/even check bit; this bit is not provided if no check is needed.
- 1 end bit (with check performed), 2 bits (without check)

**Error detection domain**

- Cyclic redundancy check (CRC)

The following table describes the data format.

11-bit character frame (Bits 1 to 8 are data bits)

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Start bit | BIT1 | BIT2 | BIT3 | BIT4 | BIT5 | BIT6 | BIT7 | BIT8 | Check bit | End bit |

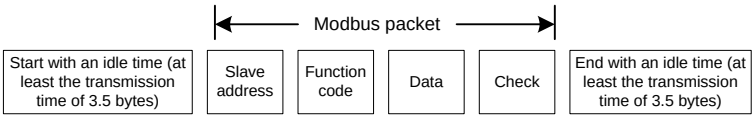
10-bit character frame (Bits 1 to 7 are data bits)

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Start bit | BIT1 | BIT2 | BIT3 | BIT4 | BIT5 | BIT6 | BIT7 | Check bit | End bit |

In a character frame, only the data bits carry information. The start bit, check bit, and end bit are used to facilitate the transmission of the data bits to the destination device. In practical applications, you must set the data bits, parity check bits, and end bits consistently.

In RTU mode, the transmission of a new frame always starts from an idle time (the transmission time of 3.5 bytes). On a network where the transmission rate is calculated based on the baud rate, the transmission time of 3.5 bytes can be easily obtained. After the idle time ends, the data domains are transmitted in the following sequence: slave address, operation command code, data, and CRC check character. Each byte transmitted in each domain includes 2 hexadecimal characters (0–9, A–F). The network devices always monitor the communication bus. After receiving the first domain (address information), each network device identifies the byte. After the last byte is transmitted, a similar transmission interval (the transmission time of 3.5 bytes) is used to indicate that the transmission of the frame ends. Then, the transmission of a new frame starts.

RTU data frame format




The information of a frame must be transmitted in a continuous data flow. If there is an interval greater than the transmission time of 1.5 bytes before the transmission of the entire frame is complete, the receiving device deletes the incomplete information, and mistakes the subsequent byte for the address domain of a new frame. Similarly, if the transmission interval between two frames is shorter than the transmission time of 3.5 bytes, the receiving device mistakes it for the data of the last frame. The CRC check value is incorrect due to the disorder of the frames, and thus a communication fault occurs.

The following table describes the standard structure of an RTU frame.

| | |
|---|---|
| START (frame header) | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR (slave address domain) | Communication address: 0–247 (decimal system) (0 is the broadcast address) |
| CMD (function domain) | 03H: read slave parameters<br>06H: write slave parameters |

| | |
|---|---|
| DATA (N-1)<br>…<br>DATA (0)<br>(data domain) | Data of 2×N bytes, main content of the communication as well as the core of data exchanging |
| CRC CHK (LSBs) | Detection value: CRC (16 bits) |
| CRC CHK (MSBs) | |
| END (frame tail) | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

**8.2.2.2 RTU communication frame error check modes**

During the transmission of data, errors may occur due to various factors. Without check, the data receiving device cannot identify data errors and may make a wrong response. The wrong response may cause severe problems. Therefore, the data must be checked.

The check is implemented as follows: The transmitter calculates the to-be-transmitted data based on a specific algorithm to obtain a result, adds the result to the rear of the message, and transmits them together. After receiving the message, the receiver calculates the data based on the same algorithm to obtain a result, and compares the result with that transmitted by the transmitter. If the results are the same, the message is correct. Otherwise, the message is considered wrong.

The error check of a frame includes two parts, namely, bit check on individual bytes (that is, odd/even check using the check bit in the character frame), and whole data check (CRC check).

**Bit check on individual bytes (odd/even check)**

You can select the bit check mode as required, or you can choose not to perform the check, which will affect the check bit setting of each byte.

Definition of even check: Before the data is transmitted, an even check bit is added to indicate whether the number of "1" in the to-be-transmitted data is odd or even. If it is even, the check bit is set to "0"; and if it is odd, the check bit is set to "1".

Definition of odd check: Before the data is transmitted, an odd check bit is added to indicate whether the number of "1" in the to-be-transmitted data is odd or even. If it is odd, the check bit is set to "0"; and if it is even, the check bit is set to "1".

For example, the data bits to be transmitted are "11001110", including five "1". If the even check is applied, the even check bit is set to "1"; and if the odd check is applied, the odd check bit is set to "0". During the transmission of the data, the odd/even check bit is calculated and placed in the check bit of the frame. The receiving device performs the odd/even check after receiving the data. If it finds that the odd/even parity of the data is inconsistent with the preset information, it determines that a communication error occurs.

**CRC check mode**

A frame in the RTU format includes an error detection domain based on the CRC calculation. The CRC domain checks all the content of the frame. The CRC domain consists of two bytes, including 16

binary bits. It is calculated by the transmitter and added to the frame. The receiver calculates the CRC of the received frame, and compares the result with the value in the received CRC domain. If the two CRC values are not equal to each other, errors occur in the transmission.

During CRC, 0xFFFF is stored first, and then a process is invoked to process a minimum of 6 contiguous bytes in the frame based on the content in the current register. CRC is valid only for the 8-bit data in each character. It is invalid for the start, end, and check bits.

During the generation of the CRC values, the "exclusive or" (XOR) operation is performed on the each 8-bit character and the content in the register. The result is placed in the bits from the least significant bit (LSB) to the most significant bit (MSB), and 0 is placed in the MSB. Then, LSB is detected. If LSB is 1, the XOR operation is performed on the current value in the register and the preset value. If LSB is 0, no operation is performed. This process is repeated 8 times. After the last bit (8th bit) is detected and processed, the XOR operation is performed on the next 8-bit byte and the current content in the register. The final values in the register are the CRC values obtained after operations are performed on all the bytes in the frame.

The calculation adopts the international standard CRC check rule. You can refer to the related standard CRC algorithm to compile the CRC calculation program as required.

The following is a simple CRC calculation function for your reference (using the C programming language):

```
unsigned int crc_cal_value(unsigned char*data_value,unsigned char data_length)
{
    int i;
    unsigned int crc_value=0xffff;
    while(data_length--)
    {
        crc_value^=*data_value++;
        for(i=0;i<8;i++)
        {
            if(crc_value&0x0001)
                crc_value=(crc_value>>1)^0xa001;
            else
                crc_value=crc_value>>1;
        }
    }
    return(crc_value);
}
```

In the ladder logic, CKSM uses the table look-up method to calculate the CRC value according to the content in the frame. The program of this method is simple, and the calculation is fast, but the ROM space occupied is large. Use this program with caution in scenarios where there are space occupation limits on programs.

## 8.3 RTU command code and communication data

### 8.3.1 Command code: 03H, reading N words (continuously reading a maximum of 16 words)

The command code 03H is used by the master to read data from the servo drive. The quantity of data to be read depends on the "data quantity" in the command. A maximum of 16 pieces of data can be read. The addresses of the read parameters must be contiguous. Each piece of data occupies 2 bytes, that is, one word. The command format is presented using the hexadecimal system (a number followed by "H" indicates a hexadecimal value). One hexadecimal value occupies one byte.

The 03H command is used to read information including the parameters and operation state of the servo drive.

For example, starting from the data address of 0004H, to read two contiguous pieces of data (that is, to read content from the data addresses 0004H and 0005H) from the servo drive whose address is 01H, the structure of the frame is described in the following table.

RTU master command (transmitted by the master to the servo drive)

| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
|---|---|
| ADDR (address) | 01H |
| CMD (command code) | 03H |
| Most significant byte (MSB) of the start address | 00H |
| Least significant byte (LSB) of the start address | 04H |
| MSB of data quantity | 00H |
| LSB of data quantity | 02H |
| LSB of CRC | 85H |
| MSB of CRC | CAH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

The value in START and END is "T1-T2-T3-T4 (transmission time of 3.5 bytes)", indicating that the RS485 needs to stay idle for at least the transmission time of 3.5 bytes. An idle time is required to distinguish on message from another to ensure that the two messages are not regarded as one.

The value of ADDR is 01H, indicating that the command is transmitted to the servo drive whose address is 01H. The ADDR information occupies one byte.

The value of CMD is 03H, indicating that the command is used to read data from the servo drive. The CMD information occupies one byte.

"Start address" indicates that data reading is started from this address. It occupies two bytes, with the

MSB on the left and LSB on the right.

"Data quantity" indicates the quantity of data to be read (unit: word).

The value of "Start address" is 0004H, and that of "Data quantity" is 0002H, indicating that data is to be read from the data addresses of 0004H and 0005H.

CRC check occupies two bytes, with the LSB on the left, and MSB on the right.

RTU slave response (transmitted by the servo drive to the master)

| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
|---|---|
| ADDR | 01H |
| CMD | 03H |
| Number of bytes | 04H |
| MSB of data in 0004H | 13H |
| LSB of data in 0004H | 88H |
| MSB of data in 0005H | 00H |
| LSB of data in 0005H | 00H |
| LSB of CRC | 7EH |
| MSB of CRC | 9DH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

The definition of the response information is described as follows:

The value of ADDR is 01H, indicating that the message is transmitted by the servo drive whose address is 01H. The ADDR information occupies one byte.

The value of CMD is 03H, indicating that the message is a response of the servo drive to the 03H command of the master for reading data. The CMD information occupies one byte.

"Number of bytes" indicates the number of bytes between a byte (not included) and the CRC byte (not included). The value 04 indicates that there are four bytes of data between "Number of bytes" and "LSB of CRC", that is, "MSB of data in 0004H", "LSB of data in 0004H", "MSB of data in 0005H", and "LSB of data in 0005H".

A piece of data is two bytes, with the MSB on the left and LSB on the right. From the response, we can see that the data in 0004H is 1388H, and that in 0005H is 0000H.

CRC check occupies two bytes, with the LSB on the left, and MSB on the right.

**8.3.2 Command code: 06H, writing a word**

This command is used by the master to write data to the servo drive. One command can be used to write only one piece of data. It is used to modify the parameters and operation mode of the servo drive.

For example, to write 5000 (1388H) to 0004H of the servo drive whose address is 02H, the structure of the frame is described in the following table.

RTU master command (transmitted by the master to the servo drive)

| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
|---|---|
| ADDR | 02H |
| CMD | 06H |
| MSB of data writing address | 00H |
| LSB of data writing address | 04H |
| MSB of to-be-written data | 13H |
| LSB of to-be-written data | 88H |
| LSB of CRC | C5H |
| MSB of CRC | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

RTU slave response (transmitted by the servo drive to the master)

| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
|---|---|
| ADDR | 02H |
| CMD | 06H |
| MSB of data writing address | 00H |
| LSB of data writing address | 04H |
| MSB of to-be-written data | 13H |
| LSB of to-be-written data | 88H |
| LSB of CRC | C5H |
| MSB of CRC | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

**Note:**

The sections 8.3.1 and 8.3.2 mainly describes the command formats. For the detailed application, see the examples in section 8.3.8.

**8.3.3 Command code: 08H, diagnosis**

Sub-function code description

| Sub-function code | Description |
|---|---|
| 0000 | Return data based on query requests |

For example, to query about the circuit detection information about the servo drive whose address is 01H, the query and return strings are the same, and the format is described in the following tables.

RTU master command

| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
|---|---|
| ADDR | 01H |

| | |
|---|---|
| CMD | 08H |
| MSB of the sub-function code | 00H |
| LSB of the sub-function code | 00H |
| MSB of data | 12H |
| LSB of data | ABH |
| LSB of CRC CHK | ADH |
| MSB of CRC CHK | 14H |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

RTU slave response

| | |
|---|---|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 01H |
| CMD | 08H |
| MSB of the sub-function code | 00H |
| LSB of the sub-function code | 00H |
| MSB of data | 12H |
| LSB of data | ABH |
| LSB of CRC CHK | ADH |
| MSB of CRC CHK | 14H |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

**8.3.4 Command code: 10H, continuous writing**

The command code 10H is used by the master to write data to the servo drive. The quantity of data to be written is determined by "Data quantity", and a maximum of 16 pieces of data can be written.

For example, to write 5000 (1388H) and 50 (0032H) respectively to 0004H and 0005H of the servo drive whose slave address is 02H, the structure of the frame is described in the following table.

RTU master command (transmitted by the master to the servo drive)

| | |
|---|---|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 02H |
| CMD | 10H |
| MSB of data writing address | 00H |
| LSB of data writing address | 04H |
| MSB of data quantity | 00H |
| LSB of data quantity | 02H |
| Number of bytes | 04H |
| MSB of data to be written to 0004H | 13H |

| | |
|---|---|
| LSB of data to be written to 0004H | 88H |
| MSB of data to be written to 0005H | 00H |
| LSB of data to be written to 0005H | 32H |
| LSB of CRC | C5H |
| MSB of CRC | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

RTU slave response (transmitted by the servo drive to the master)

| | |
|---|---|
| START | T1-T2-T3-T4 (transmission time of 3.5 bytes) |
| ADDR | 02H |
| CMD | 10H |
| MSB of data writing address | 00H |
| LSB of data writing address | 04H |
| MSB of data quantity | 00H |
| LSB of data quantity | 02H |
| LSB of CRC | C5H |
| MSB of CRC | 6EH |
| END | T1-T2-T3-T4 (transmission time of 3.5 bytes) |

**8.3.5 Data address definition**

This section describes the address definition of communication data. The addresses are used for controlling the running, obtaining the state information, and setting related function parameters of the servo drive.

**8.3.5.1 Function code address representation rules**

The address of a function code consists of two bytes, with the MSB on the left and LSB on the right. The MSB ranges from 00 to ffH, and the LSB also ranges from 00 to ffH. The MSB is the hexadecimal form of the group number before the dot mark, and LSB is that of the number behind the dot mark. Take P05.06 as an example, the group number is 05, that is, the MSB of the parameter address is the hexadecimal form of 05; and the number behind the dot mark is 06, that is, the LSB is the hexadecimal form of 06. Therefore, the function code address is 0506H in the hexadecimal form. For P10.01, the parameter address is 0A01H.

| Function code | Name | Detailed parameter description | Default value | Modify |
|---|---|---|---|---|
| P10.00 | Simple PLC mode | 0: Stop after running once; the inverter stops automatically after running for one cycle, and it can be started only after receving running command.<br>1: Keep running in the final value after running once; The inverter keeps the running frequency and direction of the last section after a single cycle.<br>2: Cyclic running; the inverter enters the next cycle after completing one cycle until receving stop command and stops. | 0 | ○ |
| P10.01 | Simple PLC memory selection | 0: No memory after power dip<br>1: Memory after power dip; PLC memories its running stage and running frequency before power dip. | 0 | ○ |

**Note:**

- The parameters in the P29 group are set by the manufacturer. They cannot be read or modified. Some parameters cannot be modified when the servo drive is running; some cannot be modified regardless of the state of the servo drive. Pay attention to the setting range, unit, and related description of a parameter when modifying it.
- The service life of the Electrically Erasable Programmable Read-Only Memory (EEPROM) may be reduced if it is frequently used for storage. For users, some function codes do not need to be stored during communication. The application requirements can be met by modifying the value of the on-chip RAM, that is, modifying the MSB of the corresponding function code address from 0 to 1. For example, if P00.07 is not to be stored in the EEPROM, you need only to modify the value of the RAM, that is, set the address to 8007H. The address can be used only for writing data to the on-chip RAM, and it is invalid when used for reading data.

**8.3.5.2 Description of other function code addresses**

In addition to modifying the parameters of the servo drive, the master can also control the servo drive, such as start and stop it, and monitor the operation state of the servo drive.

The following table describes other function parameters.

| Function | Address | Data description | R/W |
|---|---|---|---|
| Communication-based control command | 2000H | 0001H: Forward running | R/W |
| | | 0002H: Reverse running | |
| | | 0003H: Forward jogging | |
| | | 0004H: Reverse jogging | |
| | | 0005H: Stop | |
| | | 0006H: Coast to stop (emergency stop) | |
| | | 0007H: Fault reset | |

| Function | Address | Data description | R/W |
|---|---|---|---|
| | | 0008H: Jogging to stop | |
| Communication-based value setting | 2001H | Communication-based frequency setting (0–Fmax, unit: 0.01 Hz) | R/W |
| | 2002H | PID setting, range (0–1000, 1000 corresponding to 100.0%) | |
| | 2003H | PID feedback, range (0–1000, 1000 corresponding to 100.0%) | R/W |
| | 2004H | Torque setting (-3000–+3000, 1000 corresponding to 100.0% of the rated current of the motor) | R/W |
| | 2005H | Setting of the upper limit of the forward running frequency (0–Fmax, unit: 0.01 Hz) | R/W |
| | 2006H | Setting of the upper limit of the reverse running frequency (0–Fmax, unit: 0.01 Hz) | R/W |
| | 2007H | Upper limit of the electromotion torque (0–3000, 1000 corresponding to 100.0% of the rated current of the servo drive) | R/W |
| | 2008H | Upper limit of the brake torque (0–3000, 1000 corresponding to 100.0% of the rated current of the motor) | R/W |
| | 2009H | Special control command word:<br>Bit0–1: =00: Motor 1 =01: Motor 2<br>=10: Motor 3 =11: Motor 4<br>Bit2: =1 Torque control disabled =0: Torque control cannot be disabled<br>Bit3: =1 Power consumption reset to 0<br>=0: Power consumption not reset<br>Bit4: =1 Pre-excitation =0: Pre-excitation disabled<br>Bit5: =1 DC brake =0: DC brake disabled | R/W |
| | 200AH | Virtual input terminal command, range: 0x000–0x1FF | R/W |
| | 200BH | Virtual output terminal command, range: 0x00–0x0F | R/W |
| | 200CH | Voltage setting (used when V/F separation is implemented)<br>(0–1000, 1000 corresponding to 100.0% of the rated voltage of the motor) | R/W |
| | 200DH | AO output setting 1 (-1000–+1000, 1000 | R/W |

| Function | Address | Data description | | R/W |
|---|---|---|---|---|
| | | corresponding to 100.0%) | | |
| | 200EH | AO output setting 2 (-1000–+1000, 1000 corresponding to 100.0%) | | R/W |
| Servo drive state word 1 | 2100H | 0001H: Forward running | | R |
| | | 0002H: Reverse running | | |
| | | 0003H: Stopped | | |
| | | 0004H: Faulty | | |
| | | 0005H: POFF | | |
| | | 0006H: Pre-excited | | |
| Servo drive state word 2 | 2101H | Bit0: =0: Not ready to run =1: Ready to run<br>Bi1–2: =00: Motor 1 =01: Motor 2<br>=10: Motor 3 =11: Motor 4<br>Bit3: =0: Asynchronous machine =1: Synchronous machine<br>Bit4: =0: No overload alarm =1: Overload alarm<br>Bit5–Bit6: =00: Keypad-based control =01: Terminal-based control<br>=10: Communication-based control | | R |
| Servo drive fault code | 2102H | See the description of fault types. | | R |
| Servo drive identification code | 2103H | DSV110-----0x0109 | | R |
| Running frequency | 3000H | 0–Fmax (unit: 0.01Hz) | Compatible with CHF100A and CHV100 communication addresses | R |
| Set frequency | 3001H | 0–Fmax (unit: 0.01Hz) | | R |
| Bus voltage | 3002H | 0.0–2000.0 V (unit: 0.1V) | | R |
| Output voltage | 3003H | 0–1200V (unit: 1V) | | R |
| Output current | 3004H | 0.0–3000.0A (unit: 0.1A) | | R |
| Rotating speed | 3005H | 0–65535 (unit: 1RPM) | | R |
| Outptut power | 3006H | -300.0–+300.0% (unit: 0.1%) | | R |
| Output torque | 3007H | -250.0–+250.0% (unit: 0.1%) | | R |
| Closed-loop setting | 3008H | -100.0–+100.0% (unit: 0.1%) | | R |
| Closed-loop feedback | 3009H | -100.0–+100.0% (unit: 0.1%) | | R |
| Input state | 300AH | 000–1FF | | R |
| Output state | 300BH | 000–1FF | | R |
| Analog input 1 | 300CH | 0.00–10.00 V (unit: 0.01V) | | R |
| Analog input 2 | 300DH | 0.00–10.00 V (unit: 0.01V) | | R |

| Function | Address | Data description | | R/W |
|---|---|---|---|---|
| Analog input 3 | 300EH | -10.00–+10.00 V (unit: 0.01V) | | R |
| Analog input 4 | 300FH | | | R |
| Read input of high-speed pulse 1 | 3010H | 0.00–50.00 kHz (unit: 0.01Hz) | | R |
| Read input of high-speed pulse 2 | 3011H | | | R |
| Read current step of multi-step speed | 3012H | 0–15 | | R |
| Torque setting | 3015H | -300.0–+300.0% (unit: 0.1%) | | R |
| Identification code | 3016H | | | R |
| Fault code | 5000H | | | R |

The Read/Write (R/W) characteristics indicate whether a function can be read and written. For example, "Communication-based control command" can be written, and therefore the command code 06H is used to control the servo drive. The R characteristic indicates that a function can only be read, and W indicates that a function can only be written.

**Note:** Some parameters in the preceding table are valid only after they are enabled. Take the running and stop operations as examples, you need to set "Channel of running commands" (P00.01) to "Communication", and set "Communication running command channel" (P00.02) to the Modbus communication channel. For another example, when modifying "PID setting", you need to set "PID reference source" (P09.00) to Modbus communication.

### 8.3.6 Fieldbus scale

In practical applications, communication data is represented in the hexadecimal form, but hexadecimal values cannot represent decimals. For example, 50.12 Hz cannot be represented in the hexadecimal form. In such cases, we can multiply 50.12 by 100 to obtain an integer 5012, and then 50.12 can be represented as 1394H (5012 in the decimal form) in the hexadecimal form.

In the process of multiplying a non-integer by a multiple to obtain an integer, the multiple is referred to as a fieldbus scale.

The fieldbus scale depends on the number of decimals in the value specified in "Detailed parameter description" or "Default value". If there are n decimals in the value, the fieldbus scale m is the nth-power of 10. Take the following value as an example, m is 10.

| Function code | Name | Detailed parameter description | Default value |
|---|---|---|---|
| P01.20 | Wake-up-from-sleep delay | 0.0–3600.0s (valid when P01.19 is 2) | 0.0s |
| P01.21 | Restart after power cut | 0: Restart is disabled<br>1: Restart is enabled | 0 |

The value specified in "Detailed parameter description" or "Default value" contains one decimal, so the fieldbus scale is 10. If the value received by the upper computer is 50, the value of

"Wake-up-from-sleep delay" of the servo drive is 5.0 (5.0=50/10).

To set the "Wake-up-from-sleep delay" to 5.0s through Modbus communication, you need first to multiply 5.0 by 10 according to the scale to obtain an integer 50, that is, 32H in the hexadecimal form, and then transmit the following write command:

| 01 | 06 | 01 14 | 00 32 | 49 E7 |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Parameter data | CRC |

After receiving the command, the servo drive converts 50 into 5.0 based on the fieldbus scale, and then sets "Wake-up-from-sleep delay" to 5.0s.

For another example, after the upper computer transmits the "Wake-up-from-sleep delay" parameter read command, the master receives the following response from the servo drive:

| 01 | 03 | 02 | 00 32 | 39 91 |
|---|---|---|---|---|
| Servo drive address | Read command | 2-byte data | Parameter data | CRC |

The parameter data is 0032H, that is, 50, so 5.0 is obtained based on the fieldbus scale (50/10=5.0). In this case, the master identifies that the "Wake-up-from-sleep delay" is 5.0s.

**8.3.7 Error message response**

Operation errors may occur in communication-based control. For example, some parameters can only be read, but a write command is transmitted. In this case, the servo drive returns an error message response.

Error message responses are transmitted by the servo drive to the master. The following table describes the codes and definitions of the error message responses.

| Code | Name | Definition |
|---|---|---|
| 01H | Invalid command | The command code received by the upper computer is not allowed to be executed. The possible causes are as follows:<br>• The function code is applicable only on new devices and is not implemented on this device.<br>• The slave is in the faulty state when processing this request. |
| 02H | Invalid data address | For the servo drive, the data address in the request of the upper computer is not allowed. In particular, the combination of the register address and the number of the to-be-transmitted bytes is invalid. |
| 03H | Invalid data bit | The received data domain contains a value that is not allowed. The value indicates the error of the remaining structure in the combined |

| Code | Name | Definition |
|---|---|---|
| | | request.<br>**Note:** It does not mean that the data item submitted for storage in the register includes a value unexpected by the program. |
| 04H | Operation failure | The parameter is set to an invalid value in the write operation. For example, a function input terminal cannot be set repeatedly. |
| 05H | Password error | The password entered in the password verification address is different from that set in P07.00. |
| 06H | Data frame error | The length of the data frame transmitted by the upper computer is incorrect, or in the RTU format, the value of the CRC check bit is inconsistent with the CRC value calculated by the lower computer |
| 07H | Parameter read-only | The parameter to be modified in the write operation of the upper computer is a read-only parameter. |
| 08H | Parameter cannot be modified in running | The parameter to be modified in the write operation of the upper computer cannot be modified during the running of the servo drive. |
| 09H | Password protection | A user password is set, and the upper computer does not provide the password to unlock the system when performing a read or write operation. The error of "system locked" is reported. |

When returning a response, the device uses a function code domain and fault address to indicate whether it is a normal response (no error) or exception response (some errors occur). In a normal response, the device returns the corresponding function code and data address or sub-function code. In an exception response, the device returns a code that is equal to a normal code, but the first bit is logic 1.

For example, if the master device transmits a request message to a slave device for reading a group of function code address data, the code is generated as follows:

0 0 0 0 0 0 1 1 (03H in the hexadecimal form)

For a normal response, the same code is returned.

For an exception response, the following code is returned:

1 0 0 0 0 0 1 1 (83H in the hexadecimal form)

In addition to the modification of the code, the slave returns a byte of exception code that describes the cause of the exception. After receiving the exception response, the typical processing of the master device is to transmit the request message again or modify the command based on the fault information.

For example, to set the "Channel of running commands" (P00.01, the parameter address is 0001H) of the servo drive whose address is 01H to 03, the command is as follows:

| 01 | 06 | 00 01 | 00 03 | 98 0B |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Parameter data | CRC |

But the setting range of the "Running command channel" is 0 to 2. The value 3 exceeds the setting range. In this case, the servo drive returns an error message response as shown in the following:

| 01 | 86 | 04 | 43 A3 |
|---|---|---|---|
| Servo drive address | Exception response code | Error code | CRC |

The exception response code 86H (generated based on the MSB "1" of the write command 06H) indicates that it is an exception response to the write command (06H). The error code is 04H. From the preceding table, we can see that it indicates the error "Operation failure", which means "The parameter is set to an invalid value in the write operation".

**8.3.8 Read/Write operation example**

For the formats of the read and write commands, see sections 8.3.1 and 8.3.2.

**8.3.8.1 Read command 03H examples**

Example 1: Read state word 1 of the servo drive whose address is 01H. From the table of other function parameters, we can see that the parameter address of state word 1 of the servo drive is 2100H.

The read command transmitted to the servo drive is as follows:

| 01 | 03 | 21 00 | 00 01 | 8E 36 |
|---|---|---|---|---|
| Servo drive address | Read command | Parameter address | Data quantity | CRC |

Assume that the following response is returned:

| 01 | 03 | 02 | 00 03 | F8 45 |
|---|---|---|---|---|
| Servo drive address | Read command | Number of bytes | Data content | CRC |

The data content returned by the servo drive is 0003H, which indicates that the servo drive is in the stopped state.

Example 2: View information about the servo drive whose address is 03H, including "Type of current fault" (P07.27) to "Type of last but four fault" (P07.32) of which the parameter addresses are 071BH to 0720H (contiguous 6 parameter addresses starting from 071BH).

The command transmitted to the servo drive is as follows:

| 03 | 03 | 07 1B | 00 06 | B5 59 |
|---|---|---|---|---|
| Servo drive address | Read command | Start address | 6 parameters in total | CRC |

Assume that the following response is returned:

| 03 | 03 | 0C | 00 23 | 00 23 | 00 23 | 00 23 | 00 23 | 00 23 | 5F D2 |
|---|---|---|---|---|---|---|---|---|---|
| Servo drive address | Read command | Number of bytes | Type of current fault | Type of last fault | Type of last but one fault | Type of last but two fault | Type of last but three fault | Type of last but four fault | CRC |

From the returned data, we can see that all the fault types are 0023H, that is, 35 in the decimal form, which means the misadjustment fault (STo)

**8.3.8.2 Write command 06H examples**

Example 1: Set the servo drive whose address is 03H to be forward running. Refer to the table of other function parameters, the address of "Communication-based control command" is 2000H, and 0001H indicates forward running, as shown in the following figure.

| Function | Address | Data description | R/W |
|---|---|---|---|
| Communication-based control command | 2000H | 0001H: Forward running | R/W |
| | | 0002H: Reverse running | |
| | | 0003H: Forward jogging | |
| | | 0004H: Reverse jogging | |
| | | 0005H: Stop | |
| | | 0006H: Coast to stop (emergency stop) | |
| | | 0007H: Fault reset | |
| | | 0008H: Jogging to stop | |

The command transmitted by the master is as follows:

| 03 | 06 | 20 00 | 00 01 | 42 28 |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Forward running | CRC |

If the operation is successful, the following response is returned (same as the command transmitted by the master):

| 03 | 06 | 20 00 | 00 01 | 42 28 |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Forward running | CRC |

Example 2: Set the "Max. output frequency" of the servo drive whose address is 03H to 100 Hz.

| Function code | Name | Detailed parameter description | Default value | Modify |
|---|---|---|---|---|
| P00.03 | Max. output frequency | Used to set the max. output frequency of the inverter. It is the basis of frequency setup and the acceleration/deceleration.<br>Setting range: Max (P00.04, 10.00) –630.00Hz | 50.00Hz | ◎ |

From the number of decimals, we can see that the fieldbus scale of the "Max. output frequency" (P00.03) is 100. Multiply 100 Hz by 100. The value 10000 is obtained, and it is 2710H in the hexadecimal form.

The command transmitted by the master is as follows:

| 03 | 06 | 00 03 | 27 10 | 62 14 |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Parameter data | CRC |

If the operation is successful, the following response is returned (same as the command transmitted by the master):

| 03 | 06 | 00 03 | 27 10 | 62 14 |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Parameter data | CRC |

**Note:** In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

**8.3.8.3 Continuously write command 10H examples**

Example 1: Set the servo drive whose address is 01H to be forward running at the frequency of 10 Hz. Refer to the table of other function parameters, the address of "Communication-based control command" is 2000H, 0001H indicates forward running, and the address of "Communication-based value setting" is 2001H, as shown in the following figure. 10 Hz is 03E8H in the hexadecimal form.

| Function | Address | Data description | R/W |
|---|---|---|---|
| Communication-based control command | 2000H | 0001H: Forward running | R/W |
| | | 0002H: Reverse running | |
| | | 0003H: Forward jogging | |
| | | 0004H: Reverse jogging | |
| | | 0005H: Stop | |
| | | 0006H: Coast to stop (emergency stop) | |
| | | 0007H: Fault reset | |
| | | 0008H: Jogging to stop | |
| Communication-based value setting | 2001H | Communication-based frequency setting (0 – Fmax, unit: 0.01 Hz) | R/W |
| | 2002H | PID setting, range (0–1000, 1000 corresponding to 100.0%) | |

In the actual operation, set P00.01 to 2 and P00.06 to 8.

The command transmitted by the master is as follows:

| 01 | 10 | 20 00 | 00 02 | 04 | 00 01 | 03 E8 | 3B 10 |
|---|---|---|---|---|---|---|---|
| Servo drive address | Continuous write command | Parameter address | Parameter quantity | Number of bytes | Froward running | 10 Hz | CRC |

If the operation is successful, the following response is returned:

| 01 | 10 | 20 00 | 00 02 | 4A 08 |
|---|---|---|---|---|
| Servo drive address | Continuous write command | Parameter address | Parameter quantity | CRC |

Example 2: Set "ACC time 1" of the servo drive whose address is 01H to 10s, and "DEC time 1" to 20s.

| Function code | Name | Detailed parameter description | Default value | Modify |
|---|---|---|---|---|
| P00.11 | ACC time 1 | Indicates the time the servo drive takes to accelerate from 0 Hz to P00.03 (Max. output frequency).<br>Setting range: 0.0–3600.0s | Depend on model | ○ |
| P00.12 | DEC time 1 | Indicates the time the servo drive takes to decelerate from P00.03 (Max. output frequency) to0 Hz.<br>Setting range: 0.0–3600.0s | Depend on model | ○ |

The address of P00.11 is 000B, 10s is 0064H in the hexadecimal form, and 20s is 00C8H in the hexadecimal form.

The command transmitted by the master is as follows:

| 01 | 10 | 00 0B | 00 02 | 04 | 00 64 | 00 C8 | F2 55 |
|---|---|---|---|---|---|---|---|
| Servo drive address | Continuous write command | Parameter address | Parameter quantity | Number of bytes | 10s | 20s | CRC |

If the operation is successful, the following response is returned:

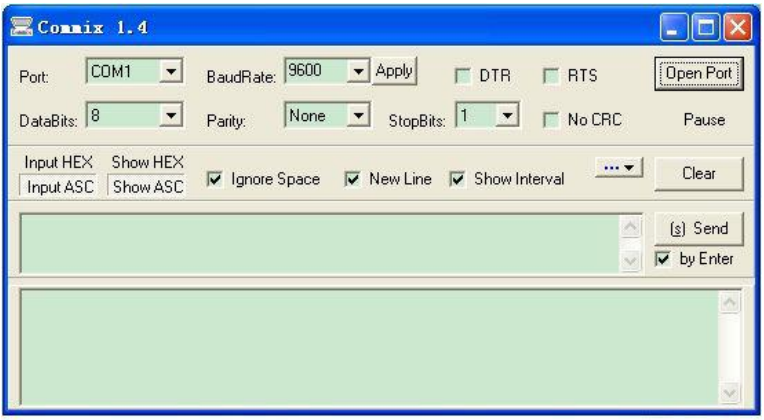
| 01 | 10 | 00 0B | 00 02 | 30 0A |
|---|---|---|---|---|
| Servo drive address | Continuous write command | Parameter address | Parameter quantity | CRC |

**Note:** In the preceding command description, spaces are added to a command just for explanatory purposes. In practical applications, no space is required in the commands.

**8.3.8.4 Modbus communication commissioning example**

A PC is used as the host, an RS232-RS485 converter is used for signal conversion, and the PC serial port used by the converter is COM1 (an RS232 port). The upper computer commissioning software is the serial port commissioning assistant Commix, which can be downloaded from the Internet. Download a version that can automatically execute the CRC check function. The following figure

shows the interface of Commix.




First, set the serial port to **COM1**. Then, set the baud rate consistently with P14.01. The data bits, check bits, and end bits must be set consistently with P14.02. If the RTU mode is selected, you need to select the hexadecimal form **Input HEX**. To set the software to automatically execute the CRC function, you need to select **ModbusRTU**, select **CRC16 (MODBU SRTU)**, and set the start byte to **1**. After the auto CRC check function is enabled, do not enter CRC information in commands. Otherwise, command errors may occur due to repeated CRC check.

The commissioning command to set the servo drive whose address is 03H to be forward running is as follows (see example 1 in section 8.3.8.2):

| **03** | **06** | **20 00** | **00 01** | **42 28** |
|---|---|---|---|---|
| Servo drive address | Write command | Parameter address | Forward running | CRC |

**Note:**

1. Set the address (P14.00) of the servo drive to 03.
2. Set "Channel of running commands" (P00.01) to "Communication", and set "Communication channel of running commands" (P00.02) to the Modbus communication channel.
3. Click **Send**. If the line configuration and settings are correct, a response transmitted by the servo drive.

## 8.4 Common communication faults

Common communication faults include the following:

- No response is returned.
- The servo drive returns an exception response.

Possible causes of no response include the following:

- The serial port is set incorrectly. For example, the converter uses the serial port COM1, but

COM2 is selected for the communication.

- The settings of the baud rates, data bits, end bits, and check bits are inconsistent with those set on the servo drive.
- The positive pole (+) and negative pole (-) of the RS485 bus are connected reversely.
- The 485 terminal cap on the terminal block of the servo drive is not plugged in.

# Appendix A Extension cards

## A.1 Optional PROFIBUS cards

See the manual of optional PROFIBUS cards.

## A.2 Optional CANopen cards

See the manual of optional CANopen cards.

# Appendix B Technical data

## B.1 Grid specifications

| | |
|---|---|
| Grid voltage | AC 3PH 380V (-15%)–440V (+10%) |
| Short-circuit capacity | According to the definition in IEC 60439-1, the maximum allowable short-circuit current at the incoming end is 100 kA. Therefore, the servo drive is applicable to scenarios where the transmitted current in the circuit is no larger than 100 kA when the servo drive runs at the maximum rated voltage. |
| Frequency | 50/60 Hz±5%, with a maximum change rate of 20%/s |

## B.2 Motor connection data

| | |
|---|---|
| Motor type | Asynchronous induction motor or permanent-magnet synchronous motor |
| Voltage | 0–U1 (rated voltage of the motor), 3PH symmetrical, Umax (rated voltage of the servo drive) at the field-weakening point |
| Short-circuit protection | The short-circuit protection for the motor output meets the requirements of IEC 61800-5-1. |
| Frequency | 0–400 Hz |
| Frequency resolution | 0.01 Hz |
| Current | See the rated current. |
| Power limit | 1.5 times of the rated power of the motor |
| Field-weakening point | 10–400 Hz |
| Carrier frequency | 4, 8, 12, or 15 kHz |

### B.2.1 EMC compatibility and motor cable length

The following table describes the maximum motor cable lengths that meet the requirements of the EU EMC directive (2004/108/EC) when the carrier frequency is 4 kHz.

| All models (with external EMC filters) | Maximum motor cable length (m) |
|---|---|
| Environment category II (C3) | 30 |
| Environment category I (C2) | 30 |

You can learn the maximum length of the motor cable through the running parameters of the servo drive. To understand the accurate maximum cable length for using an external EMC filter, contact the local INVT office.

For description about the environment categories I (C2) and II (C3), see section "EMC regulations".

## B.3 Application standards

The following table describes the standards that the servo drives comply with.

| | |
|---|---|
| EN/ISO 13849-1:2008 | Safety of machinery—Safety-related parts of control systems—Part 1: General principles for design |

| | |
|---|---|
| IEC/EN 60204-1:2006 | Safety of machinery—Electrical equipment of machines. Part 1: General requirements |
| IEC/EN 62061:2005 | Safety of machinery—Safety-related functional safety of electrical, electronic, and programmable electronic control systems |
| IEC/EN 61800-3:2004 | Adjustable speed electrical power drive systems—Part 3:EMC requirements and specific test methods |
| IEC/EN 61800-5-1:2007 | Adjustable speed electrical power drive systems—Part 5-1: Safety requirements—Electrical, thermal and energy |
| IEC/EN 61800-5-2:2007 | Adjustable speed electrical power drive systems—Part 5-2: Safety requirements—Function |

**B.3.1 CE marking**

The CE marking on the name plate of a servo drive indicates that the servo drive is CE-compliant, meeting the regulations of the European low-voltage directive (2006/95/EC) and EMC directive (2004/108/EC).

**B.3.2 EMC compliance declaration**

European Union (EU) stipulates that the electric and electrical devices sold in Europe cannot generate electromagnetic disturbance that exceeds the limits stipulated in related standards, and can work properly in environments with certain electromagnetic interference. The EMC product standard (EN 61800-3:2004) describes the EMC standards and specific test methods for adjustable speed electrical power drive systems. Products must strictly follow these EMC regulations.

## B.4 EMC regulations

The EMC product standard (EN 61800-3:2004) describes the EMC requirements on servo drives.

**Application environment categories**

Category I: Civilian environments, including application scenarios where servo drives are directly connected to the civil power supply low-voltage grids without intermediate transformers

Category II: All environments except those in Category I.

**Servo drive categories**

C1: Rated voltage lower than 1000 V, applied to environments of Category I.

C2: Rated voltage lower than 1000 V, non-plug, socket, or mobile devices; power drive systems that must be installed and operated by specialized personnel when applied to environments of Category I

**Note:** The EMC standard IEC/EN 61800-3 no longer restricts the power distribution of servo drives, but it specifies their use, installation, and commissioning. Specialized personnel or organizations must have the necessary skills (including the EMC-related knowledge) for installing and/or performing commissioning on the electrical drive systems.

C3: Rated voltage lower than 1000 V, applied to environments of Category II. They cannot be applied to environments of Category I.

C4: Rated voltage higher than 1000 V, or rated current higher or equal to 400 A, applied to complex systems in environments of Category II.

### B.4.1 Servo drive category of C2

The induction disturbance limit meets the following stipulations:

1. Select an optional EMC filter according to Appendix D and install it following the description in the EMC filter manual.
2. Select the motor and control cables according to the description in the manual.
3. Install the servo drive according to the description in the manual.
4. For the maximum length of the motor cable when the switching frequency is 4 kHz, see section "EMC compatibility and motor cable length".

| | |
|---|---|
|  | Currently in environments in China, the inverter may generate radio interference, and you need to take measures to reduce the interference. |

### B.4.2 Servo drive category of C3

The anti-interference performance of the servo drive meets the requirements of environment Category II in the IEC/EN 61800-3 standard.

The induction disturbance limit meets the following stipulations:

1. Select an optional EMC filter according to Appendix D and install it following the description in the EMC filter manual.
2. Select the motor and control cables according to the description in the manual.
3. Install the servo drive according to the description in the manual.
4. For the maximum length of the motor cable when the switching frequency is 4 kHz, see section "EMC compatibility and motor cable length".

| | |
|---|---|
|  | Servo drives of C3 category cannot be applied to civilian low-voltage common grids. When applied to such grids, the servo drive may generate radio frequency electromagnetic interference. |

# Appendix C Dimension diagrams

## C.1 Keypad structure

### C.1.1 Structure diagram

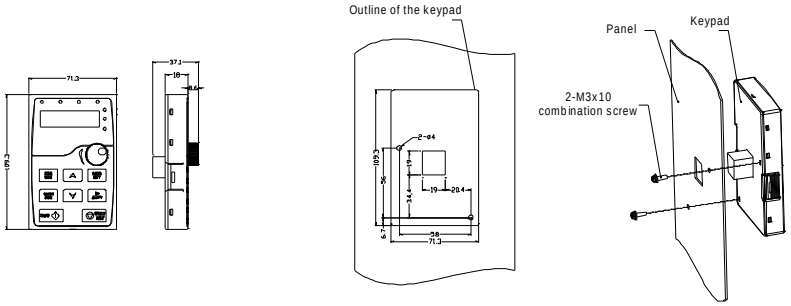



Figure C-1 Structure diagram

### C.1.2 Keypad installation bracket

**Note:** When installing a keypad externally, you can directly use M3 thread screws to fix it or use a keypad mounting bracket. For servo drives of 380 V, 1.5 to 30 kW, keypad mounting brackets are optional, and you need to purchase them if required. For those of 380 V, 37 to 315 kW, the keypad can be installed externally by using the standard keypad mounting bracket or an optional one.

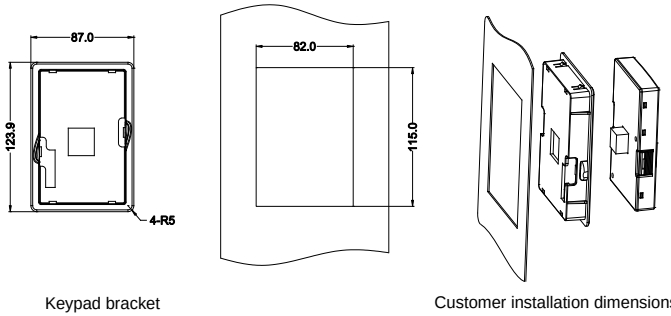



Figure C-2 Keypad installation bracket (optional) for servo drives of 380 V, 4 to 315 kW

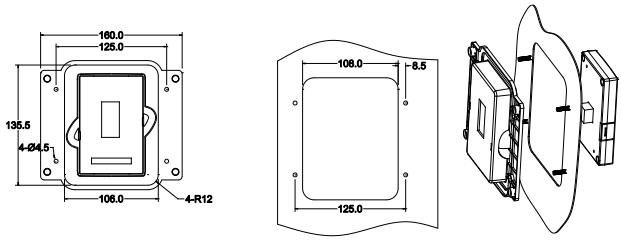



Figure C-3 Keypad installation bracket (standard) for servo drives of 380 V, 37 to 315 kW

## C.2 Dimension diagrams

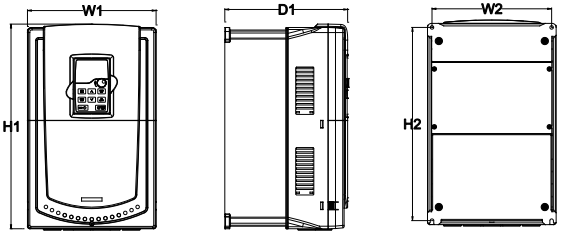



Figure C-4 Wall-mounting diagram of servo drives of 380 V, 4 to 30 kW

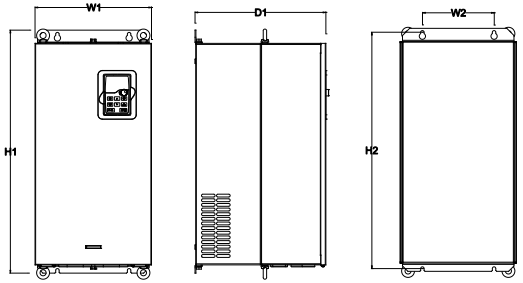



Figure C-5 Wall-mounting diagram of servo drives of 380 V, 37 to 110 kW

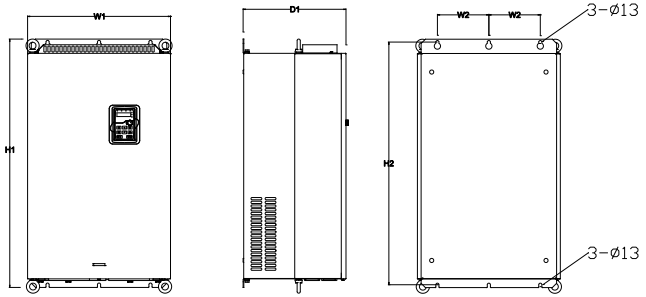



Figure C-6 Wall-mounting diagram of servo drives of 380 V, 132 to 200 kW

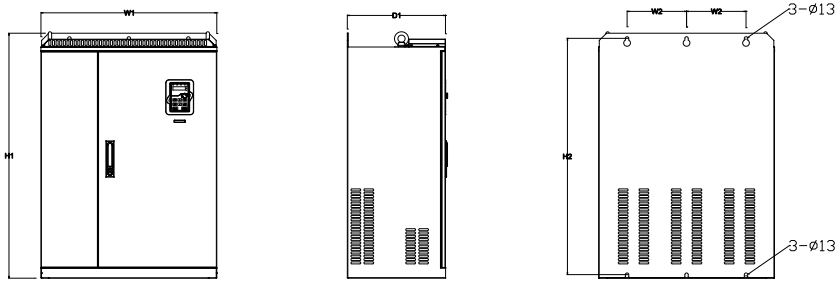



Figure C-7 Wall-mounting diagram of servo drives of 380 V, 220 to 315 kW

Wall-mounting dimensions of 380 V servo drives (unit: mm)

| Servo drive specification | W1 | W2 | H1 | H2 | D1 | Installation hole |
|---|---|---|---|---|---|---|
| 4kW–5.5kW | 146 | 131 | 263 | 243.5 | 181 | 6 |
| 7.5kW–11kW | 170 | 151 | 331.5 | 303.5 | 216 | 6 |
| 15kW–18.5kW | 230 | 210 | 342 | 311 | 216 | 6 |
| 22kW–30kW | 255 | 237 | 407 | 384 | 245 | 7 |
| 37kW–55kW | 270 | 130 | 555 | 540 | 325 | 7 |
| 75kW–110kW | 325 | 200 | 680 | 661 | 365 | 9.5 |
| 132kW–200kW | 500 | 180 | 870 | 850 | 360 | 11 |
| 220kW–315kW | 680 | 230 | 960 | 926 | 380 | 13 |

# Appendix D Optional peripheral accessories

## D.1 Wiring of peripheral accessories

The following figure shows the external wiring of a DSV110 flying shear-dedicated servo drive.

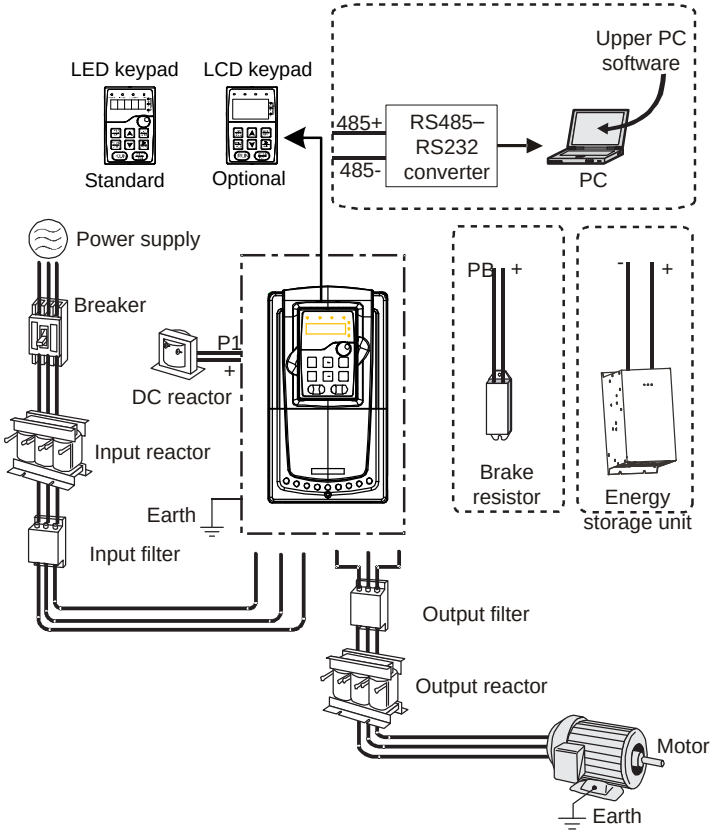



Figure D-1 Diagram of external wiring

**Note:**

- Servo drives of 380 V, 30 kW or lower are equipped with built-in brake units.
- Only servo drives of 380 V, 37 kW or higher are equipped with the P1 terminal that can be used to connect an external DC reactor.
- INVT CBU series energy storage units are used. For details, see section D.2.

| Image | Name | Description |
|---|---|---|
|  | Cable | Accessory for signal transmission |
|  | Breaker | Device for electric shock prevention and protection against short-to-ground that may cause current leakage and fire. Select residual-current circuit breakers (RCCBs) that are applicable to the servo drive and can restrict high-order harmonics, and of which the rated sensitive current for one servo drive is larger than 30 mA. |
|  | Input reactor | Accessories used to improve the current adjustment coefficient on the input side of the servo drive, and thus restrict high-order harmonic currents.<br>Servo drives of 380 V, 37 kW or higher and 660 V series can be connected to external DC reactors. |
|  | DC reactor | |
|  | Input filter | Accessory that restricts the electromagnetic interference generated by the servo drive and transmitted to the public grid through the power cable. Try to install the input filter near the input terminal side of the servo drive. |
|  | Brake resistor | Accessories used to consume the regenerative energy of the motor to reduce the deceleration time.<br>Servo drives of 380 V, 30 kW or lower need only to be configured with brake resistors. |
|  | Output filter | Accessory used to restrict interference generated in the wiring area on the output side of the servo drive. Try to install the output filter near the output terminal side of the servo drive. |
|  | Output reactor | Accessory used to lengthen the valid transmission distance of the servo drive, which effectively restrict the transient high voltage generated during the switch-on and switch-off of the IGBT module of the servo |

| Image | Name | Description |
|---|---|---|
| | | drive. |
|  | Energy storage unit | Accessories used to absorb the regenerative energy to reduce the deceleration time, and release the stored energy to reduce the acceleration time. |

## D.2 Capacitor components

They consume a large amount of energy and generate a large amount of heat during dynamic braking. Capacitor components can be used to absorb and release energy to conserve energy during the running of flying shears.

1. Capacitor component models

| Model | Capacity (mF) | Corresponding power level | Buffer resistor | Structure |
|---|---|---|---|---|
| CBU-005C-4 | 5 | 30 kW or lower | One wire-wound resistor: 80 W, 20 Ω, ±5%, | C1 |
| CBU-010C-4 | 10 | 37 kW, 45 kW | | C2 |
| CBU-015C-4 | 15 | 55 kW | One wire-wound resistor: 3000 W, 10 Ω, ±5% | C3 |
| CBU-020C-4 | 20 | 75 kW | | C4 |
| CBU-025C-4 | 25 | 90 kW | | C5 |

Ordering instruction: A capacitor component model includes a capacitor component and a buffer resistor.

2. Wiring diagram of a capacitor component

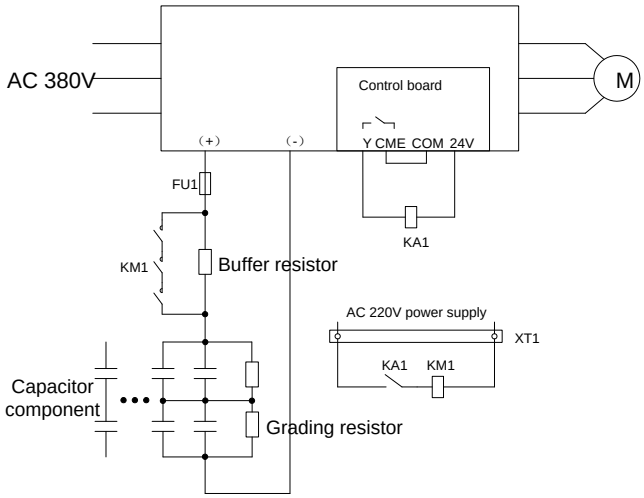



Figure D-2 Wiring diagram of a capacitor component

2. Installation dimensions

(1) C1 installation dimensions

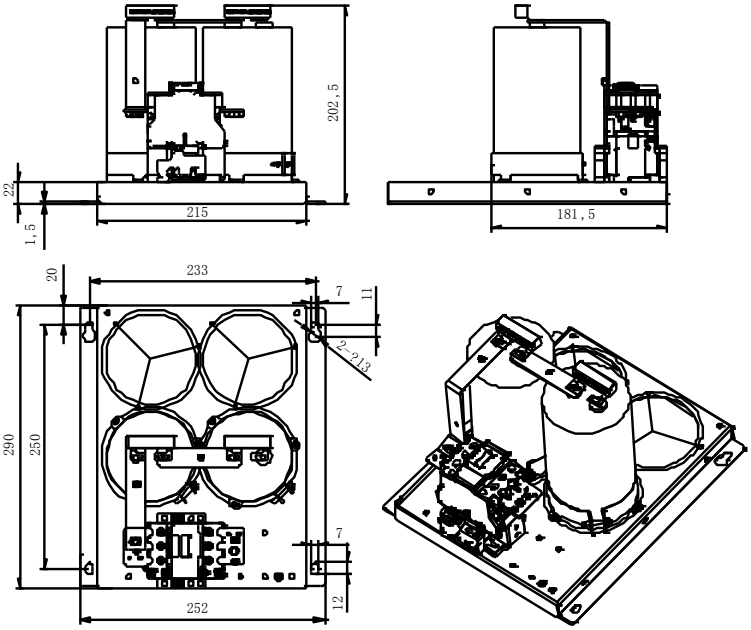



Figure D-3 Installation dimensions of 2 capacitor components

(2) C1 installation dimensions

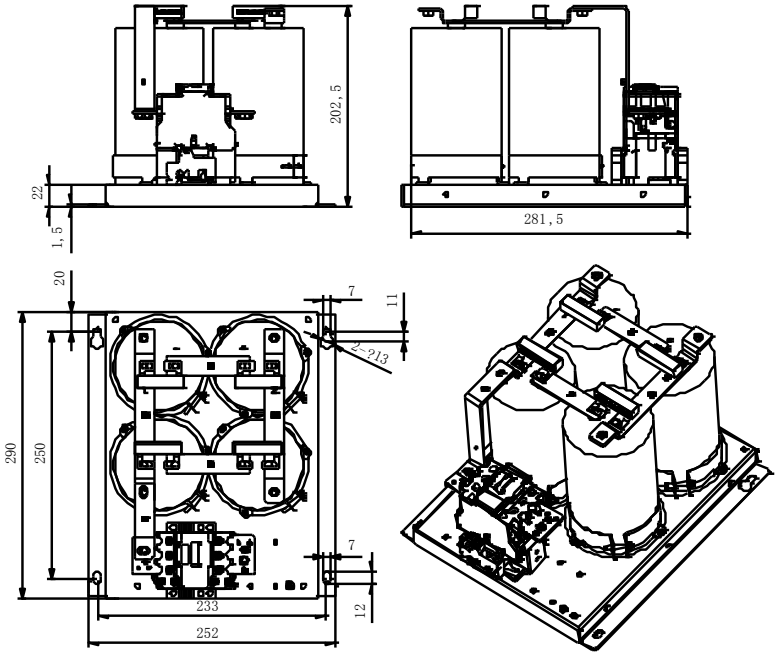



Figure D-4 Installation dimensions of 4 capacitor components

(3) C3 installation dimensions

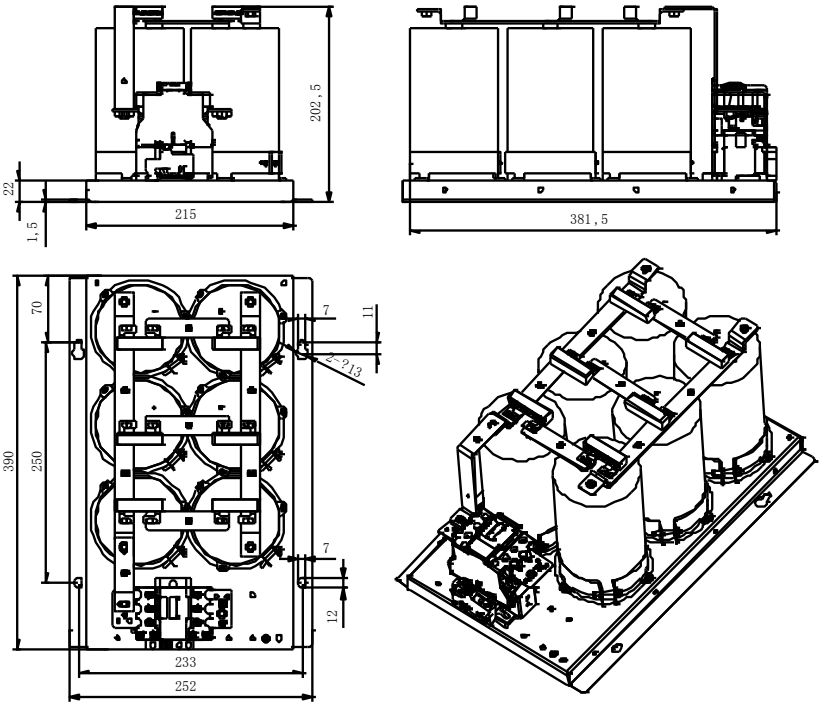



Figure D-5 Installation dimensions of 6 capacitor components

(4) C4 installation dimensions

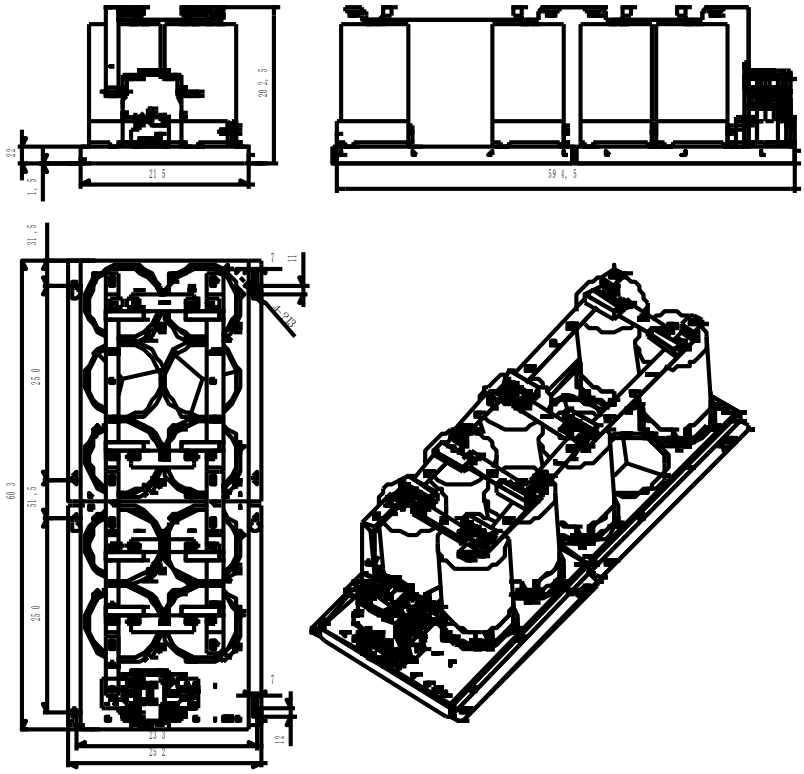


Figure D-8 Installation dimensions of 8 capacitor components

(5) C5 installation dimensions

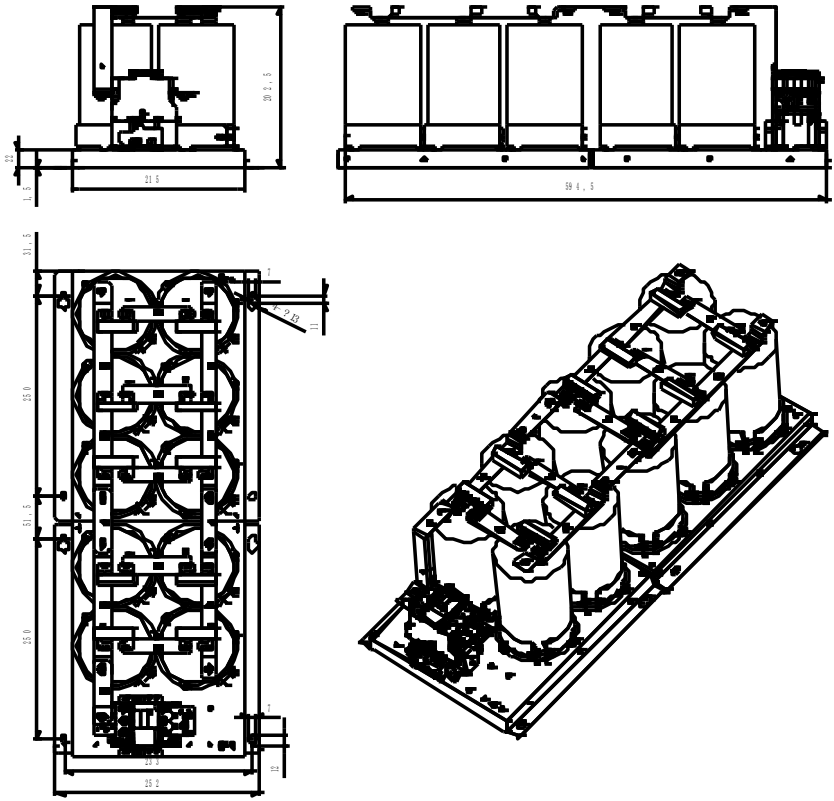


Figure D-7 Installation dimensions of 10 capacitor components

(6) C6 installation dimensions

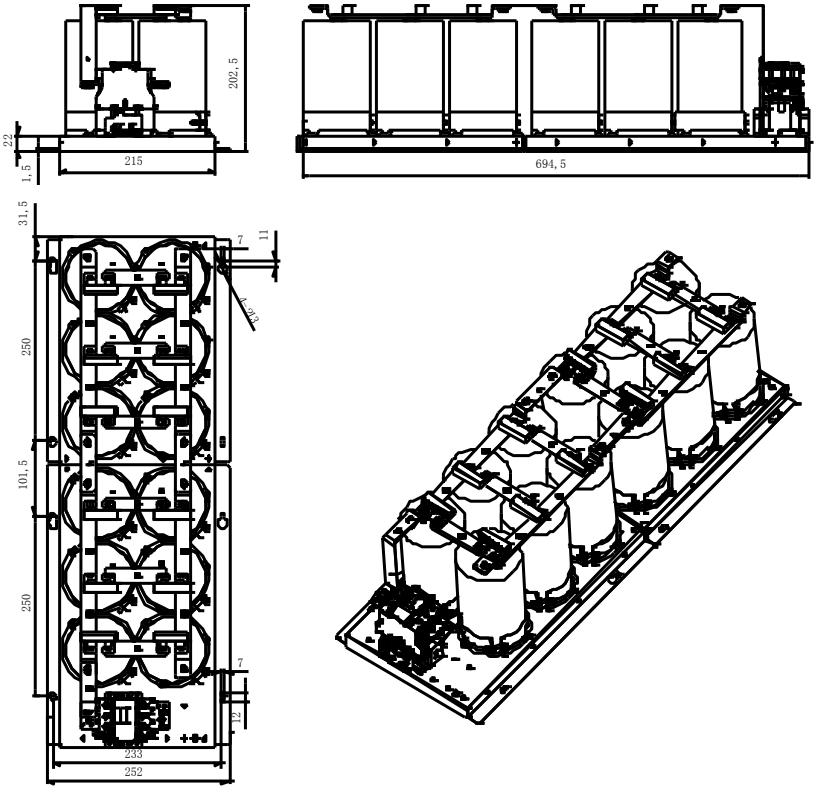



Figure D-8 Installation dimensions of 12 capacitor components

## D.3 Brake resistors

| Model | Brake unit type | Resistance applicable for 100% brake torque (Ω) | Power of brake resistor (W) | Min. allowable brake resistance (Ω) |
|---|---|---|---|---|
| DSV110-004G-4 | Built-in brake unit | 60 | 1000 | 50 |
| DSV110-5R5G-4 | | 50 | 1000 | 47 |
| DSV110-7R5G-4 | | 40 | 1500 | 38 |
| DSV110-011G-4 | | 40 | 2000 | 27 |
| DSV110-015G-4 | | 27 | 2000 | 23 |
| DSV110-018G-4 | | 27 | 4000 | 19 |
| DSV110-022G-4 | | 20 | 6000 | 17 |
| DSV110-030G-4 | | 17 | 9600 | 17 |

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201808 (V1.0)