# *User Manual for EL5 Servo*

# *Introduction*

**Thanks for purchasing Leadshine EL5-series AC servo drivers, this instruction manual provides knowledge and attention for using this driver.**

***Contact tech@leadshine.com if you need more technical service .***

Incorrect operation may cause unexpected accident, please read this manual carefully before using product.

- ✧ We reserve the right to modify equipment and documentation without prior notice.
- ✧ We won't undertake any responsibility with customer's any modification of product, and the warranty of product will be cancel at the same time.

Be attention to the following warning symbol:

**Warning** indicates that the error operation could result in loss of life or serious injury.

**Caution** indicates that the error operation could result in operator injured, also make equipment damaged.

**Attention** indicates that the error use may damage product and equipment.

## Safety precautions

**Warning**

- The design and manufacture of product doesn't use in mechanic and system which have a threat to operator.
- The safety protection must be provided in design and manufacture when using this product to prevent incorrect operation or abnormal accident.

## Acceptance

**Caution**

- The product which is damaged or have fault is forbidden to use.

## Transportation

**Caution**

- The storage and transportation must be in normal condition.
- Don't stack too high, prevent falling.
- The product should be packaged properly in transportation,
- Don't hold the product by the cable, motor shaft or encoder while transporting it.
- The product can't undertake external force and shock.

# Installation

**Caution**

***Servo Driver and Servo Motor:***

- Don't install them on inflammable substance or near it to preventing fire hazard.
- Avoid vibration, prohibit direct impact.
- Don't install the product while the product is damaged or incomplete.

***Servo Driver:***

- Must install in control cabinet with sufficient safeguarding grade.
- Must reserve sufficient gap with the other equipment.
- Must keep good cooling condition.
- Avoid dust, corrosive gas, conducting object, fluid and inflammable ,explosive object from invading.

***Servo Motor:***

- Installation must be steady, prevent drop from vibrating.
- Prevent fluid from invading to damage motor and encoder.
- Prohibit knocking the motor and shaft, avoid damaging encoder.
- The motor shaft can't bear the load beyond the limits.

# Wiring

**Warning**

- The workers of participation in wiring or checking must possess sufficient ability do this job.
- The wiring and check must be going with power off after five minutes
- Ground the earth terminal of the motor and driver without fail.
- The wiring should be connected after servo driver and servo motor installed correctly
- After correctly connecting cables, insulate the live parts with insulator.

**Caution**

- The wiring must be connected correctly and steadily, otherwise servo motor may run incorrectly, or damage the equipment .
- Servo motor U, V, W terminal should be connected correctly , it is forbidden to connect them directly to AC power.
- We mustn't connect capacitors ,inductors or filters between servo motor and servo driver .
- The wire and temperature-resistant object must not be close to radiator of servo driver and motor.
- The freewheel diode which connect in parallel to output signal DC relay mustn't connect reversely.

# Debugging and running

**Caution**

- Make sure the servo driver and servo motor installed properly before power on, fixed steadily, power voltage and wiring correctly.
- The first time of debugging should be run without loaded, debugging with load can be done after confirming parameter setting correctly, to prevent mechanical damage because of error operation.

## Using

**Caution**

- Install a emergency stop protection circuit externally, the protection can stop running immediately to prevent accident happened and the power can be cut off immediately.
- The run signal must be cut off before resetting alarm signal, just to prevent restarting suddenly.
- The servo driver must be matched with specified motor.
- Don't power on and off servo system frequently, just to prevent equipment damaged.
- Forbidden to modify servo system.

## Fault Processing

**Warning**

- The high voltage also will contain in several minutes even if the servo driver is powered off, please don't touch terminal strip or separate the wiring.
- The workers of participation in wiring or checking must possess sufficient ability do this job.

**Caution**

- The reason of fault must be figured out after alarm occurs, reset alarm signal before restart.
- Keep away from machine, because of restart suddenly if the driver is powered on again after momentary interruption(the design of the machine should be assured to avoid danger when restart occurs)

## System selection

**Attention**

- The rate torque of servo motor should be larger than effective continuous load torque.
- The ratio of load inertia and motor inertia should be smaller than recommended value.
- The servo driver should be matched with servo motor.

# Table of Contents

# Chapter 1 Introduction

## 1.1 Product Introduction

Since early 1990s, AC servo technology has been improved, AC servo is now widely used in the field of CNC machine tools, printing and packaging machinery, textile machinery, and automated production line automation.

The EL5 series AC servo motor &driver is the latest servo system that's meets all demands for a variety of machines which require high speed, high precision and high performance or which require simplified settings.

**Talent feature:**

◆Width ratio, constant torque

Speed ratio :1:5000, stable torque features from low speed to high speed

◆High-speed, high-precision

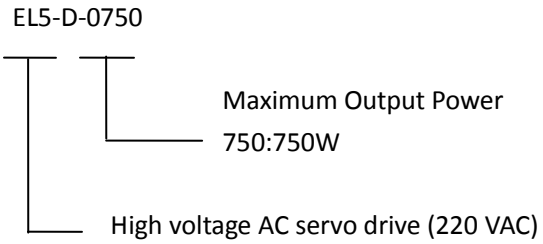
The maximum speed of the servo motor up to 5000rpm, rotation positioning accuracy up to $1/2^{17}$r.

◆Simple, flexible to control

By modifying the parameters of the servo system, the operating characteristics make the appropriate setting to suit different requirements.

## 1.2 Inspection of product

1. **You must check the following thing before using the products :**
   a. Check if the product is damaged or not during transportation.
   b. Check if the servo driver & motor are complete or not.
   c. Check the packing list if the accessories are complete or not
2. **Type meaning**
   a. EL5 series servo driver

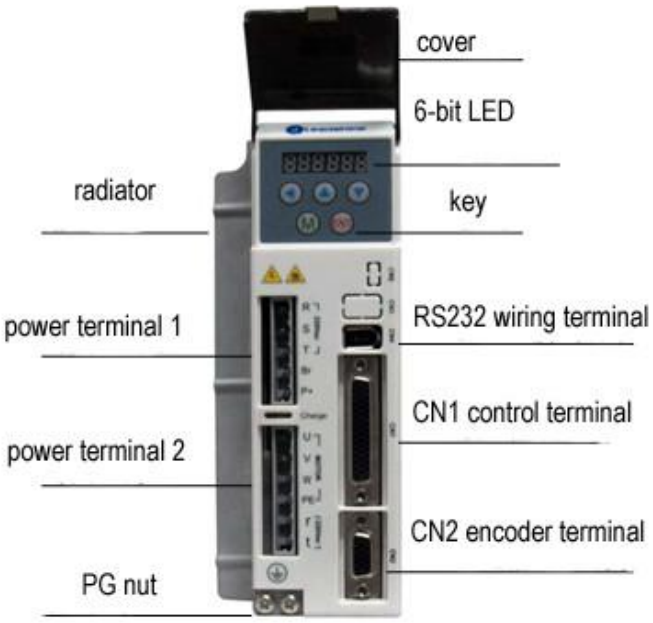



   b. Servo motor type

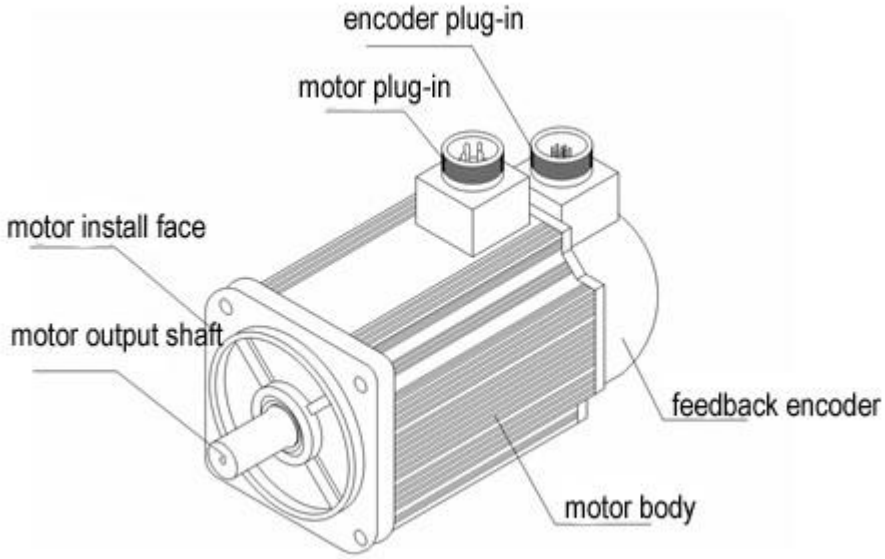
The EL5 series AC servo driver can be matched with a variety of domestic and foreign servo motor.

## 1.3 Product Appearance

1. **EL5 series AC servo driver appearance:**




**2. Servo motor appearance:**




**3. Accessory**

EL5 series servo driver standard accessories

a. user manual

b.CN1 connector (DB44)

c. CN2 plug (DB15 pin)

〖Note〗: The ACH series driver supports the PC debugging software which can be downloaded from our website

# Chapter 2 Installation

## 2.1 Storage and Installation Circumstance

**Table 2.1 Servo Driver, Servo Motor Storage Circumstance Requirement**

| Item | EL5 series driver | EL5 servo motor |
|---|---|---|
| Temperature | -20-80℃ | -25-70℃ |
| Humility | Under 90%RH (free from condensation) | Under 80%RH(free from condensation) |
| Atmospheric environment | Indoor(no exposure)no corrosive gas or flammable gas, no oil or dust | Indoor(no exposure)no corrosive gas or flammable gas, no oil or dust |
| Altitude | Lower than 1000m | Lower than 2500m |
| Vibration | Less than 0.5G (4.9m/s$^2$) 10-60Hz (non-continuous working) | |
| Protection level | IP00(no protection) | IP65 |

**Table 2.2 Servo Driver, Servo Motor Installation Circumstance Requirement**

| Item | EL5 series driver | EL5 servo motor |
|---|---|---|
| Temperature | 0-55℃ | -25-40℃ |
| Humility | Under 90%RH(free from condensation) | Under 90%RH(free from condensation) |
| Atmospheric environment | Indoor(no exposure)no corrosive gas or flammable gas, no oil or dust | Indoor(no exposure)no corrosive gas or flammable gas, no oil or dust |
| Altitude | Lower than 1000m | Lower than 2500m |
| Vibration | Less than 0.5G (4.9m/s$^2$) 10-60Hz (non-continuous working) | |
| Protection level | IP00(no protection) | IP65 |

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## 2.2 Servo Driver Installation

| Notice |
|---|
| ● Must install in control cabinet with sufficient safeguarding grade. |
| ● Must install with specified direction and intervals, and ensure good cooling condition. |
| ● Don't install them on inflammable substance or near it to prevent fire hazard. |

### 2.2.1 Installation Method

Install in vertical position ,and reserve enough space around the servo driver for ventilation.

Here is the installation diagram:

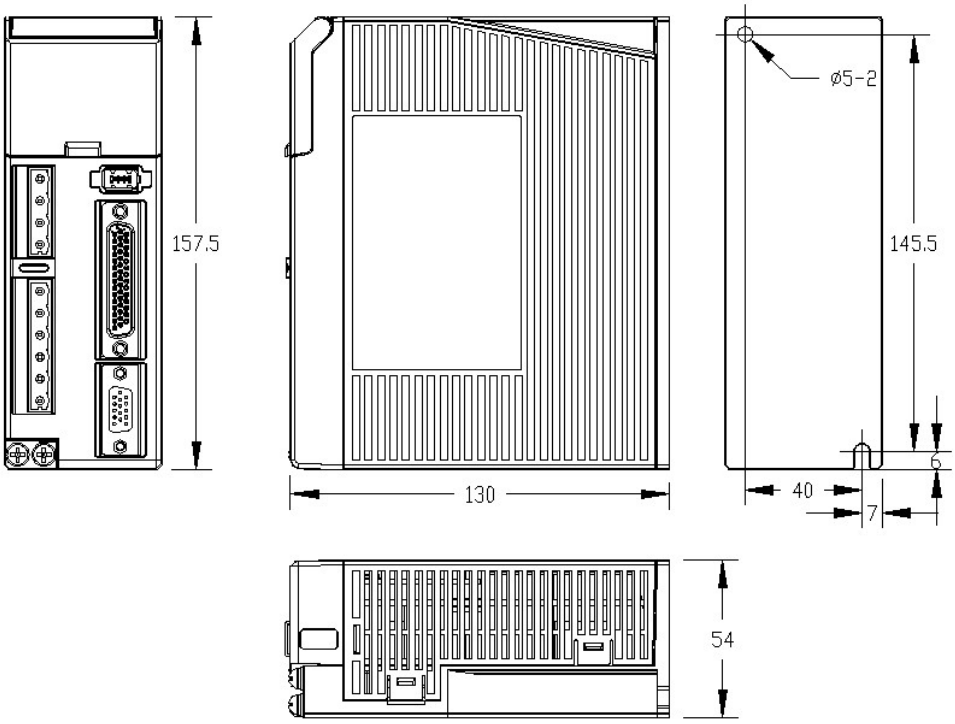


**Figure 2.1 installation method of driver EL5-D-400**

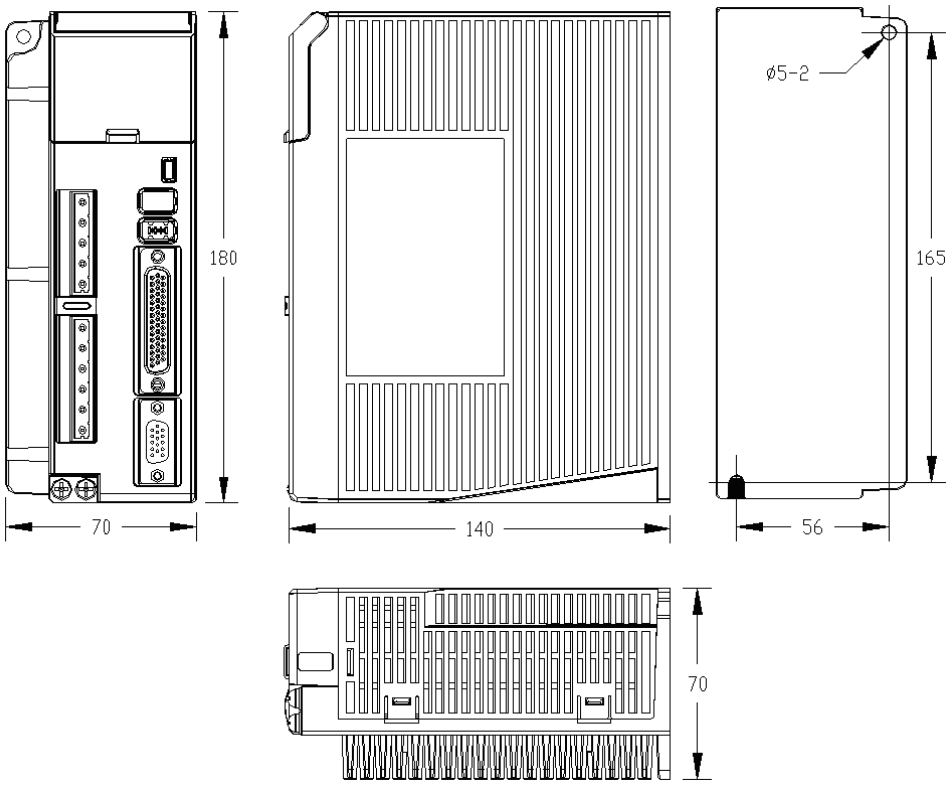


**Figure 2.2 installation method of driver EL5-D-750**

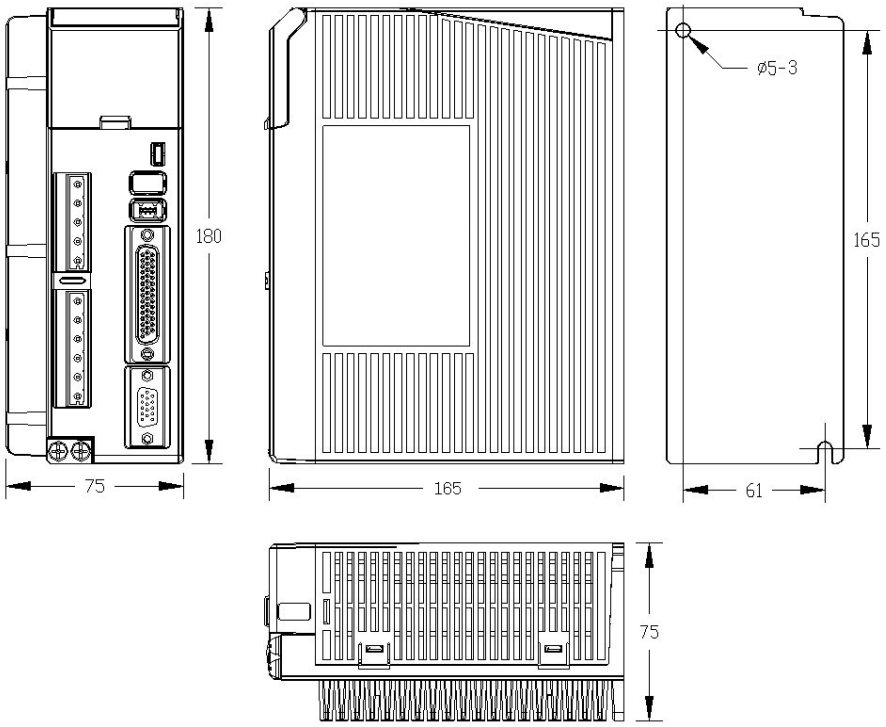


**Figure 2.3 installation method of driver EL5-D-1000/EL5-D-1500**

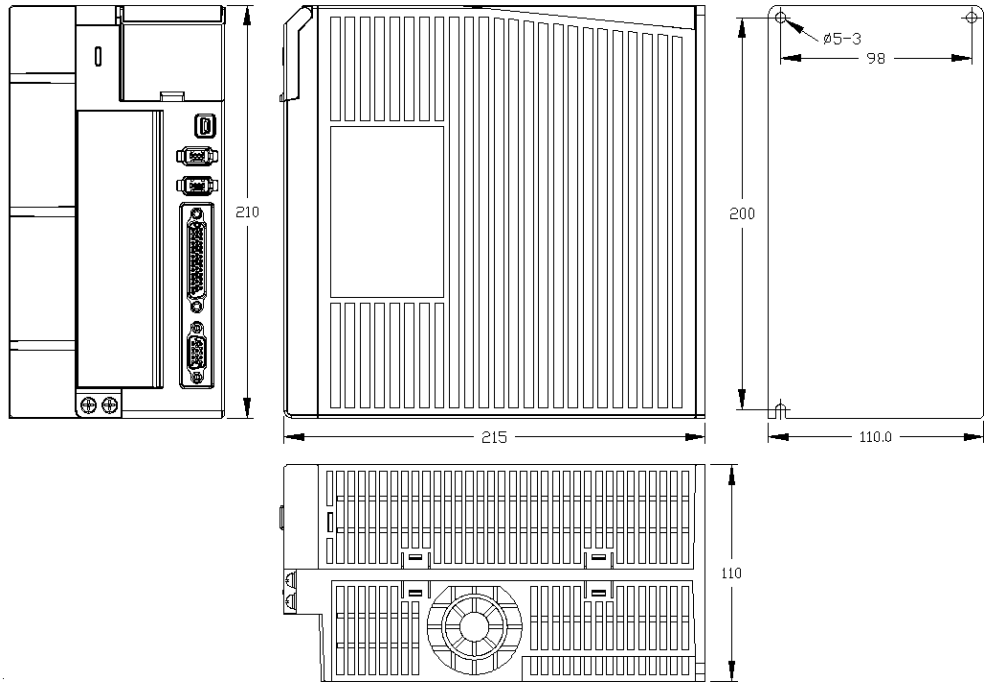


**Figure 2.4 installation method of driver EL5-D-2000/EL5-D-3000**

### *2.2.2 Installation Space*

Reserve enough surrounding space for effective cooling.

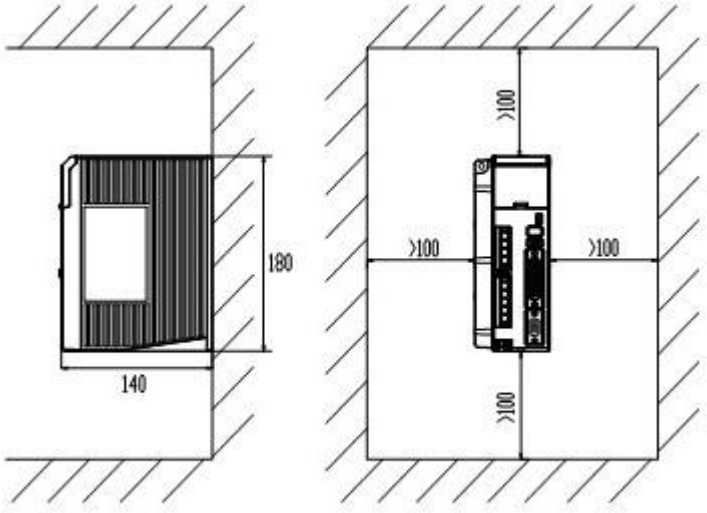


**Figure 2-5 Installation Space for Single Driver**

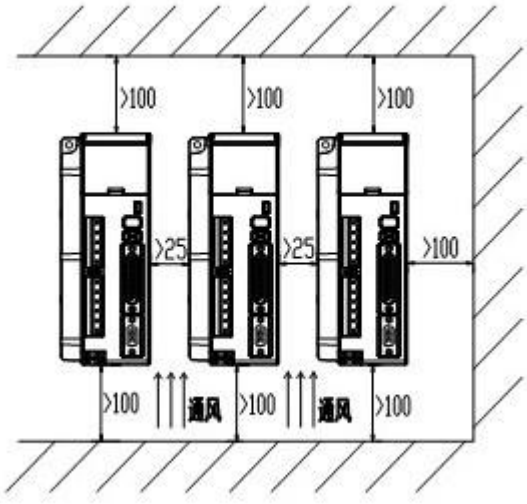


**Figure 2-6 Installation Space for several Drivers**

## *2.3 Servo Motor Installation*

| Notice |
|---|
| ● Don’t hold the product by the cable, motor shaft or encoder while transporting it.<br>● No knocking motor shaft or encoders, prevent motor by vibration or shock.<br>● The motor shaft can’t bear the load beyond the limits.<br>● Motor shaft does not bear the axial load, radial load, otherwise you may damage the motor.<br>● Use a flexible with high stiffness designed exclusively for servo application in order to make a radial thrust caused by micro misalignment smaller than the permissible value.<br>● Install must be steady, prevent drop from vibrating. |

# Chapter 3 Wiring

**Warning**

- The workers of participation in wiring or checking must possess sufficient ability do this job.
- The wiring and check must be going with power off after five minutes.

**Caution**

- Ground the earth terminal of the motor and driver without fail.
- The wiring should be connected after servo driver and servo motor installed correctly

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## 3.1 Wiring

### 3.1.1 Wire Gauge

(1)Power supply terminal TB

● Diameter: R, S, T, PE, U, V, W terminals diameter ≥ 1.5mm$^2$ (AWG14-16), r, t terminal diameter ≥ 1.0 mm$^2$ (AWG16-18).

● Grounding: The grounding wire should be as thick as possible, drive servo motor the PE terminal point ground, ground resistance <100 Ω.

●Use noise filter to remove external noise from the power lines and reduce an effect of the noise generated by the servo driver.

● Install fuse (NFB) promptly to cut off the external power supply if driver error occurs.

(2) The control signal CN1 feedback signal CN2

● Diameter: shielded cable (twisting shield cable is better), the diameter ≥ 0.12mm$^2$ (AWG24-26), the shield should be connected to FG terminal.

● Length of line: cable length should be as short as possible and control CN1 cable is no more than 3 meters, the CN2 cable length of the feedback signal is no more than 20 meters.

● Wiring: be away from the wiring of power line, to prevent interference input.

●Install a surge absorbing element for the relevant inductive element (coil),: DC coil should be in parallel connection with freewheeling diode reversely; AC coil should be in parallel connection with RC snubber circuit.

**Attention**

- Match the colors of the motor lead wires to those of the corresponding motor output terminals (U.V.W)
- Never start nor stop the servo motor with this magnetic contactor.
- Cable must be fixed steadily, avoid closing to radiator and motor to prevent reducing the properties of heat insulation

## *3.1.2 Position Control Mode*

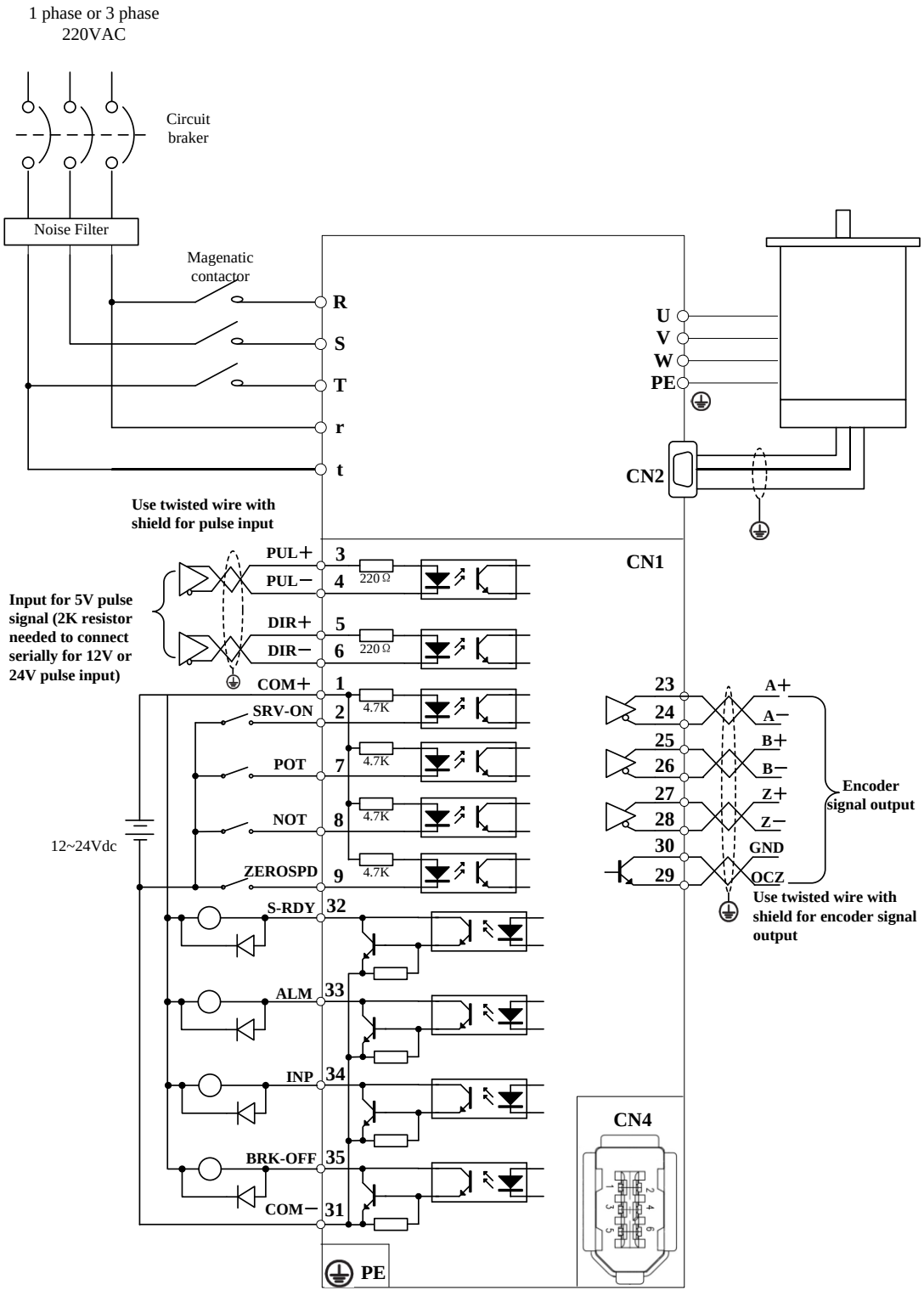



**Figure 3-1 Positional Control Mode Wiring**

**Note:**

**Single phase 220VAC input is sufficient if the power of driver is no more 1.5kw ,connect R,T for single phase , however, 3 phase is better than single phase .**

## *3.1.3 Torque /Velocity Control Mode*

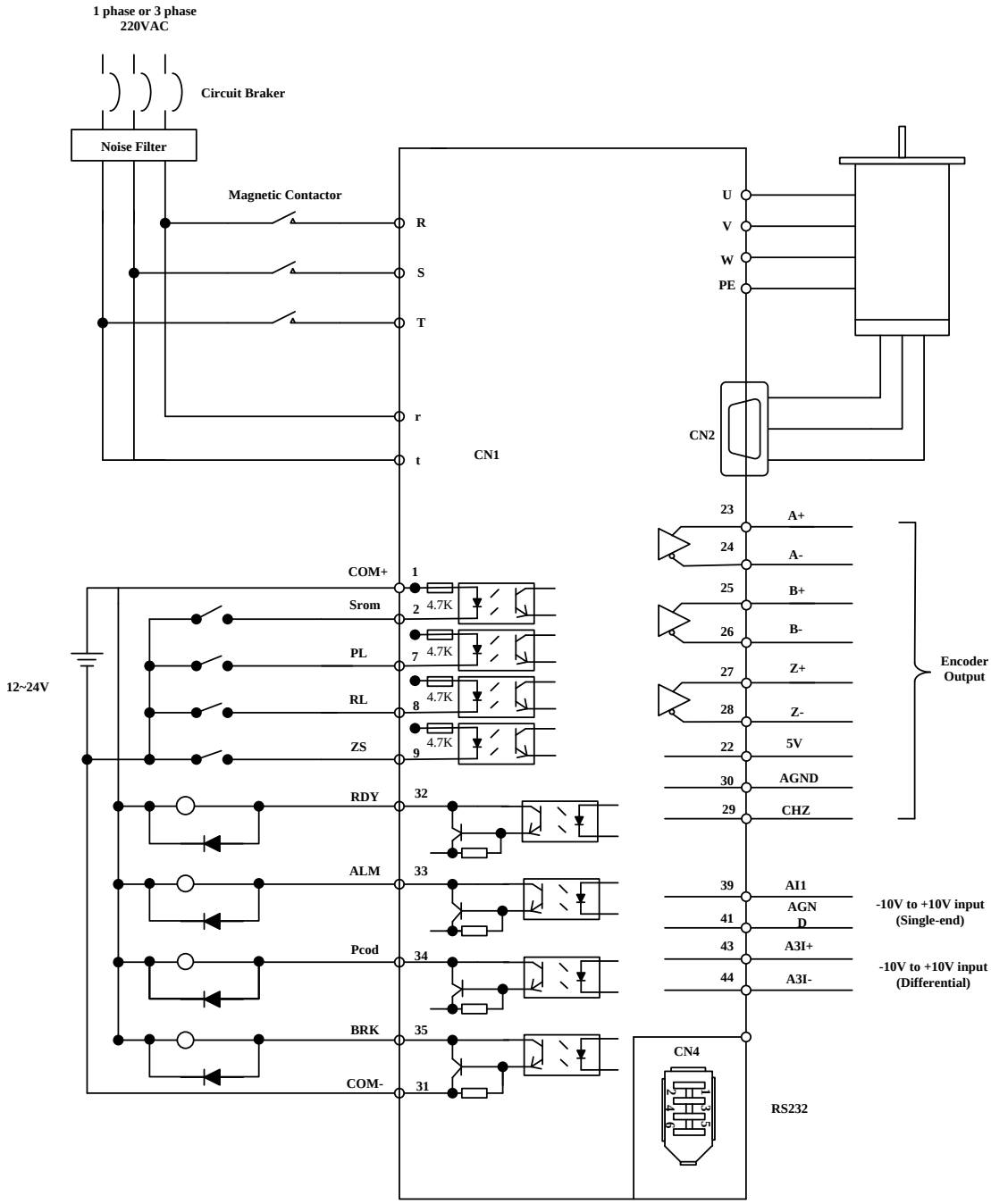



**Figure 3-2 Torque/Velocity Control Mode Wiring**

**Note:**

**Single phase 220VAC input is sufficient if the power of driver is no more 1.5kw ,connect R,T for single phase , however, 3 phase is better than single phase .**

# 3.2 Driver Terminals Function

## 3.2.1 Control Signal Port-CN1 Terminal

The left on Figure 3.3 is control signal port CN1 of servo driver with DB44 connector; And, the right on Figure 3.3 is SI input of the switch, SO output of the switch, analog A1 input, the A3 input from top to bottom.

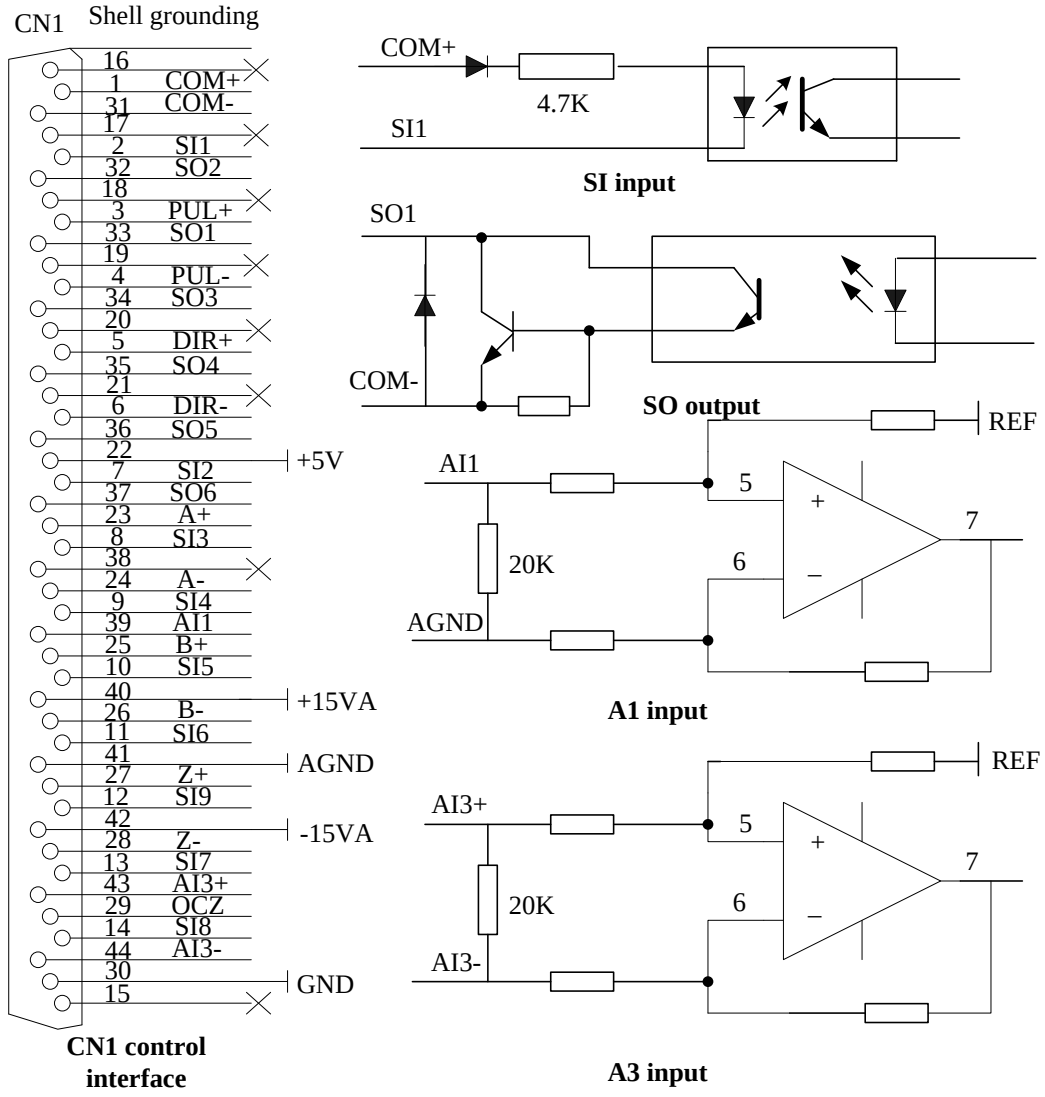



**Figure 3-3 Servo Driver Port Terminal**

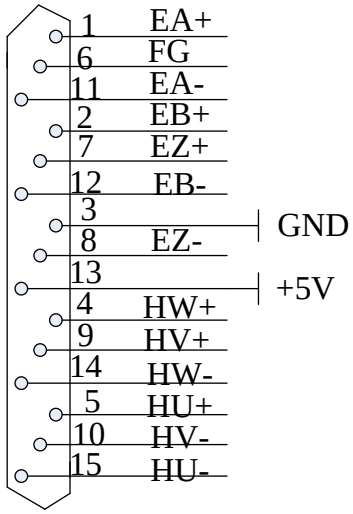
**Table 3.1 Signal Explanation of Control Signal Port-CN1**

| Pin No | Signal | Input/output | Name and Explanation |
|---|---|---|---|
| 1 | COM+ | input | power supply positive terminal of the external input control signal, 12V ~ 24V |
| 2 | SI1 | input | Digital input signal 1, default value is servo on signal in position mode , low level available in default , the maximum voltage is 24V input |
| 3 | PUL+ | input | positive and negative pulse input, respectively. TTL level (5V), the rising edge available in default |
| 4 | PUL- | input | |

| | | | | |
|---|---|---|---|---|
| 5 | DIR+ | input | positive and negative direction input, respectively. TTL level (5V), optical coupling deadline available in default | |
| 6 | DIR- | input | | |
| 7 | SI2 | input | Digital input signal 2, default value is forward run prohibited (POT)signal in position mode ,high level available in default , the maximum voltage is 24V input | |
| 8 | SI3 | input | Digital input signal 3, default value is reverse run prohibited (NOT) signal in position mode , high level available in default , the maximum voltage is 24V input | |
| 9 | SI4 | input | Digital input signal 4, default value is zero-speed clamp (ZEROSPD) signal in position mode ,high level available in default , the maximum voltage is 24V input | |
| 10 | SI5 | input | Digital input signal 5, default value is deviation counter clear input in position mode , low level available in default , the maximum voltage is 24V input | |
| 11 | SI6 | input | Digital input signal 6, low level available in default , the maximum voltage is 24V input | |
| 12 | SI9 | input | Digital input signal 9, low level available in default , the maximum voltage is 24V input | |
| 13 | SI7 | input | Digital input signal 7, low level available in default , the maximum voltage is 24V input | |
| 14 | SI8 | input | Digital input signal 8, low level available in default , the maximum voltage is 24V input | |
| 22 | +5V | output | Reserved, encoder signal output +5V | |
| 23 | A+ | output | Positive/negative differential output terminal of motor encoder A phase | |
| 24 | A- | output | | |
| 25 | B+ | output | Positive/negative differential output terminal of motor encoder B phase | |
| 26 | B- | output | | |
| 27 | Z+ | output | Positive/negative differential output terminal of motor encoder Z phase | |
| 28 | Z- | output | | |
| 29 | OCZ | output | Z signal OC output | |
| 30 | GND | output | Power ground of encoder signal output | |
| 31 | COM- | output | Digital output signal commonality ground | |
| 32 | SO2 | output | Digital output signal 2 , default value is servo ready output (S-RDY) in position mode , low level available in default | Low resistor output in default . OC, the maximum voltage/current is no more than 30V, 50mA . Recommend the voltage : 12 V-24V. Current :10mA |
| 33 | SO1 | output | Digital output signal 1 , default value is alarm output (ALM) in position mode , high level available in default | |
| 34 | SO3 | output | Digital output signal 3 , default value is positioning complete (INP) in position mode , high level available in default | |
| 35 | SO4 | output | Digital output signal 4, default value is external brake release output (BRK-OFF) in position mode , low level available in default | |
| 36 | SO5 | output | Digital output signal 5 | |
| 37 | SO6 | output | Digital output signal 6 | |
| 39 | AI1 | input | Analog input 1, voltage input range : -10 - 10V , input resistor 20KΩ | |
| 40 | +15VA | output | Reserved, output voltage:15V, current :less than 50mA | |
| 41 | GND1 5VA | output | Reserve,+15V ground | |
| 43 | AI3+ | input | The positive/ negative terminal of analog input 3, voltage input range -10-10V, input resistor : 20KΩ | |
| 44 | AI3- | input | | |
| 15-21, 38,42 | NC | / | Not connection | |
| Shell | FG | / | Shield ground | |

## 3.2.2 Encoder Input Port-CN2 Terminal

**Table 3.2 Encoder Input Port-CN2 Terminal Signal Explain**

| Pin | Signal | Name | Terminal Arrangement Figure |
|---|---|---|---|
| 1 | EA+ | Encoder channel A+ input |  |
| 2 | EB+ | Encoder channel B+ input | |
| 3 | EGND | Signal ground | |
| 4 | Hall W+ | Hall sensor W+ input | |
| 5 | Hall U+ | Hall sensor U+ input | |
| 6 | FG | Ground terminal for shielded | |
| 7 | EZ+ | Encoder channel Z+ input | |
| 8 | EZ- | Encoder channel Z- input | |
| 9 | Hall V+ | Hall sensor V+ input | |
| 10 | Hall V- | Hall sensor V- input | |
| 11 | EA- | Encoder channel A- input | |
| 12 | EB- | Encoder channel B- input | |
| 13 | VCC | +5V for encoder power supply | |
| 14 | Hall W- | Hall sensor W- input | |
| 15 | Hall U- | Hall sensor U- input | |



## 3.2.3 Communication Port

**Table 3.3 Signal Explanation of connection and debugging Port-CN4**

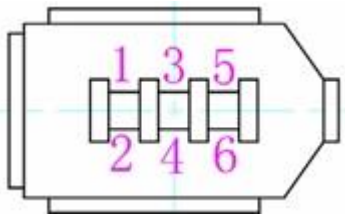
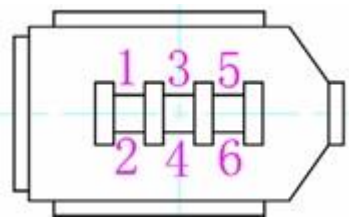
| | | | |
|---|---|---|---|
| RS232 | connect PC or STU using dedicated series cable, prohibited to insert if power on. and suggest to use twisted-pair or shielded wire. the length of wire is less than 2 meter | | |
| RS485 | Recommend shield twisted-pair. | | |
| Terminal | signal | name |  |
| 1 | GND | Power ground | |
| 2 | TxD | sending terminal of RS232 | |
| 3 | 5V | Reserved, the current is less than 50mA | |
| 4 | RxD | received terminal of RS232 | |
| 5 | RS485+ | Reserve,RS485+/A | |
| 6 | RS485- | Reserve,RS485-/B | |



**Table 3.4 signal explanation of driver interconnection interface-CN3**

| | | | |
|---|---|---|---|
| RS485 | Recommend shield twisted-pair. | | |
| Terminal | signal | name |  |
| 1 | GND | Power ground | |
| 2 | NC | Not connect | |
| 3 | 5V | Reserve, the current is less than 50mA | |
| 4 | NC | Not connect | |
| 5 | RS485+ | Reserve,RS485+/A | |
| 6 | RS485- | Reserve,RS485-/B | |

### *3.2.4 Power Port*

**Table 3.5 Main Power Input Port-CN5**

| Terminal | Signal | Name | |
|---|---|---|---|
| 1 | R | the main power input: connecting 3-phase 220Vac or single phase 220Vac, For single phase 220V ,recommend to connect to the R and T. | |
| 2 | S | | |
| 3 | T | | |
| 4 | BR | Outside brake resistor input terminal | external brake resistor connect between BR1 and P+ |
| 5 | P+ | DC bus voltage+ | |

**Table 3.6 Control Power Input Port-CN6**

| Terminal | Signal | Name | |
|---|---|---|---|
| 1 | U | 3 phase motor power input | |
| 2 | V | | |
| 3 | W | | |
| 4 | PE | Frame ground | |
| 5 | r | Control power input 1 | Control power voltage range between 1 and 2: 85Vac-265Vac |
| | t | Control power input 2 | |

## *3.3 I/O Interface Principle*

### *3.3.1 Switch Input Interface*

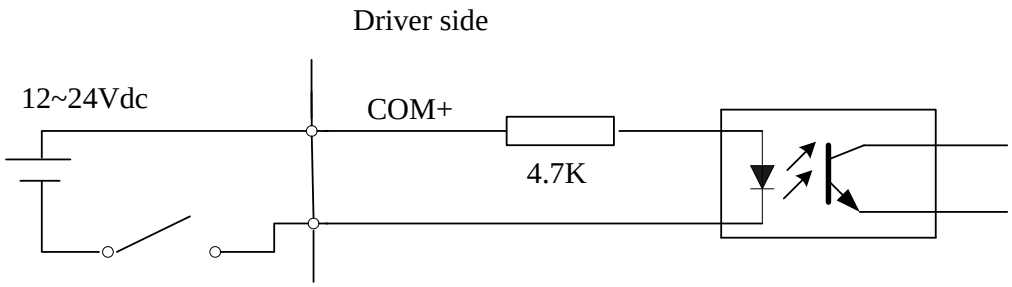



**Figure 3-4 Switch Input Interface**

⑴The user provide power supply, DC 12-24V, current≥100mA

⑵**Notice:** if current polar connect reversely, servo driver doesn't run.

## 3.3.2 Switch Output Interface

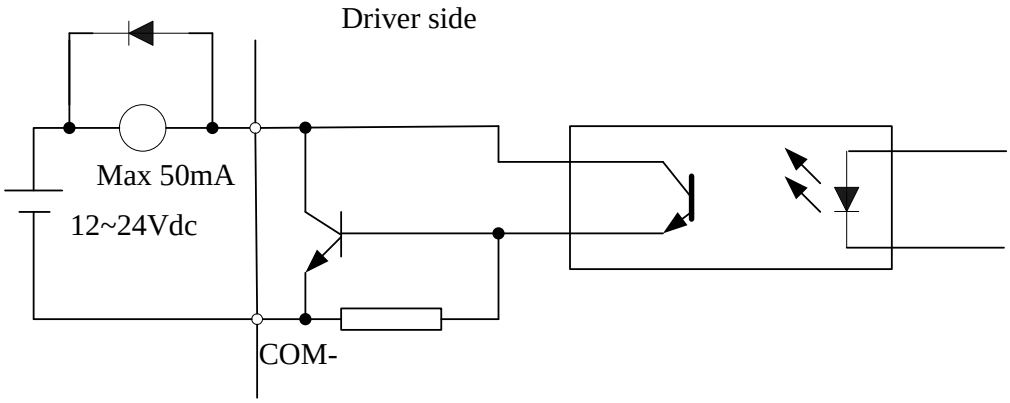



**Figure 3.5 Switch Output Interface**

(1) The user provide the external power supply . However, if current polarity connects reversely, servo driver is damaged.
(2) The output of the form is open-collector, the maximum voltage is 25V, and maximum current is 50mA. Therefore, the load of switch output signal must match the requirements. If you exceed the requirements or output directly connected with the power supply, the servo drive is damaged.
(3) If the load is inductive loads relays, etc., there must be anti-parallel freewheeling diode across the load. If the freewheeling diode is connected reversely, the servo drive is damaged.

## 3.3.3 Pulse Input Interface

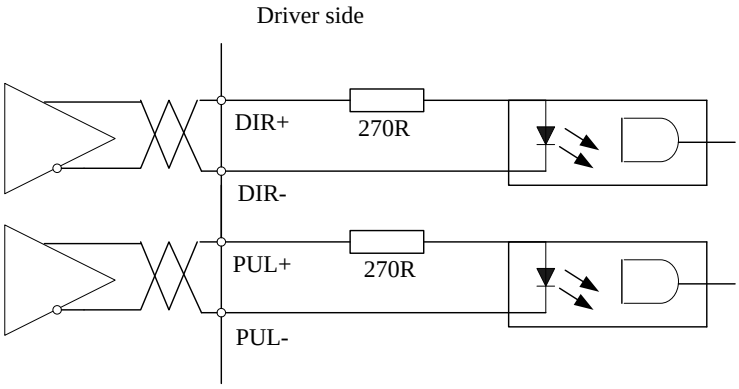
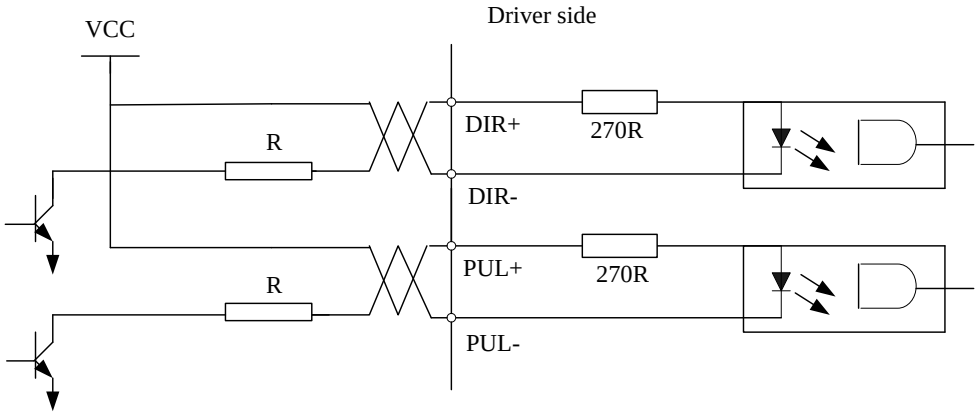



**Figure 3-6 Pulse Input Interface Differential Drive Mode**



Vcc =12V, R = 1K, 0.25W

Vcc =24V, R = 2K, 0.25W

**Figure3-7 Pulse Input Interface Single Terminal Drive Mode**

(1) In order to transmit pulse data properly , we recommend using the differential drive mode.

(2) The differential drive mode, AM26LS31, MC3487 or similar RS422 line drive.

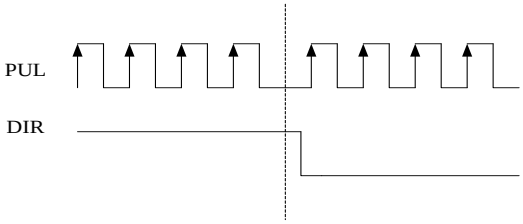
(3) Using of single-ended drive will cause reduction of the operation frequency. The value of the resistance R depends on pulse input circuit and the external voltage,while drive current should be at the range of 10 - 15mA and the maximum voltage is no more than 25V .

**Recommendation:**
VCC = 24V, R = 1.3 to 2KΩ;
VCC = 12V, R = 510 ~ 820Ω;
VCC = 5V, R = 82 ~~ 120Ω.

(4) The user provide external power supply for single-ended drive. However, if current polarity connect reversely, servo driver is damaged.

(5) The form of pulse input is the following form 3.7 below, while the arrows indicates the count .

**Table 3.7 Pulse Input Form**

| Pulse command form | CCW | CW | Parameter setting value |
|---|---|---|---|
| Pulse symbol |  | | Pulse + direction |

The form of pulse input timing parameter is the following form 3.8 below. The 4 times pulse frequency ≤ 500kH if 2-phase input form is used.

**Table 3.8 the parameters of pulse input time sequence**

| parameter | Differential drive input | Single-ended drive input |
|---|---|---|
| $t_{ck}$ | ＞2μs | ＞5μs |
| $t_h$ | ＞1μs | ＞2.5μs |
| $t_l$ | ＞1μs | ＞2.5μs |
| $t_{rh}$ | ＜0.2μs | ＜0.3μs |
| $t_{rl}$ | ＜0.2μs | ＜0.3μs |
| $t_s$ | ＞1μs | ＞2.5μs |
| $t_{qck}$ | ＞8μs | ＞10μs |
| $t_{qh}$ | ＞4μs | ＞5μs |
| $t_{ql}$ | ＞4μs | ＞5μs |
| $t_{qrh}$ | ＜0.2μs | ＜0.3μs |
| $t_{qrl}$ | ＜0.2μs | ＜0.3μs |
| $t_{qs}$ | ＞1μs | ＞2.5μs |

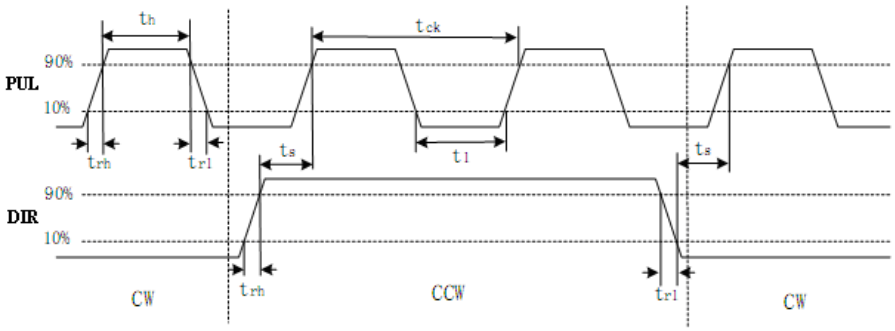



**Figure 3.8 pulse + direction input interface timing (the maximum of pulse frequency : 500KHZ)**

## *3.3.4 Analog Value Input Interface*

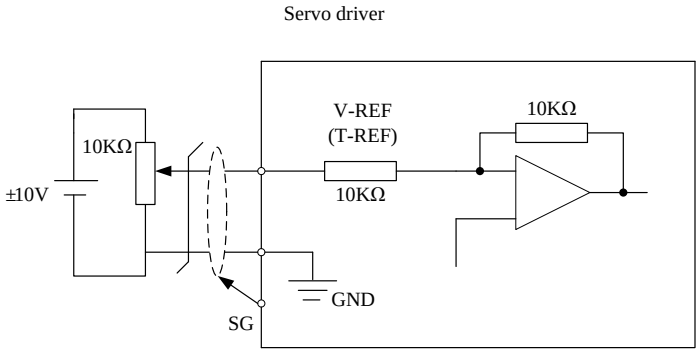



**Figure 3-9 Analog AI1 Input Interface**

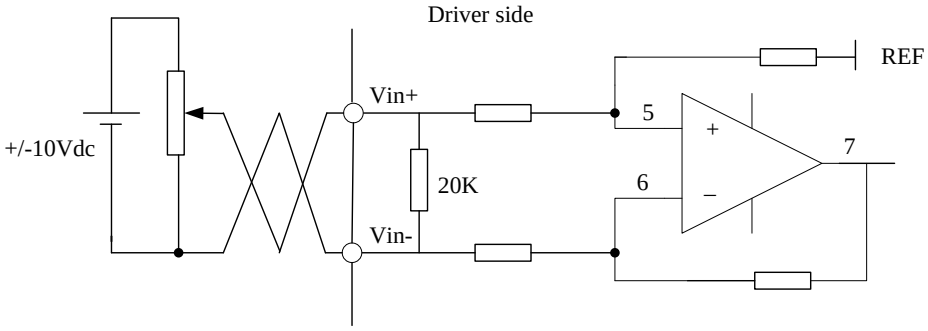



**Figure 3-10 Analog AI3 Input Interface**

## *3.3.5 Servo Motor Encoder Input Interface*

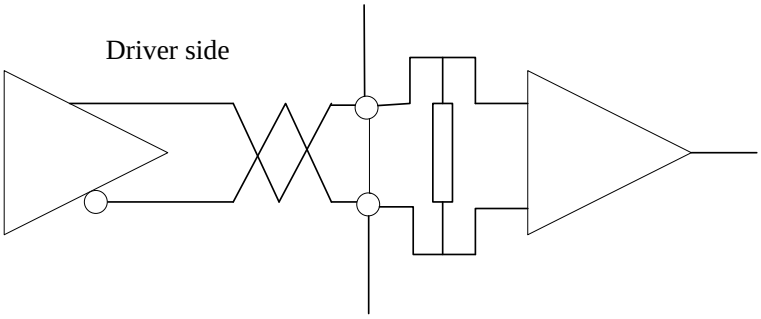



**Figure 3-11 Servo Motor optical-electrical Encoder Input Interface**

# Chapter 4 Parameter

## 4.1 Parameter List

| Mode | | | Parameter Number | | Name |
|---|---|---|---|---|---|
| P | S | T | Classify | Number | |
| P | S | T | 【Class 0】Basic setting | 01 | control mode setup |
| P | S | T | | 02 | real-time auto-gain tuning |
| P | S | T | | 03 | selection of machine stiffness at real-time auto-gain tuning |
| P | S | T | | 04 | Inertia ratio |
| P | | | | 06 | command pulse rotational direction setup |
| P | | | | 07 | command pulse input mode setup |
| P | | | | 09 | 1st numerator of electronic gear |
| P | | | | 10 | denominator of electronic gear |
| P | S | T | | 11 | output pulse counts per one motor revolution |
| P | S | T | | 12 | reversal of pulse output logic |
| P | S | T | | 13 | 1st torque limit |
| P | | | | 14 | position deviation excess setup |
| P | | | 【Class 1】Gain Adjust | 00 | 1st gain of position loop |
| P | S | T | | 01 | 1st gain of velocity loop |
| P | S | T | | 02 | 1st time constant of velocity loop integration |
| P | S | T | | 03 | 1st filter of velocity detection |
| P | S | T | | 04 | 1st time constant of torque filter |
| P | | | | 05 | 2nd gain of position loop |
| P | S | T | | 06 | 2nd gain of velocity loop |
| P | S | T | | 07 | 2nd time constant of velocity loop integration |
| P | S | T | | 08 | 2nd filter of velocity detection |
| P | S | T | | 09 | 2nd time constant of torque filter |
| P | | | | 10 | Velocity feed forward gain |
| P | | | | 11 | Velocity feed forward filter |
| P | S | | | 12 | Torque feed forward gain |
| P | S | | | 13 | Torque feed forward filter |
| P | S | T | | 14 | 2nd gain setup |
| P | | | | 15 | Control switching mode |
| P | | | | 17 | Control switching level |
| P | | | | 18 | Control switch hysteresis |
| P | | | | 19 | Gain switching time |
| P | | | | 35 | Positional command filter setup |
| P | S | T | | 36 | Encoder feedback pulse digital filter setup |
| P | S | | 【Class 2】Vibration Restrain | 00 | adaptive filter mode setup |
| P | S | T | | 01 | 1st notch frequency |
| P | S | T | | 02 | 1st notch width selection |

| | | | | | |
|---|---|---|---|---|---|
| P | S | T | **Function** | 03 | 1st notch depth selection |
| P | S | T | | 04 | 2nd notch frequency |
| P | S | T | | 05 | 2nd notch width selection |
| P | S | T | | 06 | 2nd notch depth selection |
| P | | | | 22 | Positional command smooth filter |
| P | | | | 23 | Positional command FIR filter |
| | S | | 【Class 3】 | 00 | Velocity setup internal/external switching |
| | S | | **Speed,** | 01 | Speed command rotational direction selection |
| | S | T | **Torque** | 02 | Speed command input gain |
| | S | | **Control** | 03 | Speed command reversal input |
| | S | | | 04 | 1st speed setup |
| | S | | | 05 | 2nd speed setup |
| | S | | | 06 | 3rd speed setup |
| | S | | | 07 | 4th speed setup |
| | S | | | 08 | 5th speed setup |
| | S | | | 09 | 6th speed setup |
| | S | | | 10 | 7th speed setup |
| | S | | | 11 | 8th speed setup |
| | S | | | 12 | time setup acceleration |
| | S | | | 13 | time setup deceleration |
| | S | | | 14 | Sigmoid acceleration/deceleration time setup |
| | | | | 15 | Speed zero-clamp function selection |
| | S | T | | 16 | Speed zero-clamp level |
| | | T | | 18 | Torque command direction selection |
| | | T | | 19 | Torque command input gain |
| | | T | | 20 | Torque command input reversal |
| | | T | | 21 | Speed limit value 1 |
| P | S | T | | 24 | maximum speed of motor rotation |
| P | S | T | 【Class 4】 | 00 | input selection SI1 |
| P | S | T | **I/F Monitor** | 01 | input selection SI2 |
| P | S | T | **Setting** | 02 | input selection SI3 |
| P | S | T | | 03 | input selection SI4 |
| P | S | T | | 04 | input selection SI5 |
| P | S | T | | 10 | output selection SO1 |
| P | S | T | | 11 | output selection SO2 |
| P | S | T | | 12 | output selection SO3 |
| P | S | T | | 13 | output selection SO4 |
| P | S | T | | 22 | Analog input 1(AI 1) offset setup |
| P | S | T | | 23 | Analog input 1(AI 1) filter |
| P | S | T | | 28 | Analog input 3(AI 3) offset setup |
| P | S | T | | 29 | Analog input 3(AI 3) filter |
| P | | | | 31 | Positioning complete range |
| P | | | | 32 | Positioning complete output setup |

| | | | | | |
|---|---|---|---|---|---|
| P | | | | 33 | INP hold time |
| P | S | T | | 34 | Zero-speed |
| | S | | | 35 | Speed coincidence range |
| P | S | T | | 36 | At-speed |
| P | S | T | | 37 | Mechanical brake action at stalling setup |
| P | S | T | | 38 | Mechanical brake action at running setup |
| P | S | T | | 39 | Brake action at running setup |
| P | | | 【Class 5】 | 00 | 2nd numerator of electronic gear |
| P | | | **Extended** | 01 | 3rd numerator of electronic gear |
| P | | | **Setup** | 02 | 4th numerator of electronic gear |
| P | S | T | | 03 | Denominator of pulse output division |
| P | S | T | | 06 | Sequence at servo-off |
| P | S | T | | 08 | Main power off LV trip selection |
| P | S | T | | 09 | Main power off detection time |
| P | S | T | | 13 | Over-speed level setup |
| P | S | T | | 15 | I/F reading filter |
| P | S | T | | 28 | LED initial status |
| P | S | T | | 29 | RS232 baud rate setup |
| P | S | T | | 30 | RS485 baud rate setup |
| P | S | T | | 31 | Axis address |
| P | S | T | | 35 | Front panel lock setup |
| P | S | T | 【Class 6】 | 03 | JOG trial run command torque |
| P | S | T | **Special** | 04 | JOG trial run command speed |
| P | S | T | **Setup** | 08 | Positive direction torque compensation value |
| P | S | T | | 09 | Negative direction torque compensation value |
| P | | | | 20 | distance of trial running |
| P | | | | 21 | waiting time of trial running |
| P | | | | 22 | cycling times of trial running |

# 4.2 Parameter Function

Here is the explanation of parameters ,you can check them or modify the value using software Protuner or the front panel of driver.

***Contact tech@leadshine.com if you need more technical service .***

## 4.2.1【Class 0】Basic Setting

| Pr0.00 | Mode loop gain | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -32767 | 0.1Hz | 0 | P | | |

Set up the bandwidth of MFC , it is similar to the response bandwidth

| Setup value | Meaning |
|---|---|
| 0 | Disable the function. |
| 1 | Enable the function , set the bandwidth automatically , recommended for most application . |
| 2-10 | Forbidden and reserved . |
| 11-20000 | Set the bandwidth manually , 1.1Hz – 2000Hz |

MFC is used to enhance the performance of dynamic tracing for input command , make positioning faster , cut down the tracking error , run more smooth and steady . It is very useful for multi-axis synchronous movement and interpolation, the performance will be better.

**The main way to use this function :**

a. Choose the right control mode : Pr001 = 0
b. Set up the inertia of ratio : Pr004
c. Set up the rigidity : Pr003
d. Set up the Pr000 :
   1) If no multi-axis synchronous movement , set Pr000 as 1 or more than 10 ;
   2) If multi-axis synchronous movement needed , set Pr000 as the same for all the axes .
   3) If Pr000 is more than 10 , start with 100 , or 150 , 200 , 250 , …. .

**Caution:**

1. Set up the right control mode , the right inertia of ratio and rigidity firstly .
2. Don't change the value of Pr000 when the motor is running , otherwise vibration occurs
3. Set up a small value from the beginning if using it in manual mode , smaller value means running more smooth and steady , while bigger one means faster positioning

| Pr0.01* | Control Mode Setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -2 | - | 0 | P | S | T |

Set using control mode

| Setup value | Content | |
|---|---|---|
| | 1st mode | 2nd mode |
| 0 | Position | - |
| 1 | Velocity | - |
| 2 | Torque | - |
| 3 | Position | Velocity |
| 4 | Position | Torque |
| 5 | Velocity | Torque |

When you set up the combination mode of 3.4.5, you can select either the 1st or the 2nd with control mode switching input(C-MODE).
When C-MODE is open, the 1st mode will be selected.
When C-MODE is shorted, the 2nd mode will be selected.

| Pr0.02 | Real-time Auto-gain Tuning | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -2 | - | 0 | P | S | T |

You can set up the action mode of the real-time auto-gain tuning.

| Setup value | mode | Varying degree of load inertia in motion |
|---|---|---|
| 0 | invalid | Real-time auto-gain tuning function is disabled. |
| 1 | standard | Basic mode. do not use unbalanced load, friction compensation or gain switching |
| 2 | positioning | Main application is positioning. it is recommended to use this mode on equipment without unbalanced horizontal axis, ball screw driving equipment with low friction, etc. |

**Caution:** If pr0.02=1 or 2 , you can't modify the values of pr1.01 – pr1.13, the values of them depend on the real-time auto-gain tuning ,all of them are set by the driver itself.

| Pr0.03 | selection of machine stiffness at real time auto gain tuning | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -31 | - | 11 | P | S | T |

You can set up response while the real-time auto-gain tuning is valid.

Low ⟶ Machine stiffness ⟶ High

Low ⟶ Servo gain ⟶ High

0.1·····11.12.13·····30.31

Low ⟶ Response ⟶ High

**Notice:** Higher the setup value, higher the velocity response and servo stiffness will be obtained. However, when increasing the value, check the resulting operation to avoid oscillation or vibration. Control gain is updated while the motor is stopped. If the motor can't be stopped due to excessively low gain or continuous application of one-way direction command ,any change made to Pr0.03 is not used for update. If the changed stiffness setting is made valid after the motor stopped, abnormal sound or oscillation will be generated. To prevent this problem, stop the motor after changing the stiffness setting and check that the changed setting is enabled.

| Pr0.04 | Inertia ratio | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -10000 | % | 250 | P | S | T |

You can set up the ratio of the load inertia against the rotor(of the motor)inertia.

**Pr0.04=( load inertia/rotate inertia)×100%**

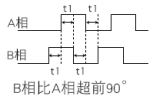
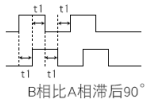
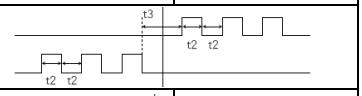
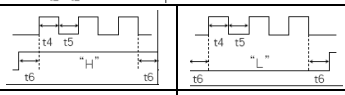
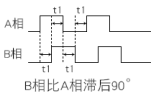
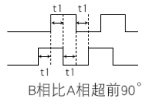
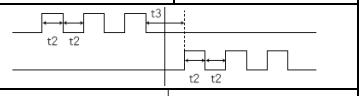
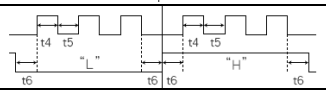
Notice:

If the inertia ratio is correctly set, the setup unit of Pr1.01 and Pr1.06 becomes (Hz). When the inertia ratio of Pr0.04 is larger than the actual value, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr0.04 is smaller than the actual value, the setup unit of the velocity loop gain becomes smaller.

| Pr0.06* | Command Pulse Rotational Direction Setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 0 | P | | |

Set command pulse input rotate direction, command pulse input type

| Pr0.07* | Command Pulse Input Mode Setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -3 | - | 3 | P | | |

| Pr0.06 | Pr0.07 | Command Pulse Format | Signal | Positive Direction Command | Negative Direction Command |
|---|---|---|---|---|---|
| 0 | 0 or 2 | 90 phase difference 2-phase pulse(A phase +B phase) | Pulse sign |   |   |
| | 1 | Positive direction pulse + negative direction pulse | Pulse sign |   | |
| | 3 | Pulse + sign | Pulse sign |   |   |
| 1 | 0 or 2 | 90 phase difference 2 phase pulse(A phase +B phase) | Pulse sign |   |   |
| | 1 | Positive direction pulse + negative direction pulse | Pulse sign |   | |
| | 3 | Pulse + sign | Pulse sign |   | |

Command pulse input signal allow largest frequency and smallest time width

| PULS/SIGN Signal Input I/F | | Permissible Max. Input Frequency | Smallest Time Width | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | t1 | t2 | t3 | t4 | t5 | t6 |
| Pulse series interface | Long distance interface | 500kpps | 2 | 1 | 1 | 1 | 1 | 1 |
| | Open-collector output | 200kpps | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |

| Pr0.09 | 1st numerator of electronic gear | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 1-32767 | - | 1 | P | | |

Set the numerator of division/multiplication operation made according to the command pulse input.

| Pr0.10 | denominator of electronic gear | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 1-32767 | - | 1 | P | | |

Set the denominator of division/multiplication operation made according to the command pulse input.

| Pr0.09 | Pr0.10 | Command division/multiplication operation |
|---|---|---|
| 1-32767 | 1-32767 | Command pulse input → 【Pr0.09 set value】 / 【Pr0.10 set value】 → position command |

| Pr0.11* | Output pulse counts per one motor | Range | unit | default | Related control mode |
|---|---|---|---|---|---|

| | revolution | 1-2500 | P/r | 2500 | P | S | T |
|---|---|---|---|---|---|---|---|

Set the numerator of division/multiplication operation made according to the command pulse input.

| Pr5.03* | denominator of pulse output division | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 1-2500 | - | 250<br>0 | P | S | T |

**Combination of Pr0.11 Output pulse counts per one motor revolution and Pr5.03 Denominator of pulse output division**

| Pr0.11 | Pr5.03 | Pulse output process |
|---|---|---|
| 1-2500 | 1-2500 | encoder pulse → 【Pr0.11set value】 / 【Pr5.03 set value】 → output pulse |

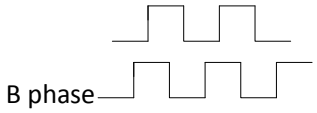
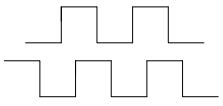
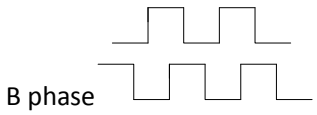
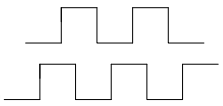
Pulse output resolution after dividing double frequency 4 times

$$\text{Pulse output resolution} = \text{encoder} \times 4 \times \frac{\text{Pr0.11(pulse output divide frequency molecule)}}{\text{Pr5.03(pulse output divide frequency denominator)}}$$

| Pr0.12* | reversal of pulse output logic | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 0 | P | S | T |

You can set up the B phase logic and the output source of the pulse output. With this parameter, you can reverse the phase relation between the A-phase pulse and B-phase pulse by reversing the B-phase logic.

< **reversal of pulse output logic** >

| Pr0.12 | B-phase Logic | CCW Direction Rotation | CW Direction Rotation |
|---|---|---|---|
| 0 | Non-Reversal | A phase<br>  <br>B phase | A phase<br>  <br>B phase |
| 1 | Reversal | A phase<br>  <br>B phase | A phase<br>  <br>B phase |

| Pr0.13 | 1st Torque Limit | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -500 | % | 300 | P | S | T |

You can set up the limit value of the motor output torque, as motor rate current %, the value can't exceed the maximum of output current.

| Pr0.14 | Position Deviation Excess Setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -500 | 0.1 rev | 200 | P | | |

Set excess range of positional deviation by the command unit(default).Setting the value too small will cause Err18.0 (position deviation excess detection)

## 4.2.2【Class 1】Gain Adjust

| Pr1.00 | 1st gain of position loop | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -30000 | 0.1/s | 320 | P | | |
| You can determine the response of the positional control system. Higher the gain of position loop you set, faster the positioning time you can obtain. Note that too high setup may cause oscillation. | | | | | | | |

| Pr1.01 | 1st gain of velocity loop | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -32767 | 0.1Hz | 180 | P | S | T |
| You can determine the response of the velocity loop. In order to increase the response of overall servo system by setting high position loop gain, you need higher setup of this velocity loop gain as well. However, too high setup may cause oscillation. | | | | | | | |

| Pr1.02 | 1st Time Constant of Velocity Loop Integration | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -10000 | 0.1ms | 310 | P | S | T |
| You can set up the integration time constant of velocity loop, Smaller the set up, faster you can dog-in deviation at stall to 0.The integration will be maintained by setting to"9999".The integration effect will be lost by setting to"10000". | | | | | | | |

| Pr1.03 | 1st Filter of Velocity Detection | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -31 | - | 15 | P | S | T |

You can set up the time constant of the low pass filter (LPF) after the speed detection, in 32 steps (0 to 31).Higher the setup, larger the time constant you can obtain so that you can decrease the motor noise, however, response becomes slow.

You can set the filter parameters through the loop gain, referring to the following table:

| Set Value | Speed Detection Filter Cut-off Frequency(Hz) | Set Value | Speed Detection Filter Cut-off Frequency(Hz) |
|---|---|---|---|
| 0 | 2500 | 16 | 750 |
| 1 | 2250 | 17 | 700 |
| 2 | 2100 | 18 | 650 |
| 3 | 2000 | 19 | 600 |
| 4 | 1800 | 20 | 550 |
| 5 | 1600 | 21 | 500 |
| 6 | 1500 | 22 | 450 |
| 7 | 1400 | 23 | 400 |
| 8 | 1300 | 24 | 350 |
| 9 | 1200 | 25 | 300 |
| 10 | 1100 | 26 | 250 |
| 11 | 1000 | 27 | 200 |
| 12 | 950 | 28 | 175 |
| 13 | 900 | 29 | 150 |
| 14 | 850 | 30 | 125 |
| 15 | 800 | 31 | 100 |

| Pr1.04 | 2nd Time Constant of torque filter | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -2500 | 0.01ms | 126 | P | S | T |
| Pr1.05 | 2nd gain of position loop | Range | unit | default | Related control mode | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 0 -30000 | 0.1/s | 380 | P | | |
| Pr1.06 | 2nd gain of velocity loop | Range | unit | default | Related control mode | | |
| | | 0 -32767 | 0.1Hz | 180 | P | S | T |
| Pr1.07 | 2nd Time Constant of Velocity Loop Integration | Range | unit | default | Related control mode | | |
| | | 0 -10000 | 0.1ms | 10000 | P | S | T |
| Pr1.08 | 2nd Filter of Velocity Detection | Range | unit | default | Related control mode | | |
| | | 0 -31 | - | 15 | P | S | T |
| Pr1.09 | 2nd Time Constant of torque filter | Range | unit | default | Related control mode | | |
| | | 0 -2500 | 0.01ms | 126 | P | S | T |
| Position loop, velocity loop, velocity detection filter, torque command filter have their 2 pairs of gain or time constant(1st and 2nd). | | | | | | | |

| Pr1.10 | Velocity feed forward gain | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1000 | 0.1% | 300 | P | | |
| Multiply the velocity control command calculated according to the internal positional command by the ratio of this parameter and add the result to the speed command resulting from the positional control process. | | | | | | | |

| Pr1.11 | Velocity feed forward filter | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -6400 | 0.01ms | 50 | P | | |
| Set the time constant of 1st delay filter which affects the input of speed feed forward.<br>**(usage example of velocity feed forward)**<br>The velocity feed forward will become effective as the velocity feed forward gain is gradually increased with the speed feed forward filter set at approx.50 (0.5ms). The positional deviation during operation at a constant speed is reduced as shown in the equation below in proportion to the value of velocity feed forward gain.<br>Position deviation [ unit of command]=command speed [ unit of command /s]/position loop gain[1/s] ×(100-speed feed forward gain[%]/100 | | | | | | | |

| Pr1.12 | Torque feed forward gain | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1000 | 0.1% | 0 | P | S | |

- Multiply the torque control command calculated according to the velocity control command by the ratio of this parameter and add the result to the torque command resulting from the velocity control process.
- To use torque feed forward, correctly set ratio of inertia. Set the inertia ratio that can be calculated from the machine specification to Pr0.04 inertia ratio.
- Positional deviation at a constant acceleration/deceleration can be minimized close to 0 by increasing the torque forward gain .this means that positional deviation can be maintained at near 0 over entire operation range while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active.

| Pr1.13 | Torque feed forward filter | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -6400 | 0.01ms | 0 | P | S | |
| Set up the time constant of 1st delay filter which affects the input of torque feed forward.<br>zero positional deviation is impossible in actual situation because of disturbance torque. as with | | | | | | | |

the velocity feed forward, large torque feed forward filter time constant decreases the operating noise but increases positional deviation at acceleration change point.

| Pr1.15 | Mode of position control switching | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | 0 -10 | - | 0 | P |

| Setting value | Switching condition | Gain switching condition |
|---|---|---|
| 0 | Fixed to 1st gain | Fixed to the 1st gain (Pr1.00-Pr1.04) |
| 1 | Fixed to 2nd gain | Fixed to the 2nd gain (Pr1.05-Pr1.09) |
| 2 | with gain switching input | ● 1st gain when the gain switching input is open.<br>● 2nd gain when the gain switching input is connected to com- .<br>✧ If no input signal is allocated to the gain switching input, the 1st gain is fixed. |
| 3 | Torque command is large | ● Shift to the 2nd gain when the absolute value of the torque command exceeded (level + hysteresis)[%]previously with the 1st gain.<br>● Return to the 1st gain when the absolute value of the torque command was kept below (level + hysteresis) [%]previously during delay time with the 2nd gain. |
| 4 | reserve | reserve |
| 5 | Speed command is large | ● Valid for position and speed controls.<br>● Shift to the 2nd gain when the absolute value of the speed command exceeded (level + hysteresis)[r/min]previously with the 1st gain.<br>● Return to the 1st gain when the absolute value of the speed command was kept below (level + hysteresis) [r/min] previously during delay time with the 2nd gain. |
| 6 | Position deviation is large | ● Valid for position control.<br>● Shift to the 2nd gain when the absolute value of the positional deviation exceeded (level + hysteresis)[pulse] previously with the 1st gain.<br>● Return to the 1st gain when the absolute value of the positional deviation was kept below (level + hysteresis)[r/min]previously during delay time with the 2nd gain.<br>✧ Unit of level and hysteresis [pulse] is set as the encoder resolution for positional control. |
| 7 | position command exists | ● Valid for position control.<br>● Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain.<br>● Return to the 1st gain when the positional command was kept 0 previously during delay time with the 2nd gain. |
| 8 | Not in positioning complete | ● Valid for position control.<br>● Shift to the 2nd gain when the positioning was not completed previously with the 1st gain.<br>● Return to the 1st gain when the positioning was kept in completed condition previously during delay time with the 2nd gain. |
| 9 | Actual speed is large | ● Valid for position control.<br>● Shift to the 2nd gain when the absolute value of the actual speed exceeded (level + hysteresis) (r/min) previously with the 1st gain.<br>● Return to the 1st gain when the absolute value of the actual speed was kept below (level - hysteresis) (r/min) previously during delay time with the 2nd gain. |
| 10 | Have position command +actual speed | ● Valid for position control.<br>● Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain.<br>● Return to the 1st gain when the positional command was kept |

| | | |
|---|---|---|
| | | at 0 during the delay time and the absolute value of actual speed was kept below (level - hysteresis) (r/min) previously with the 2nd gain. |

In position control mode, setup Pr1.15=3,5,6,9,10;
In speed control mode, setup Pr1.15=3,5,9;

| Pr1.17 | Level of position control switching | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -20000 | Mode dependent | 50 | P | | |

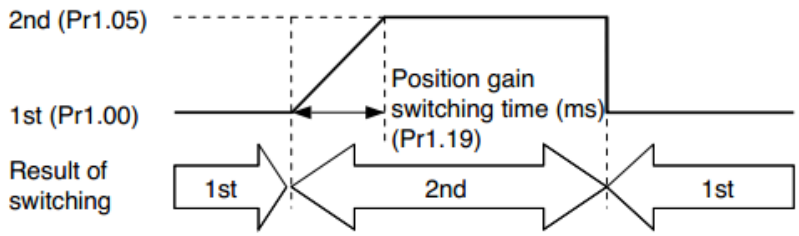
Unit of setting varies with switching mode.
switching condition: position :encoder pulse number ; speed : r/min ; torque : % .
Notice: set the level equal to or higher than the hysteresis.

| Pr1.18 | Hysteresis at position control switching | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -20000 | Mode dependent | 33 | P | | |

Combining Pr1.17(control switching level)setup
Notice: when level< hysteresis, the hysteresis is internally adjusted so that it is equal to level.

| Pr1.19 | position gain switching time | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -10000 | 0.1ms | 33 | P | | |

For position controlling: if the difference between 1st gain and 2nd gain is large, the increasing rate of position loop gain can be limited by this parameter.
**<Position gain switching time>**
Notice: when using position control, position loop gain rapidly changes, causing torque change and vibration. By adjusting Pr1.19 position gain switching time, increasing rate of the position loop gain can be decreased and variation level can be reduced.
Example: 1st (pr1.00) <-> 2nd (Pr1.05)




| Pr1.35* | positional command filter setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -200 | 0.05us | 0 | P | | |

Do filtering for positional command pulse, eliminate the interference of the narrow pulse, over-large setup will influence the input of high frequency positional command pulse, and make more time-delayed.

| Pr1.36* | pulse digital filter of encoder feedback setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -10000 | 0.1ms | 33 | P | | |

Do filtering for pulse of encoder feedback, eliminate the interference of the narrow pulse, over-large setup will influence the performance of motor in large speed, and influence the control performance of motor causing by large time-delayed.

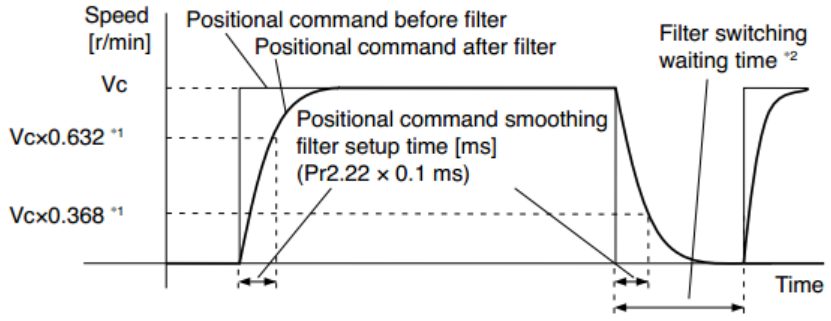
## 4.2.3【Class 2】Vibration Suppression

| Pr2.01 | 1st notch frequency | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 50 -2000 | HZ | 2000 | P | S | T |
| Set the center frequency of the 1st notch filter<br>Notice: the notch filter function will be invalidated by setting up this parameter to "2000". | | | | | | | |
| Pr2.02 | 1st notch width selection | Range | unit | default | Related control mode | | |
| | | 0 -20 | - | 2 | P | S | T |
| Set the width of notch at the center frequency of the 1st notch filter.<br>Notice: Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation. | | | | | | | |
| Pr2.03 | 1st notch depth selection | Range | unit | default | Related control mode | | |
| | | 0 -99 | - | 0 | P | S | T |
| Set the depth of notch at the center frequency of the 1st notch filter.<br>Notice: Higher the setup, shallower the notch depth and smaller the phase delay you can obtain. | | | | | | | |

| Pr2.04 | 2nd notch frequency | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 50 -2000 | HZ | 2000 | P | S | T |
| Set the center frequency of the 2nd notch filter<br>Notice: the notch filter function will be invalidated by setting up this parameter to "2000". | | | | | | | |
| Pr2.05 | 2nd notch width selection | Range | unit | default | Related control mode | | |
| | | 0 -20 | - | 2 | P | S | T |
| Set the width of notch at the center frequency of the 2nd notch filter.<br>Notice: Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation. | | | | | | | |
| Pr2.06 | 2nd notch depth selection | Range | unit | default | Related control mode | | |
| | | 0 -99 | - | 0 | P | S | T |
| Set the depth of notch at the center frequency of the 2nd notch filter.<br>Notice: Higher the setup, shallower the notch depth and smaller the phase delay you can obtain. | | | | | | | |

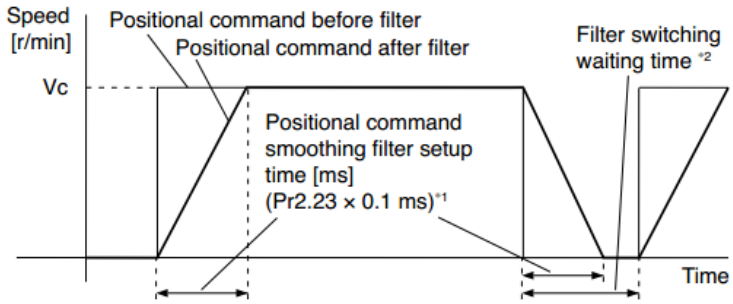
| Pr2.22 | positional command smoothing filter | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -32767 | 0.1ms | 0 | P | | |

- Set up the time constant of the1st delay filter in response to the positional command.
- When a square wave command for the target speed Vc is applied ,set up the time constant of the 1st delay filter as shown in the figure below.



| Pr2.23 | positional command FIR filter | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -10000 | 0.1ms | 0 | P | | |

- Set up the time constant of the1st delay filter in response to the positional command.
- When a square wave command for the target speed Vc is applied , set up the Vc arrival time as shown in the figure below.




**Note: For parameters which No. have a suffix of "*",changed contents will be validated when you turn on the control power.**

## *4.2.4【Class 3】Velocity/ Torque Control*

| Pr3.00 | Speed setup, Internal /External switching | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -3 | - | 0 | | S | |

This driver is equipped with internal speed setup function so that you can control the speed with contact inputs only.

| Setup value | Speed setup method |
|---|---|
| 0 | Analog speed command(SPR) |
| 1 | Internal speed command 1st to 4th speed(PR3.04-PR3.07) |
| 2 | Internal speed command 1st to 3rd speed (PR3.04-PR3.06), Analog speed command(SPR) |
| 3 | Internal speed command 1st to 8th speed (PR3.04-PR3.11) |

**<relationship between Pr3.00 Internal/External switching speed setup and the internal command speed selection 1-3 and speed command to be selected>**

| Setup value | selection 1 of internal command speed(INTSPD1) | selection 2 of internal command speed (INTSPD2) | selection 3 of internal command speed (INTSPD3) | selection of Speed command |
|---|---|---|---|---|
| 1 | OFF | OFF | NO effect | 1st speed |
| | ON | OFF | | 2nd speed |
| | OFF | ON | | 3rd speed |
| | ON | ON | | 4th speed |
| 2 | OFF | OFF | NO effect | 1st speed |
| | ON | OFF | | 2nd speed |
| | OFF | ON | | 3rd speed |
| | ON | ON | | Analog speed command |
| 3 | The same as [Pr3.00=1] | | OFF | 1st to 4th speed |
| | OFF | OFF | ON | 5th speed |
| | ON | OFF | ON | 6th speed |
| | OFF | ON | ON | 7th speed |

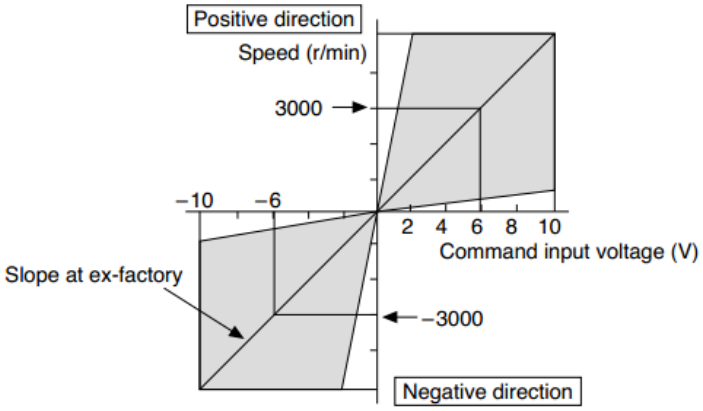
| Pr3.01 | Speed command rotational direction selection | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 0 | | S | |

Select the Positive /Negative direction specifying method

| Setup value | Select speed command sign (1st to 8th speed) | Speed command direction (VC-SIGN) | Position command direction |
|---|---|---|---|
| 0 | + | No effect | Positive direction |
| | - | No effect | Negative direction |
| 1 | Sign has no effect | OFF | Positive direction |
| | Sign has no effect | ON | Negative direction |

| Pr3.02 | Input gain of speed command | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 10 -2000 | (r/min)/v | 500 | | S | T |

Based on the voltage applied to the analog speed command (SPR), set up the conversion gain to motor command speed.
You can set up "slope" of relation between the command input voltage and motor speed, with Pr3.02. Default is set to Pr3.02=500(r/min)/V, hence input of 6V becomes 3000r/min.
Notice:
1. Do not apply more than ±10V to the speed command input(SPR).
2. When you compose a position loop outside of the driver while you use the driver in velocity control mode, the setup of Pr3.02 gives larger variance to the overall servo system.
3. Pay an extra attention to oscillation caused by larger setup of Pr3.02.




| Pr3.03 | Reversal of speed command input | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 500 | | S | |

Specify the polarity of the voltage applied to the analog speed command (SPR).

| **Setup value** | **Motor rotating direction** | |
|---|---|---|
| 0 | Non-reversal | [+ voltage] →[+ direction] [- voltage] → [-direction] |
| 1 | reversal | [+ voltage] →[- direction] [- voltage] → [+direction] |

**Caution:** When you compose the servo drive system with this driver set to velocity control mode and external positioning unit, the motor might perform an abnormal action if the polarity of the speed command signal from the unit and the polarity of this parameter setup does not match.

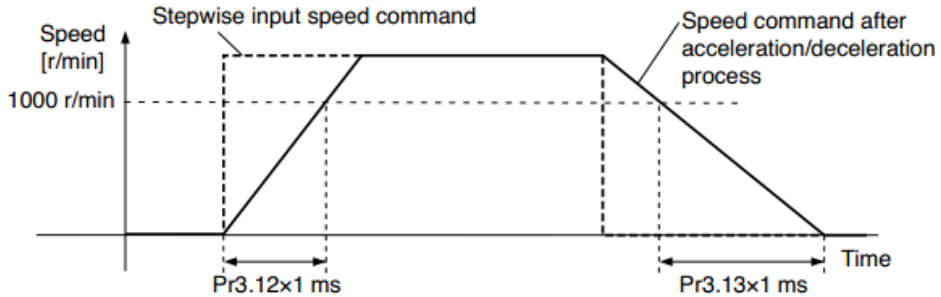
| Pr3.04 | 1st speed of speed setup | Range | unit | default | Related control mode |
|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.05 | 2nd speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.06 | 3rd speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.07 | 4th speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.08 | 5th speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.09 | 6th speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.10 | 7th speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Pr3.11 | 8th speed of speed setup | Range | unit | default | Related control mode | |
| | | -20000 -20000 | r/min | 0 | | S |
| Set up internal command speeds, 1st to 8th | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Pr3.12 | time setup acceleration | Range | unit | default | Related control mode | |
| | | 0 -10000 | Ms(1000r/min) | 100 | | S |
| Pr3.13 | time setup deceleration | Range | unit | default | Related control mode | |
| | | 0 -10000 | Ms(1000r/min) | 100 | | S |

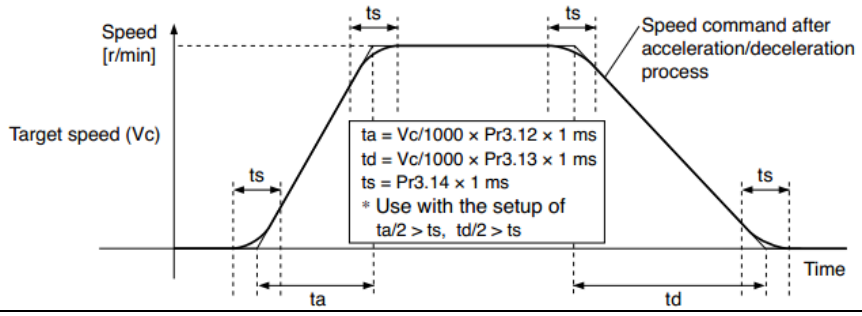
**Set** up acceleration/deceleration processing time in response to the speed command input.
Set the time required for the speed command(stepwise input)to reach 1000r/min to Pr3.12 Acceleration time setup. Also set the time required for the speed command to reach from 1000r/min to 0 r/min, to Pr3.13 Deceleration time setup.
Assuming that the target value of the speed command is Vc(r/min), the time required for acceleration/deceleration can be computed from the formula shown below.

Acceleration time (ms)=Vc/1000 *Pr3.12 *1ms
Deceleration time (ms)=Vc/1000 *Pr3.13 *1ms




| | | | | | | |
|---|---|---|---|---|---|---|
| Pr3.14 | Sigmoid acceleration/deceleration time setup | Range | unit | default | Related control mode | |
| | | 0 -1000 | ms | 0 | | S |

Set S-curve time for acceleration/deceleration process when the speed command is applied. According to Pr3.12 Acceleration time setup and Pr3.13 Deceleration time setup, set up sigmoid time with time width centering the inflection point of acceleration/deceleration.




| Pr3.15 | Speed zero-clamp function selection | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -3 | - | 0 | | S | T |

1. If Pr3.15=0, the function of zero clamp is forbidden. It means the motor rotates with actual velocity which is controlled by the analog voltage input 1 even if the velocity is less than 10 rpm. The motor runs no matter what the value of Pr3.16 is. The actual velocity is controlled by external the analog voltage input .
2. If Pr3.15=1 and the input signal of Zero Speed is available in the same time, the function of zero clamp works. It means motor will stop rotating in servo-on condition no matter what the velocity of motor is, and motor stop rotating no matter what the value of Pr3.16 is.
3. If Pr3.15=2 , the function of zero clamp belongs to the value of Pr3.16. If the actual velocity is less than the value of Pr3.16, the motor will stop rotating in servo-on condition.

| Pr3.16 | Speed zero-clamp level | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -20000 | r/min | 30 | | S | T |

When analog speed given value under speed control mode less than zero speed clamp level setup, speed command will set to 0 strongly.

| Pr3.18 | Torque command direction selection | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 0 | | | T |

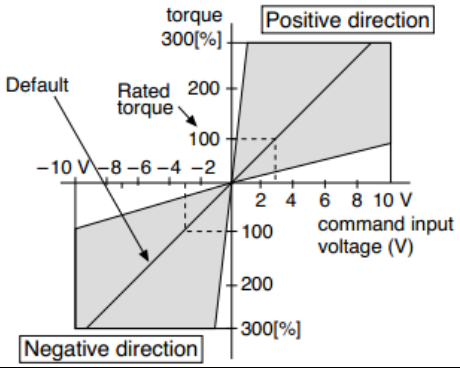
Select the direction positive/negative direction of torque command

| Setup value | designation |
|---|---|
| 0 | Specify the direction with the sign of torque command<br>Torque command input[+] → positive direction, [-] → negative direction |
| 1 | Specify the direction with torque command sign(TC-SIGN).<br>OFF: positive direction ON: negative direction |

| Pr3.19 | Torque command input gain | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 500 | | | T |

Based on the voltage (V) applied to the analog torque command (TRQR),set up the conversion gain to torque command(%) .

- Unit of the setup value is [0.1V/100%] and set up input voltage necessary to produce the rated torque.
- Default setup of 30 represents 3V/100%




| Pr3.20 | Torque command input reversal | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -1 | - | 0 | | | T |

Set up the polarity of the voltage applied to the analog torque command(TRQR).

| Setup value | Direction of motor output torque | |
|---|---|---|
| 0 | Non-reversal | [+ voltage] →[+ direction] [- voltage] → [-direction] |
| 1 | reversal | [+ voltage] →[- direction] [- voltage] → [+direction] |

| Pr3.21 | Speed limit value 1 | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -20000 | r/min | 0 | | | T |

Set up the speed limit used for torque controlling.
During the torque controlling, the speed set by the speed limit value cannot be exceeded.

| Pr3.24* | Motor rotate maximum speed limit | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -6000 | r/min | 3000 | P | S | T |

Set up motor running max rotate speed, but can't be exceeded motor allowed max rotate speed.

**Note: For parameters which No. have a suffix of "*",changed contents will be validated when you turn on the control power.**

## *4.2.5【Class 4】I/F Monitor Setting*

| Pr4.00* | Input selection SI1 | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-00FFFFFFh | - | 00030303h | P | S | T |
| Pr4.01* | Input selection SI2 | Range | unit | default | Related control mode | | |
| | | 0-00FFFFFFh | - | 00828282h | P | S | T |
| Pr4.02* | Input selection SI3 | Range | unit | default | Related control mode | | |
| | | 0-00FFFFFFh | - | 00818181h | P | S | T |
| Pr4.03* | Input selection SI4 | Range | unit | default | Related control mode | | |
| | | 0-00FFFFFFh | - | 00919191h | P | S | T |

| Pr4.04* | Input selection SI5 | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-00FFFFFFh | - | 00000007h | P | S | T |

S Set SI1 input function allocation.

This parameter use 16 binary system to set up the values, as following :

00- - - - * * h: position control

00- - * * - - h: velocity control

00* * - - - - h: torque control

Please at [**] partition set up function number

For the function number, please refer to the following Figure.

| **Signal name** | **symbol** | **Set value** | |
|---|---|---|---|
| | | **a-contact** | **b- contact** |
| Invalid | - | 00h | Do not setup |
| Positive direction over-travel inhibition input | POT | 01h | 81h |
| negative direction over-travel inhibition input | NOT | 02h | 82h |
| Servo-ON input | SRV-ON | 03h | 83h |
| Alarm clear input | A-CLR | 04h | Do not setup |
| Control mode switching input | C-MODE | 05h | 85h |
| Gain switching input | GAIN | 06h | 86h |
| Deviation counter clear input | CL | 07h | Do not setup |
| Command pulse inhibition input | INH | 08h | 88h |
| Electronic gear switching input 1 | DIV1 | 0Ch | 8Ch |
| Electronic gear switching input 2 | DIV2 | 0Dh | 8Dh |
| Selection 1 input of internal command speed | INTSPD1 | 0Eh | 8Eh |
| Selection 2 input of internal command speed | INTSPD2 | 0Fh | 8Fh |
| Selection 3 input of internal command speed | INTSPD3 | 10h | 90h |
| Speed zero clamp input | ZEROSPD | 11h | 91h |
| Speed command sign input | VC-SIGN | 12h | 92h |
| Torque command sign input | TC-SIGN | 13h | 93h |
| Forced alarm input | E-STOP | 14h | 94h |

Note:

1. a-contact means input signal comes from external controller or component ,for example: PLC .
2. b-contact means input signal comes from driver internally.
3. Don’t setup to a value other than that specified in the table .
4. Don’t assign specific function to 2 or more signals. Duplicated assignment will cause Err21.0 I/F input multiple assignment error 1or Err21.1 I/F input multiple assignment error 2.

| Pr4.10* | Output selection SO1 | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-00FFFFFFh | - | 00010101h | P | S | T |
| Pr4.11* | Output selection SO2 | Range | unit | | Related control mode | | |
| | | 0-00FFFFFFh | - | 00020202h (131586) | P | S | T |
| Pr4.12* | Output selection SO3 | Range | unit | | Related control mode | | |
| | | 0-00FFFFFFh | - | 00000704h (65793) | P | S | T |
| Pr4.13* | Output selection SO4 | Range | unit | | Related control mode | | |
| | | 0-00FFFFFFh | - | 00000303h (328964) | P | S | T |

Assign functions to SO1 outputs.

This parameter use 16 binary system do setup, as following :

00- - - - * * h: position control

00- - * * - - h: velocity control
00* * - - - - h: torque control
Please at [**] partition set up function number.
For the function number, please refer to the following Figure.

| Signal name | symbol | Setup value |
|---|---|---|
| Invalid | - | 00h |
| Alarm output | Alm | 01h |
| Servo-Ready output | S-RDY | 02h |
| Eternal brake release signal | BRK-OFF | 03h |
| Positioning complete output | INP | 04h |
| At-speed output | AT-SPPED | 05h |
| Zero-speed detection output | ZSP | 07h |
| Velocity coincidence output | V-COIN | 08h |
| Positional command ON/OFF output | P-CMD | 0Bh |
| Speed command ON/OFF output | V-CMD | 0Fh |

| Pr4.22 | Analog input 1 (AI1) offset setup | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | -5578 -5578 | - | 0 | S |

Set up the offset correction value applied to the voltage fed to the analog input 1.

| Pr4.23 | Analog input 1 (AI1) filter | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | 0-6400 | 0.01ms | 0 | S |

Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 1.

| Pr4.28 | Analog input 3 (AI3) offset setup | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | 0 -1 | - | 500 | T |

Set up the offset correction value applied to the voltage fed to the analog input 3.

| Pr4.29 | Analog input 3 (AI3) filter | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | 0 -1 | - | 500 | T |

Set up the time constant of 1st delay filter that determines the lag time behind the voltage applied to the analog input 3.

| Pr4.31 | Positioning complete range | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | 0 -10000 | Encoder unit | 10 | P |

Set up the timing of positional deviation at which the positioning complete signal (INP1) is output.

| Pr4.32 | Positioning complete range | Range | unit | default | Related control mode |
|---|---|---|---|---|---|
| | | 0 -3 | command unit | 10 | P |

Select the condition to output the positioning complete signal (INP1).

| Setup value | Action of positioning complete signal |
|---|---|

| | |
|---|---|
| 0 | The signal will turn on when the positional deviation is smaller than Pr4.31 [positioning complete range]. |
| 1 | The signal will turn on when there is no position command and position deviation is smaller than Pr4.31 [positioning complete range]. |
| 2 | The signal will turn on when there is no position command, the zero-speed detection signal is ON and the positional deviation is smaller than Pr4.31 [positioning complete range]. |
| 3 | The signal will turn on when there is no position command and the positional deviation is smaller than Pr4.31 [positioning complete range].Then holds "ON" states until the next position command is entered. Subsequently, ON state is maintained until Pr4.33 INP hold time has elapsed. After the hold time, INP output will be turned ON/OFF according to the coming positional command or condition of the positional deviation. |

| Pr4.33 | INP hold time | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-30000 | 1ms | 0 | P | | |

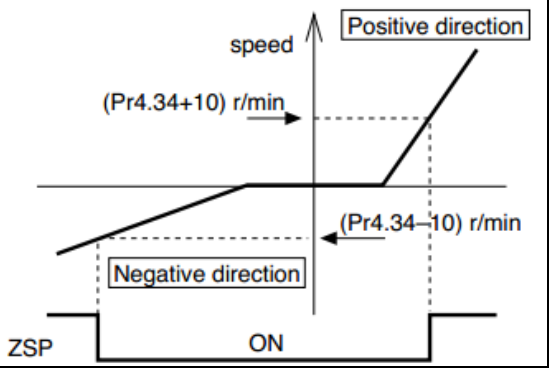
Set up the hold time when Pr 4.32 positioning complete output setup=3.

| Setup value | State of Positioning complete signal |
|---|---|
| 0 | The hold time is maintained definitely, keeping ON state until next positional command is received. |
| 1-30000 | ON state is maintained for setup time (ms)but switched to OFF state as the positional command is received during hold time. |

| Pr4.34 | Zero-speed | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 10 -20000 | r/min | 50 | P | S | T |

You can set up the timing to feed out the zero-speed detection output signal(ZSP or TCL) in rotate speed (r/min).
The zero-speed detection signal(ZSP) will be fed out when the motor speed falls below the setup of this parameter, Pr4.34

- the setup of pr4.34 is valid for both positive and negative direction regardless of the motor rotating direction.
- There is hysteresis of 10[r/min].



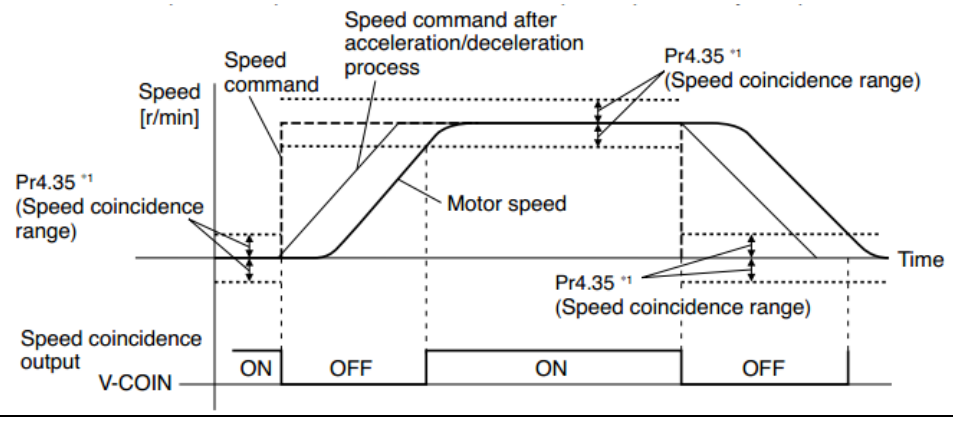

| Pr4.35 | Speed coincidence range | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 10 -20000 | r/min | 50 | | S | |

Set the speed coincidence (V-COIN) output detection timing.
Output the speed coincidence (V-COIN) when the difference between the speed command and the motor speed is equal to or smaller than the speed specified by this parameter.

Because the speed coincidence detection is associated with 10 r/min hysteresis, actual detection range is as shown below.

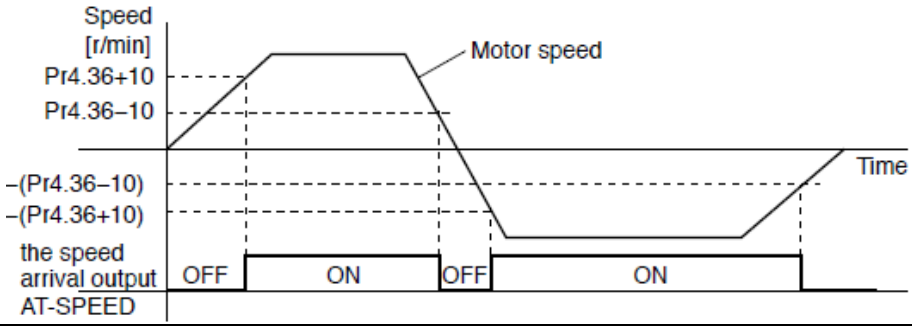
Speed coincidence output OFF -> ON timing (Pr4.35 -10) r/min

Speed coincidence output ON -> OFF timing (Pr4.35 +10) r/min




| Pr4.36 | At-speed(Speed arrival) | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 10-20000 | r/min | 1000 | | S | |

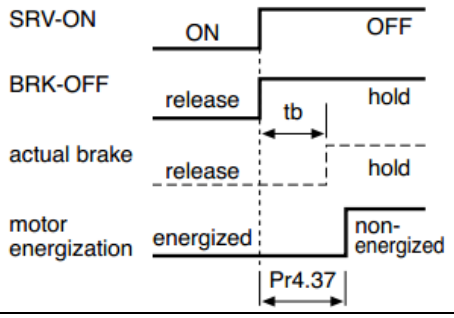
Set the detection timing of the speed arrival output (AT-SPEED).
When the motor speed exceeds this setup value, the speed arrive output (AT-SPEED) is output.
Detection is associated with 10r/min hysteresis .




| Pr4.37 | Mechanical brake action at stalling setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -10000 | 1ms | 0 | P | S | T |

Motor brake delay time setup, mainly used to prevent servo on “galloping “phenomenon.
Set up the time from when the brake release signal(BRK-OFF) turns off to when the motor is de-energized (servo-free),when the motor turns to servo-off while the motor is at stall

- Set up to prevent a micro-travel/drop of the motor (work) due to the action delay time(tb) of the brake.
- After setting up Pr4.37>=tb, then compose the sequence so as the driver turns to servo-off after the brake is actually activated.

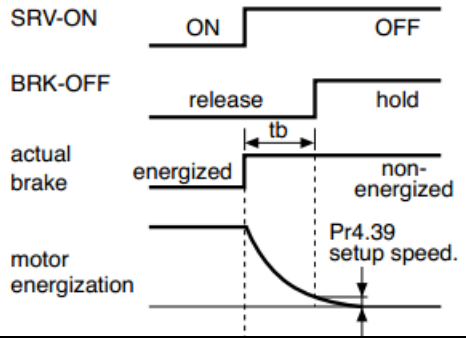



| Pr4.38 | Mechanical brake action at running | Range | unit | default | Related control mode |
|---|---|---|---|---|---|

| | setup | 0 -10000 | 1ms | 0 | P | S | T |
|---|---|---|---|---|---|---|---|

Mechanical brake start delay time setup, mainly used to prevent servo off "galloping "phenomenon. Set up time from when detecting the off of servo-on input signal(SRV-ON)is to when external brake release signal(BRK-OFF)turns off, while the motor turns to servo off during the motor in motion.

- Set up to prevent the brake deterioration due to the motor running.
- At servo-OFF during the motor is running , tb of the right fig will be a shorter one of either Pr4.38 setup time, or time lapse till the motor speed falls below Pr4.39 setup speed.




| Pr4.39 | Brake release speed setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 30 -3000 | 1ms | 30 | P | S | T |

When servo off, rotate speed less than this setup vale, and mechanical brake start delay time arrive, motor lost power.

## *4.2.6【Class 5】Extended Setup*

| Pr5.00 | 2nd numerator of electronic gear | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 1-32767 | - | 1 | P | S | T |
| Pr5.01 | 3rd numerator of electronic gear | Range | unit | default | Related control mode | | |
| | | 1-32767 | - | 1 | P | S | T |
| Pr5.02 | 4th numerator of electronic gear | Range | unit | default | Related control mode | | |
| | | 1-32767 | - | 1 | P | S | T |
| Pr5.03* | Denominator of pulse output division | Range | unit | default | Related control mode | | |
| | | 1-2500 | - | 2500 | P | S | T |

According to the command pulse input , set the 2nd to 4th numerator of electronic gear

| DIV1 | DIV2 | numerator of electronic gear | denominator of electronic gear |
|---|---|---|---|
| OFF | OFF | Pr0.09 | Pr5.03 |
| ON | OFF | Pr5.00 | Pr5.03 |
| OFF | ON | Pr5.01 | Pr5.03 |
| ON | ON | Pr5.02 | Pr5.03 |

**For details, refer to Pr0.11** .

| Pr5.06 | Sequence at servo-off | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-1 | - | 0 | P | S | T |

Specify the status during deceleration and after stop, after servo-off.

| Setup value | during deceleration | After stop |
|---|---|---|
| 0 | emergency | Free-run |
| 1 | Free-run | Free-run |

| Pr5.08 | LV trip selection at main power OFF | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-1 | - | 0 | P | S | T |

You can select whether or not to activate Err0d.0 (main power under-voltage protection)function while the main shutoff continues for the setup of Pr5.09(The main power-OFF detection time).

| Setup value | Action of main power low voltage protection |
|---|---|
| 0 | When the main power is shut off during Servo-On,Err0d.0 will not be triggered and the driver turns to Servo-OFF. The driver returns to Servo-On again after the main power resumption. |
| 1 | When the main power is shut off during Servo-On, the driver will trip due to Err0d.0 |

**Caution:** Err0d.0(main power under-voltage protection) is trigged when setup of Pr5.09 is long and P-N voltage of the main converter falls below the specified value before detecting the main power shutoff , regardless of the Pr5.08 setup.

| Pr5.09* | The main power-OFF detection time | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 70-2000 | 1ms | 70 | P | S | T |

You can set up the time to detect the shutoff while the main power is kept shut off continuously. The main power off detection is invalid when you set up this to 2000.

| Pr5.13 | Over-speed level setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-20000 | r/min | 0 | P | S | T |

If the motor speed exceeds this setup value, Err1A.0 [over-speed protect] occurs.
The over-speed level becomes 1.2 times of the motor max, speed by setting up this to 0.

| Pr5.15* | I/F reading filter | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-255 | 0.1ms | 0 | P | S | T |

I/O input digital filtering; higher setup will arise control delay.

| Pr5.28* | LED initial status | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-35 | - | 1 | P | S | T |

You can select the type of data to be displayed on the front panel LED (7-segment) at the initial status after power-on.

| Setup value | content | Setup value | content | Setup value | content |
|---|---|---|---|---|---|
| 0 | Positional command deviation | 10 | I/O signal status | 27 | Voltage across PN [V] |
| 1 | Motor speed | 11 | Analog input value | 28 | Software version |
| 2 | Positional command speed | 12 | Error factor and reference of history | 29 | Driver serial number |

| | | | | | |
|---|---|---|---|---|---|
| 3 | Velocity control command | 16 | Inertia ratio | 30 | Motor serial number |
| 4 | Torque command | 17 | Factor of no-motor running | 31 | Accumulated operation time |
| 5 | Feedback pulse sum | 23 | Communication axis address | 33 | Temperature information |
| 6 | Command pulse sum | 24 | Encoder positional deviation[encoder unit] | 36 | Safety condition monitor |
| 9 | Control mode | | | | |

| Pr5.29* | baud rate setup of RS232 communication | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-6 | - | 5 | P | S | T |

You can set up the communication speed of RS232.

| Pr5.30* | baud rate setup of RS485 communication | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-6 | - | 2 | P | S | T |

You can set up the communication speed of RS485.

| Set value | Baud rate | Set value | Baud rate |
|---|---|---|---|
| 0 | 2400bps | 4 | 38400bps |
| 1 | 4800bps | 5 | 57600bps |
| 2 | 9600bps | 6 | 115200bps |
| 3 | 19200bps | | |

Baud rate error is 2400-38400bps ±5% ,57600-115200bps ±2%

| Pr5.31* | Axis address | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-127 | - | 1 | P | S | T |

During communication with the host (e.g. PC) to control multiple shafts, the shaft being accessed by the host should be identified.
Notice: when using RS232/RS485, the maximum valid value is 31.

| Pr5.35* | Front panel lock setup | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-1 | - | 0 | P | S | T |

Lock the operation on the front panel.

| Setup value | content |
|---|---|
| 0 | No limit on the front panel operation |
| 1 | Lock the operation on the front panel |

## *4.2.7【Class 6】Special Setup*

| Pr6.03 | JOG trial run command torque | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0 -100 | % | 0 | | | T |

You can set up the command speed used for JOG trial run (torque control).

| Pr6.04 | JOG trial run command speed | Range | unit | default | Related control mode |
|---|---|---|---|---|---|

| | | 0-500 | r/min | 300 | P | S | T |
|---|---|---|---|---|---|---|---|
| You can set up the command speed used for JOG trial run (velocity control). | | | | | | | |

| Pr6.07 | JOG trial run command speed | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | -100-100 | % | 0 | P | S | T |
| Pr6.08 | JOG trial run command speed | Range | unit | default | Related control mode | | |
| | | -100-100 | % | 0 | P | S | T |
| Pr6.09 | JOG trial run command speed | Range | unit | default | Related control mode | | |
| | | -100-100 | % | 0 | P | S | T |
| This three parameters may apply feed forward torque superposition directly to torque command. | | | | | | | |

| Pr6.20 | Trial run distance | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-200 | 0.1rev | 10 | P | | |
| The distance of running each time in JOG run(position control) | | | | | | | |

| Pr6.21 | Trial run waiting time | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-30000 | Ms | 1000 | P | | |
| The waiting time after running each time in JOG run(position control) | | | | | | | |

| Pr6.22 | Trial run cycle times | Range | unit | default | Related control mode | | |
|---|---|---|---|---|---|---|---|
| | | 0-32767 | - | 10 | P | | |
| The cycling times of JOG run(position control) | | | | | | | |

# Chapter 5 Alarm and Processing

## 5.1 Alarm List

Protection function is activated when an error occurs, the driver will stop the rotation of servo motor, and the front panel will automatically display the corresponding fault error code. The history of the error can be viewed on data monitoring mode. error logging submenu displays like:“  ”.

The error code displays like:

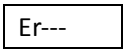



**Figure 5-1 Panel Alarm Display**

**Table 5.1 Error Code List**

| Error code | | content | Attribute | | |
|---|---|---|---|---|---|
| Main | Sub | | history | Immediate stop | Can be cleared |
| 09 | 0~F | FPGA communication error | ● | | |
| 0A | 0~1 | Current detection circuit error | ● | | |
| | 2~4 | Analog input circuit error | ● | | |
| | 5 | DC bus circuit error | ● | | |
| | 6 | Temperature detection circuit error | ● | | |
| 0b | 0 | Control power under-voltage | ● | | |
| 0C | 0 | DC bus over-voltage | ● | | ● |
| 0d | 0 | DC bus under-voltage | ● | | ● |
| 0E | 0 | Over-current | ● | | |
| | 1 | over -current of intelligent power module(IPM) | ● | | |
| 0F | 0 | Driver over-heat | ● | ● | |
| 10 | 0 | Motor over-load | ● | | ● |
| 12 | 0 | Resistor discharged circuit overload | ● | ● | |
| 15 | 0 | Encoder wiring error | ● | | |
| | 2 | Encoder initial position error | ● | | |
| 17 | 0 | Encoder data error | ● | ● | |
| 18 | 0 | Too large position pulse deviation | ● | ● | ● |
| | 1 | Too large velocity deviation | ● | ● | ● |
| 1A | 0 | Over-speed 1 | ● | ● | ● |
| 28 | 0 | I/F input interface allocation error | ● | | ● |
| | 1 | I/F input interface function set error | ● | | ● |

| | | | | | |
|---|---|---|---|---|---|
| | 2 | I/F output interface function set error | • | | • |
| 24 | 0 | CRC verification error when EEPROM parameter saved | | | |
| 26 | 0 | Positive/negative over-range input valid | • | • | • |
| 97 | 0 | Compulsory alarm input valid | • | • | |

Save: save this error history record

Emergency: error, driver will stop immediately

May remove: may through SI input/panel/software ACH Series remove alarm

# *5.2 Alarm Processing Method*

When appear error, please clear error reason, renew power on

| **Error code** | Main | Extra | **Display:** "Er.090"_"Er.09F" |
|---|---|---|---|
| | 09 | 0~F | **Content:** FPGA communication error |

| Cause | Confirmation | Solution |
|---|---|---|
| r,t terminal under-voltage | Check r,t terminal voltage | Make sure voltage of r.t terminal in proper range |
| Driver internal fault | / | replace the driver with a new one |

| **Error code** | Main | Extra | **Display:**' Er.0A0"_"Er.0A1" |
|---|---|---|---|
| | 0A | 0~1 | **Content:** current detection circuit error |

| Cause | Confirmation | Solution |
|---|---|---|
| Wiring error of motor output U,V,W terminal | Check wiring of motor output U,V,W terminal | Make sure motor U,V,W terminal wiring correctly |
| Main voltage R,S,T terminal voltage whether over-low | Check main voltage R,S,T terminal voltage | Make sure voltage of R,S,T terminal in proper range |
| Driver inner fault | / | replace the driver with a new one |

| **Error code** | Main | Extra | **Display:** "Er.0A2"_"Er.0A4" |
|---|---|---|---|
| | 0A | 2~4 | **Content:** analog input circuit error |

| Cause | Confirmation | Solution |
|---|---|---|
| Analog input Wiring error | Check wiring of analog input | Make sure analog input wiring correctly |
| Driver inner fault | / | replace the driver with a new one |

| **Error code** | Main | Extra | **Display:** "Er.0A5" |
|---|---|---|---|
| | 0A | 5 | **Content:** DC bus circuit error |

| Cause | Confirmation | Solution |
|---|---|---|
| Main voltage R,S,T terminal under-voltage | Check R,S,T terminal voltage | Make sure voltage of R,S,T terminal in proper range |

| | | |
|---|---|---|
| Driver inner fault | / | replace the driver with a new one |

| Error code | Main | Extra | Display: "Er0A6" |
|---|---|---|---|
| | 0A | 6 | **Content:** temperature detection circuit error |

| Cause | Confirmation | Solution |
|---|---|---|
| r,t terminal under-voltage | Check r,t terminal voltage | Make sure voltage of r,t terminal in proper range |
| Driver inner fault | / | replace the driver with a new one |

| Error code | Main | Extra | Display: "Er060" |
|---|---|---|---|
| | 06 | 0 | **Content:** control power under-voltage |

| Cause | Confirmation | Solution |
|---|---|---|
| r,t terminal under-voltage | Check r,t terminal voltage | Make sure voltage of r,t terminal in proper range |
| Driver inner fault | / | replace the driver with a new one |

| Error code | Main | Extr | Display: "Er0c0" |
|---|---|---|---|
| | 0c | 0 | **Content:** DC bus over-voltage |

| Cause | Confirmation | Solution |
|---|---|---|
| Main power R,S,T terminal over-voltage | Check R,S,T terminal voltage | decrease R,S,T terminal Voltage |
| Inner brake circuit damaged | / | replace the driver with a new one |
| Driver inner fault | / | replace the driver with a new one |

| Error code | Main | Extra | Display: "Er0d0" |
|---|---|---|---|
| | 0d | 0 | **Content**: DC bus under-voltage |

| Cause | Confirmation | Solution |
|---|---|---|
| Main power R,S,T terminal under-voltage | Check R,S,T terminal voltage | increase R,S,T terminal Voltage |
| Driver inner fault | / | replace the driver with a new one |

| Error code | Main | Extra | Display: "Er0E0" |
|---|---|---|---|
| | 0E | 0 | **Content:** over-current |

| Cause | Confirmation | Solution |
|---|---|---|
| Short of driver output wire | Short of driver output wire, whether short circuit to PG ground or not | Assure driver output wire no short circuit, assure motor no damage |
| Abnormal wiring of motor | Check motor wiring order | Adjust motor wiring sequence |
| Short of IGBT module | Cut off driver output wiring, make srv_on available and drive motor, check whether over-current exists | replace the driver with a new one |
| abnormal setting of control parameter | Modify the parameter | Adjust parameter to proper range |
| abnormal setting of control command | Check control command whether command changes too violently or not | Adjust control command: open filter function |

| Error code | Main | Extra | Display: "Er 0E 1" |
|---|---|---|---|
| | 0E | 1 | **Content**: IPM over-current |

| Cause | Confirmation | Solution |
|---|---|---|
| Short of driver output wire | Short of driver output wire, whether short circuit to PG ground or not | Assure driver output wire no short circuit, assure motor no damage |
| Abnormal wiring of motor | Check motor wiring order | Adjust motor wiring sequence |
| Short of IGBT module | Cut off driver output wiring, make srv_on available and drive motor, check whether over-current exists or not | replace the driver with a new one |
| Short of IGBT module | / | replace the driver with a new one |
| abnormal setting of control parameter | Modify the parameter | Adjust parameter to proper range |
| abnormal setting of control command | Check control command whether command changes too violently or not | Adjust control command: open filter function |

| Error code | Main | Extra | Display: "Er 0F 0" |
|---|---|---|---|
| | 0F | 0 | **Content**: driver over-heat |

| Cause | Confirmation | Solution |
|---|---|---|
| the temperature of power module have exceeded upper limit | Check driver radiator whether the temperature is too high or not | Strengthen cooling conditions, promote the capacity of driver and motor, enlarge acceleration/deceleration time, reduce load |

| Error code | Main | Extr | Display: "Er 10 0" |
|---|---|---|---|
| | 10 | 0 | **Content:** motor over-load |

| Cause | Confirmation | Solution |
|---|---|---|
| Load is too heavy | Check actual load if the value of parameter exceed maximum or not | Decrease load, adjust limit parameter |
| Oscillation of machine | Check the machine if oscillation exists or not | Modify the parameter of control loop; enlarge acceleration/deceleration time |
| wiring error of motor | Check wiring if error occurs or not, if line breaks or not | Adjust wiring or replace encoder/motor for a new one |
| electromagnetic brake engaged | Check brake terminal voltage | Cut off brake |

| Error code | Main | Extra | Display: "Er 12 0" |
|---|---|---|---|
| | 12 | 0 | **Content:** Resistance discharge circuit over-load |

| Cause | Confirmation | Solution |
|---|---|---|
| Regenerative energy has exceeded the capacity of regenerative resistor . | Check the speed if it is too high. Check the load if it is too large or not. | lower motor rotational speed; decrease load inertia ,increase external regenerative resistor, improve the capacity of the driver and motor |
| Resistance discharge circuit damage | / | Increase external regenerative resistor, replace the driver with a new one |

| Error code | Main | Extra | Display: "Er 15 0" |
|---|---|---|---|
| | 15 | 0 | **Content:** encoder line breaked |

| Cause | Confirmation | Solution |
|---|---|---|
| Encoder line disconnected | check wiring if it steady or not | Make encoder wiring steady |
| Encoder wiring error | Check encoder wiring if it is correct or not | Reconnect encoder wiring |
| Encoder damaged | / | replace the motor with a new one |
| Encoder measuring circuit damaged | / | replace the driver with a new one |

| Error code | Main | Extr | Display: "Er 15 2" |
|---|---|---|---|
| | 15 | 2 | **Content:** initialized position of encoder error |

| Cause | Confirmation | Solution |
|---|---|---|
| Communication data abnormal | Check encoder power voltage if it is DC5V ± 5% or not; check encoder cable and shielded line if it is damaged or not; check encoder cable whether it is intertwined with other power wire or not | Ensure power voltage of encoder normally, ensure encoder cable and shielded line well with FG ground, ensure encoder cable separated with other power wire |
| Encoder damaged | / | replace the motor with a new one |
| Encoder measuring circuit damaged | / | replace the driver with a new one |

| Error code | Main | Extra | Display: "Er 17 0" |
|---|---|---|---|
| | 17 | 0 | **Content:** encoder data error |

| Cause | Confirmation | Solution |
|---|---|---|
| Communication data abnormal | Check encoder power voltage if it is DC5V ± 5% or not ; check encoder cable and shielded line if it is damaged or not; check encoder cable whether it is intertwined with other power wire or not | Ensure power voltage of encoder normally, ensure encoder cable and shielded line well with FG ground, ensure encoder cable separated with other power wire |
| Encoder damaged | / | replace the motor with a new one |
| Encoder measuring circuit damaged | / | replace the driver with a new one |

| Error code | Main | Extra | Display: "Er 18 0" |
|---|---|---|---|
| | 18 | 0 | **Content:** position error over-large error |

| Cause | Confirmation | Solution |
|---|---|---|
| Unreasonable set of position error parameter | Check parameter PA_014 value if it is too small or not | Enlarge the value of PA_014 |
| Gain set is too small | Check parameter PA_100, PA_105 value if it is too small or not | Enlarge the value of PA_100, PA_105 |
| Torque limit is too small | Check parameter PA_013, PA_522 value whether too small or not | Enlarge the value of PA_103, PA_522 |
| Outside load is too large | Check acceleration/ deceleration time if it is too small or not , check motor rotational speed if it is too big or not ; check load if | Increase acceleration/ deceleration time decrease speed, decrease load |

| | | |
|---|---|---|
| | it is too large or not | |

| **Error code** | Main | Extra | **Display:** "Er018" |
|---|---|---|---|
| | 18 | 1 | **Content:** velocity error over-large error |

| Cause | Confirmation | Solution |
|---|---|---|
| The deviation of inner position command velocity is too large with actual speed | Check the value of PA_602 if it is too small or not | Enlarge the value of PA_602, or set the value to 0, make position deviation over-large detection invalid |
| The acceleration/ decelerate time Inner position command velocity is too small | Check the value of PA_312, PA_313 if it is too small or not | Enlarge the value of PA_312, PA_313. adjust gain of velocity control, improve trace performance. |

| **Error code** | Main | Extra | **Display:** "Er019" |
|---|---|---|---|
| | 19 | 0 | **Content:** motor vibration |

| Cause | Confirmation | Solution |
|---|---|---|
| Current vibration | Current vibration | Cut down the value of Pr003. Pr004 |
| Stiffness is too strong | Stiffness is too strong | |

| **Error code** | Main | Extra | **Display:** "Er01A0" |
|---|---|---|---|
| | 1A | 0 | **Content:** over-speed 1 |

| Cause | Confirmation | Solution |
|---|---|---|
| Motor speed has exceeded the first speed limit (PA_321) | Check speed command if it is too large or not; check the voltage of analog speed command if it is too large or not; check the value of PA_321 if it is too small or not; check input frequency and division frequency coefficient of command pulse if it is proper or not; check encoder if the wiring is correct or not | Adjust the value of input speed command, enlarge the value PA_321 value, modify command pulse input frequency and division frequency coefficient, assure encoder wiring correctly |

| **Error code** | Main | Extra | **Display:** "Er210" |
|---|---|---|---|
| | 21 | 0 | **Content:** I/F input interface allocation error |

| Cause | Confirmation | Solution |
|---|---|---|
| The input signal are assigned with two or more functions. | Check the value of PA_400, PA_401, PA_402,PA_403,PA_404 if it is proper or not | Assure the value of PA_400, PA_401, PA_402, PA_403, PA_404 set correctly |
| The input signal aren't assigned with any functions. | Check the value of PA_400, PA_401,PA_402,PA_403,PA_404 if it is proper or not | Assure parameter PA_400, PA_401, PA_402,PA_403,PA_404 set correctly |

| **Error code** | Main | Extra | **Display:** "Er211" |
|---|---|---|---|
| | 21 | 1 | **Content:** I/F input interface function set error |

| Cause | Confirmation | Solution |
|---|---|---|
| Signal allocation error | Check the value of PA_400, PA_401, PA_402,PA_403,PA_404 if it is proper | Assure the value of PA_400, PA_401, PA_402, PA_403, PA_404 |

| | | |
|---|---|---|
| | or not | set correctly |

| **Error code** | Main | Extra | **Display:** "Er212" |
|---|---|---|---|
| | 21 | 2 | **Content:** I/F input interface function set error |

| Cause | Confirmation | Solution |
|---|---|---|
| The input signal are assigned with two or more functions. | Check the value of PA_410, PA_411, PA_412, PA_413, if it is proper or not | Assure the value of PA_410, PA_411, PA_412,PA_413 set correctly |
| The input signal aren't assigned with any functions. | Check the value of PA_410, PA_411, PA_412, PA_413, if it is proper or not | Assure the value of PA_410, PA_411,PA_412,PA_413 set correctly |

| **Error code** | Main | Extra | **Display:** "Er240" |
|---|---|---|---|
| | 24 | 0 | **Content:** CRC verification error when EEPROM parameter is saved |

| Cause | Confirmation | Solution |
|---|---|---|
| r,t terminal under-voltage | Check r,t terminal voltage | Assure r,t terminal voltage in proper range |
| Driver is damaged | save the parameters for several times | replace the driver with a new one |
| The setting of driver maybe default setting which isn't suitable for motor . | Check the setting of driver if it is suitable for your motor | Download the suitable project file to driver for motor |

| **Error code** | Main | Extra | **Display:** "Er260" |
|---|---|---|---|
| | 26 | 0 | **Content:** positive negative over-travel input valid |

| Cause | Confirmation | Solution |
|---|---|---|
| positive /negative over-travelling input signal has been conducted | Check the state of positive negative over-travel input signal | / |

| **Error code** | Main | Extra | **Display:** "Er590" |
|---|---|---|---|
| | 59 | 0 | **Content**: forced alarm input valid |

| Cause | Confirmation | Solution |
|---|---|---|
| Forced-alarm input signal has been conducted | Check forced-alarm input signal | Assure input signal wiring correctly |

# Chapter 6 Display and Operation

## 6.1 Introduction

The operation interface of servo driver consists of six LED nixie tubes and five key , which are used for servo driver's status display and parameter setting. The inter face layout is as follows :


**Figure 6-1 front panel**

**Table 6.1 The name and function of keys**

| Name | Key | Function |
|---|---|---|
| Display | / | There are 6 LED nixie tubes to display monitor value, parameter value and set value |
| Key of mode switch | **M** | Press this key to switch among 4 mode:<br>1.data monitor mode 2.parameter setting mode<br>3.auxiliary function mode 4.EEPROM written mode |
| Confirming key | **ENT** | Entrance for submenu, confirming input |
| Up key | ▲ | Press this key to increase the set value of current flash bit |
| Down key | ▼ | Press this key to decrease the set value of current flash bit |
| Left key | ◄ | Press this key to shift to the next digit on the left |

# 6.2 Panel Display and Operation

## 6.2.1 Panel Operation Flow Figure

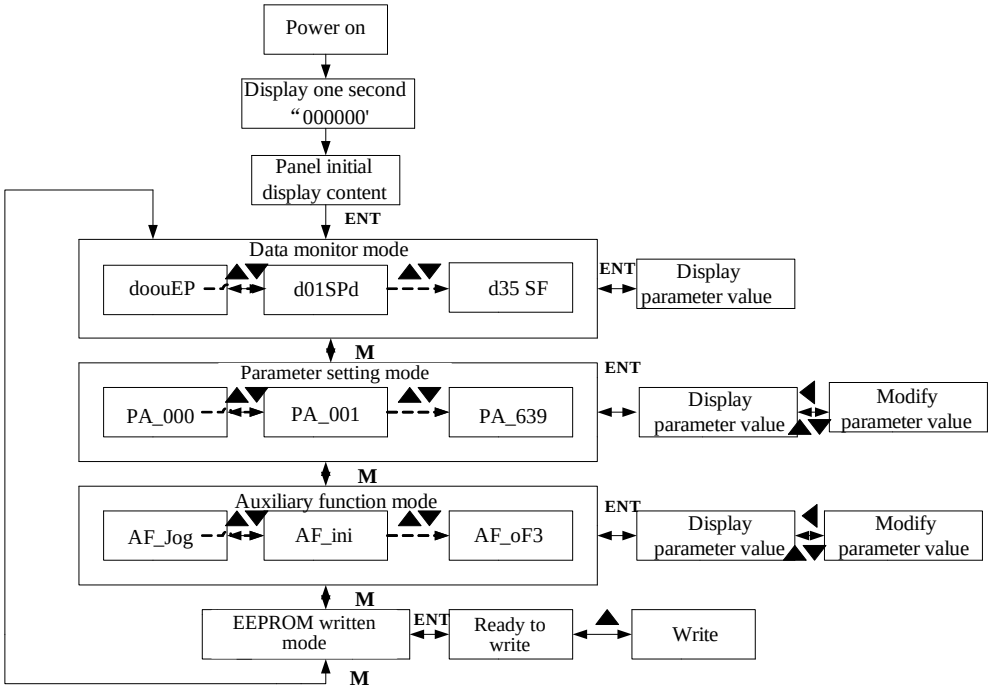



**Figure 6-2 the flow diagram of panel operation**

(1) The front panel display  for about one second firstly after turning on the power of the driver. Then if no abnormal alarm occurs, monitor mode is displayed with the value of initial parameter ; otherwise, abnormal alarm code is displayed.

(2) Press M key to switch the data monitor mode → parameter setting mode → auxiliary function mode → EEPROM written mode.

(3) If new abnormal alarm occurs, the abnormal alarm will be displayed immediately in abnormal mode no matter what the current mode is, press M key to switch to the other mode.

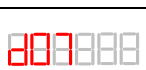
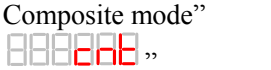
(4) In data monitor mode, press ▲ or ▼ to select the type of monitor parameter; Press ENT to enter the parameter type , then press ◀ to display the high 4 bits "H" or low 4 bits "L" of some parameter values.

(5) In parameter setting mode, press ◀ to select current editing bit of parameter No, press ▲ or ▼ to change current editing bit of parameters No. Press ENT key to enter the parameter setting mode of corresponding parameters No. Press ◀ to select current bit of parameter value when editing it, press ▲ or ▼ to change the value of the bit. Press ENT to save it and switch to the interface of parameter No.

## 6.2.2 Driver Operating Data Monitor

**Table 6.2 Function List of Driver Monitor**

| Serial Number | Name | Specification | Display | Unit | Data Format (x, y is numerical value) |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | d00uEP | Positional command deviation |  | pulse | Low-bit “L xxxx”<br>High-bit ”H xxxx” |
| 1 | d01SPd | Motor speed |  | r/min | “r xxxx” |
| 2 | d02cSP | Positional command speed |  | r/min | “r xxxx” |
| 3 | d03cuL | Velocity control command |  | r/min | “r xxxx” |
| 4 | d04trq | Torque command |  | % | “r xxxx” |
| 5 | d05nPS | Feedback pulse sum |  | pulse | Low-bit “L xxxx”<br>High-bit”H xxxx” |
| 6 | d06cPS | Command pulse sum |  | pulse | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 7 | d07 | / |  | / | “ xxxx” |
| 8 | d08FPS | External scale feedback pulse sum |  | pulse | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 9 | d09cnt | Control mode |  | / | Position:“  ”<br>Speed:”  ”<br>Torque:”  ”<br>Composite mode”<br>  ” |
| 10 | d10Io | I/O signal status |  | / | Input:”In0x y”<br>(x:interface number, arbitrary value between1-8)<br>(y:invalid -,valid A)<br>output:”ot0x y”<br>(x:interface series number, arbitrary value between1-8)<br>(y:invalid -,valid A) |
| 11 | d11Ain | Analog input value |  | v | “x yyyy”<br>x:AI1 A,AI2 b,AI3 c |
| 12 | d12Err | Error factor and reference of history |  | / | “Er xxx” |
| 13 | d13 rn | Alarm display |  | / | “m xxx” |
| 14 | d14 r9 | Regeneration load factor |  | % | “rg xxx” |
| 15 | d15 oL | Over-load factor |  | % | “oL xxx” |
| 16 | d16Jrt | Inertia ratio |  | % | “J xxx” |
| 17 | d17 ch | Factor of no-motor running |  | / | “cP xxx” |

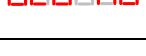
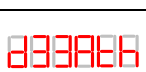
| | | | | | |
|---|---|---|---|---|---|
| 18 | d18ict | No. of changes in I/O signals |  | / | “n xxx” |
| 19 | d19 | / |  | / | “ xxxx” |
| 20 | d20Abs | Absolute encoder data |  | pulse | Low-bit “L xxxx”<br>High-bit”H xxxx” |
| 21 | d21AES | Absolute external scale position |  | pulse | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 22 | d22rEc | No of Encoder/external scale communication errors monitor |  | times | “n xxx” |
| 23 | d23 id | Communication axis address |  | / | “id xxx”<br>“Fr xxx” |
| 24 | d24PEP | Encoder positional deviation(encoder unit) |  | pulse | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 25 | d25PFE | Encoder scale deviation (external scale unit) |  | pulse | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 26 | d26hyb | hybrid deviation (command unit) |  | pulse | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 27 | d27 Pn | Voltage across PN [V] |  | V | “u xxx” |
| 28 | d28 no | Software version |  | / | “d xxx”<br>“F xxx”<br>“P xxx” |
| 29 | d29ASE | Driver serial number |  | / | “n xxx” |
| 30 | d30NSE | Motor serial number |  | / | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 31 | d31 tE | Accumulated operation time |  | / | Low-bit “L xxxx”<br>High -bit”H xxxx” |
| 32 | d32Aud | Automatic motor identification |  | / | “r xxx” |
| 33 | d33Ath | Driver temperature |  | ℃ | “th xxx” |
| 34 | d34 | / |  | / | “t xxx” |
| 35 | d35 SF | Safety condition monitor |  | / | “xxxxxx” |

**Table 6.3 “d17 ch” Motor No Rotate Reason Code Definition**

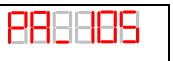
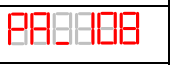
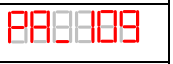
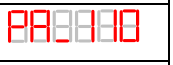
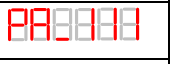
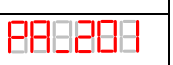
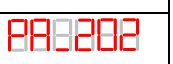
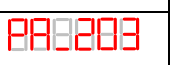
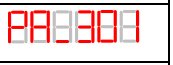
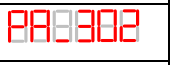
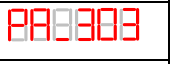
| Code | Display Code | Specification | Content |
|---|---|---|---|
| 1 |  | DC bus under-voltage | / |

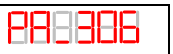
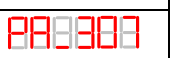
| | | | |
|---|---|---|---|
| 2 |  | No entry of Srv-On input | The Servo-ON input (SRV-ON) is not connected to COM- |
| 3 |  | POT/NOT input is valid | PA_504=0,POT is open , speed command is positive direction<br>NOT is open , speed command is negative direction |
| 4 |  | Driver fault | / |
| 5 |  | The relay inside the driver isn't closed | / |
| 6 |  | Pulse input prohibited (INH) | PA_518=0,INH is open |
| 8 |  | CL is valid | PA_517=0,deviation counter clear is connected to COM- |
| 9 |  | speed zero-clamp is valid | PA_315=1, speed zero-clamp is open |

## *6.2.3 System Parameter Setting Interface*

**Table 6.4 Setup Interface of System Parameter**

| Class | No | Name | Display Code |
|---|---|---|---|
| 0 | 01 | control mode setup |  |
| 0 | 02 | real-time auto-gain tuning |  |
| 0 | 03 | selection of machine stiffness at real-time auto-gain tuning |  |
| 0 | 04 | Inertia ratio |  |
| 0 | 06 | command pulse rotational direction setup |  |
| 0 | 07 | command pulse input mode setup |  |
| 0 | 09 | 1st numerator of electronic gear |  |
| 0 | 10 | denominator of electronic gear |  |
| 0 | 11 | output pulse counts per one motor revolution |  |
| 0 | 12 | reversal of pulse output logic |  |
| 0 | 13 | 1st torque limit |  |
| 0 | 14 | position deviation excess setup |  |
| 1 | 00 | gain of 1st position loop |  |
| 1 | 01 | gain of 1st velocity loop |  |
| 1 | 02 | time constant of 1st velocity loop integration |  |
| 1 | 03 | filter of 1st velocity detection |  |
| 1 | 04 | time constant of 1st torque filter |  |

| | | | |
|---|---|---|---|
| 1 | 05 | gain of 2nd position loop |  |
| 1 | 06 | gain of 2nd velocity loop |  |
| 1 | 07 | time constant of 2nd velocity loop integration |  |
| 1 | 08 | filter of 2nd velocity detection |  |
| 1 | 09 | time constant of 2nd torque filter |  |
| 1 | 10 | Velocity feed forward gain |  |
| 1 | 11 | Velocity feed forward filter |  |
| 1 | 12 | Torque feed forward gain |  |
| 1 | 13 | Torque feed forward filter |  |
| 1 | 14 | 2nd gain setup |  |
| 1 | 15 | Control switching mode |  |
| 1 | 17 | Control switching level |  |
| 1 | 18 | Control switch hysteresis |  |
| 1 | 19 | Gain switching time |  |
| 1 | 33 | filter time constant of velocity command |  |
| 1 | 35 | Positional command filter setup |  |
| 1 | 36 | Encoder feedback pulse digital filter setup |  |
| 2 | 00 | adaptive filter mode setup |  |
| 2 | 01 | 1st notch frequency |  |
| 2 | 02 | 1st notch width selection |  |
| 2 | 03 | 1st notch depth selection |  |
| 2 | 04 | 2nd notch frequency |  |
| 2 | 05 | 2nd notch width selection |  |
| 2 | 06 | 2nd notch depth selection |  |
| 2 | 22 | Positional command smooth filter |  |
| 2 | 23 | Positional command FIR filter |  |
| 3 | 00 | Velocity setup internal/external switching |  |
| 3 | 01 | Speed command rotational direction selection |  |
| 3 | 02 | Speed command input gain |  |
| 3 | 03 | Speed command reversal input |  |
| 3 | 04 | 1st speed setup |  |
| 3 | 05 | 2nd speed setup |  |

| | | | |
|---|---|---|---|
| 3 | 06 | 3rd speed setup |  |
| 3 | 07 | 4th speed setup |  |
| 3 | 08 | 5th speed setup |  |
| 3 | 09 | 6th speed setup |  |
| 3 | 10 | 7th speed setup |  |
| 3 | 11 | 8th speed setup |  |
| 3 | 12 | Acceleration time setup |  |
| 3 | 13 | Deceleration time setup |  |
| 3 | 14 | Sigmoid acceleration/deceleration time setup |  |
| 3 | 15 | Speed zero-clamp function selection |  |
| 3 | 16 | Speed zero-clamp level |  |
| 3 | 17 | torque setting switch |  |
| 3 | 18 | Torque command direction selection |  |
| 3 | 19 | Torque command input gain |  |
| 3 | 20 | Torque command input reversal |  |
| 3 | 21 | Speed limit value 1 |  |
| 3 | 24 | maximum speed of motor rotation |  |
| 4 | 00 | SI 1 input selection |  |
| 4 | 01 | SI 2 input selection |  |
| 4 | 02 | SI 3 input selection |  |
| 4 | 03 | SI 4 input selection |  |
| 4 | 04 | SI 5 input selection |  |
| 4 | 10 | SO 1 output selection |  |
| 4 | 11 | SO 2 output selection |  |
| 4 | 12 | SO 3 output selection |  |
| 4 | 13 | SO 4 output selection |  |
| 4 | 22 | Analog input 1(AI 1) offset setup |  |
| 4 | 23 | Analog input 1(AI 1) filter |  |
| 4 | 28 | Analog input 3(AI 3) offset setup |  |
| 4 | 29 | Analog input 3(AI 3) filter |  |
| 4 | 31 | Positioning complete range |  |
| 4 | 32 | Positioning complete output setup |  |

| | | | |
|---|---|---|---|
| 4 | 33 | INP hold time | PA_433 |
| 4 | 34 | Zero-speed | PA_434 |
| 4 | 35 | Speed coincidence range | PA_435 |
| 4 | 36 | At-speed | PA_436 |
| 4 | 37 | Mechanical brake action at stalling setup | PA_437 |
| 4 | 38 | Mechanical brake action at running setup | PA_438 |
| 4 | 39 | Brake action at running setup | PA_439 |
| 5 | 00 | 2nd numerator of electronic gear | PA_500 |
| 5 | 01 | 3rd numerator of electronic gear | PA_501 |
| 5 | 02 | 4th numerator of electronic gear | PA_502 |
| 5 | 03 | Denominator of pulse output division | PA_503 |
| 5 | 06 | Sequence at servo-off | PA_506 |
| 5 | 08 | Main power off LV trip selection | PA_508 |
| 5 | 09 | Main power off detection time | PA_509 |
| 5 | 13 | Over-speed level setup | PA_513 |
| 5 | 15 | I/F reading filter | PA_515 |
| 5 | 28 | LED initial status | PA_528 |
| 5 | 29 | RS232 baud rate setup | PA_529 |
| 5 | 30 | RS485 baud rate setup | PA_530 |
| 5 | 31 | Axis address | PA_531 |
| 6 | 03 | JOG trial run command torque | PA_603 |
| 6 | 04 | JOG trial run command speed | PA_604 |
| 6 | 08 | Positive direction torque compensation value | PA_608 |
| 6 | 09 | Negative direction torque compensation value | PA_609 |
| 6 | 20 | distance of trial running | PA_620 |
| 6 | 21 | waiting time of trial running | PA_621 |
| 6 | 22 | cycling times of trial running | PA_622 |

## *6.2.4 Auxiliary Function*

**Table 6.5 setting interface System parameter**

| No | Name | Specification | Display Code | Operation Flow |
|---|---|---|---|---|
| 0 | AF_jog | Trial run | AF_JOG | Please refer to the chapter of“trial run” |
| 1 | AF_InI | Initialization of parameter | AF_InI | 1. press ENT to enter operation, display“ AInIT ”。 |

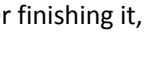
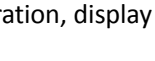
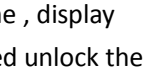
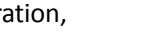
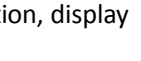
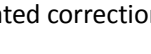
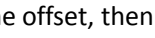
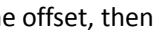
| | | | | |
|---|---|---|---|---|
| | | | | 2.press ▲ once to display “  ”, indicated initialization; after finishing it, display“  ”。 |
| 2 | AF_unL | Release of front panel lock |  | 1. press ENT to enter operation, display “  ”。<br>2. press ▲button one time , display “  ”,indicated unlock the panel successfully |
| 3 | AF_AcL | Alarm clear |  | 1. press ENT to enter operation, display“  ”。<br>2. press ▲once , display “  ”, indicated alarm clear successfully |
| 4 | AF_oF1 | A1 automatic offset adjustment |  | 1.press ENT to enter operation, display “  ”。<br>2.press ▲once , display “  ”, indication start correct, then display“  ”indicated correction finished。 |
| 5 | AF_oF2 | A2 automatic offset adjustment |  | 1.press ENT to enter operation, display “  ”。<br>2.press ▲once , display “  ”, indicated start to correct the offset, then display“”indicated that correction finished。 |
| 6 | AF_oF3 | A3 automatic offset adjustment |  | 1.press ENT to enter operation, display “”。<br>2.press ▲once , display “  ”, indicated start to correct the offset, then display“”indicated correction finished。 |

**Table 6.6 The Locked panel conditions**

| Mode | The Locked panel conditions |
|---|---|
| Monitor mode | No limitation: all monitored data can be checked. |
| Parameter set up mode | No parameter can be changed but setting can be checked. |
| Auxiliary function mode | Cannot be run except for” release of front panel lock” |
| EEPROM writing mode | No limitation |

## *6.2.5 Saving parameter*

Operation procedure:

1. press M to select EEPROM writing mode, display “  ”;

2. Press ENT to enter into writing mode operation:

3. Press and hold ▲, display LED from" EEP--- " to" EEP--- ", then it become" EEP--- ", finally it become" SEArE ", indicated EEPROM writing operation have been began;

4. Error " means that writing is unsuccessful while finish " show that the writing is successful; Follow steps 3 and 4 to repeat the operation; the drive may be damaged if repeat of several times still fails. The driver need to repair.

5. The driver need to power off and restart again if writing is successful .

**NOTE:** Don't turn off the power if EEPROM writing operation goes on, otherwise it may cause a writing wrong data; If this happens, please reset all the parameters ,then do EEPROM writing operation again.

## *6.2.6 Abnormal Alarm*

The front panel will automatically enter the abnormal alarm display mode if driver error occurs while it displays the corresponding error code. Please refer to Chapter 5 of alarm processing about the detail of error code.

# Chapter 7 Trial Run

**Attention**

- Ground the earth terminal of the motor and driver without fail. the PE terminal of driver must be reliably connected with the grounding terminal of equipment.
- The driver power need with isolation transformer and power filter in order to guarantee the security and anti-jamming capability.
- Check the wiring to make sure correctness before power on.
- Install a emergency stop protection circuit externally, the protection can stop running immediately to prevent accident happened and the power can be cut off immediately.
- If drive alarm occurs, the cause of alarm should be excluded and Svon signal must be invalid before restarting the driver.
- The high voltage also will contain in several minutes even if the servo driver is powered off, please don't touch terminal strip or separate the wiring.
-

**Note:** there are two kinds of trial run : trial run without load and trial run with load . The user need to test the driver without load for safety first.

***Contact tech@leadshine.com if you need more technical service .***

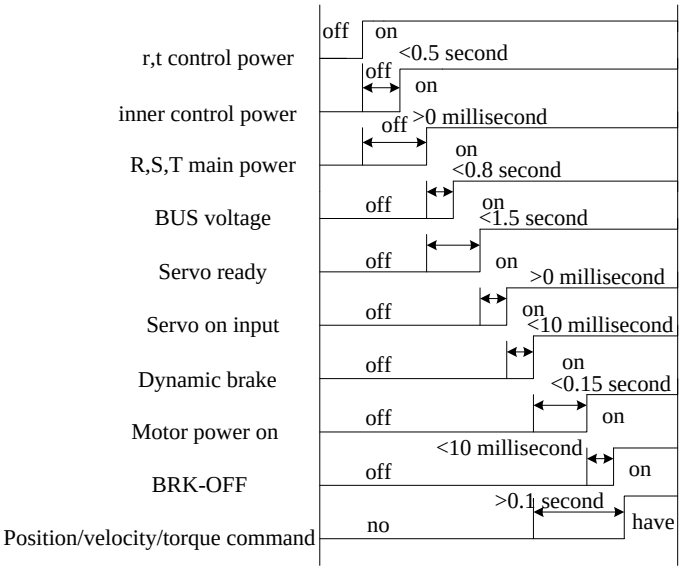
## 7.1 Inspection Before trial Run

### 7.1.1 Inspection on wiring

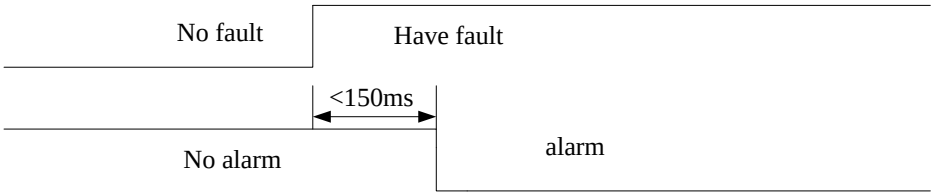
**Table 7.1 inspection Item Before Run**

| No | Item | Content |
|---|---|---|
| 1 | Inspection on wiring | 1. Ensure the following terminals are properly wired and securely connected : the input power terminals, motor output power terminal ,encoder input terminal CN2, control signal terminal CN1, communication terminal CN4(it is unnecessary to connect CN1 andCN4 in Jog run mode)<br>2.short among power input lines and motor output lines are forbidden , and no short connected with PG ground. |
| 2 | Confirmation of power supply | 1. The range of control power input r, t must be in the rated range.<br>2. The range of the main power input R, S, T must be in the rated range.<br>3. Single phase 220VAC input is sufficient if the power of driver is no more 1.5kw . |
| 3 | Fixing of position | the motor and driver must be firmly fixed |
| 4 | Inspection without load | the motor shaft must not be with a mechanical load. |
| 5 | Inspection on control signal | 1, all of the control switch must be placed in OFF state.<br>2, servo enable input Srv_on must be in OFF state. |

## 7.1.2 Timing chart on power-up




## 7.1.3 Timing chart on fault

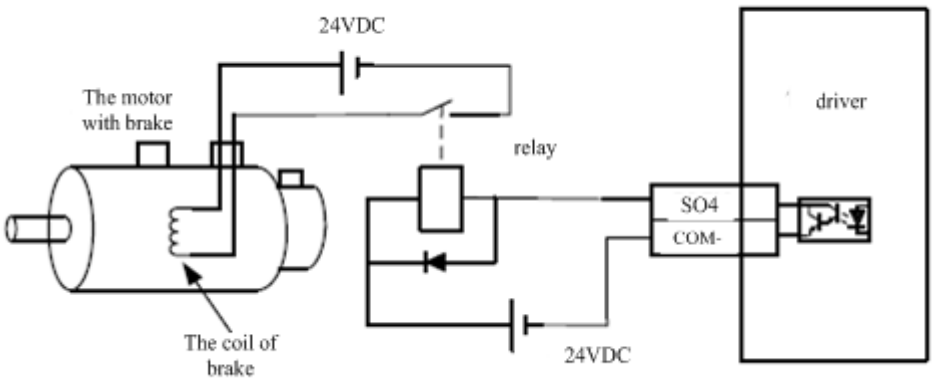



## 7.1.4 holding brake

In applications where the motor drives the vertical axis, this brake would be used to hold and prevent the work (moving load) from falling gravity while the power to the servo is shut off .

**Never use this for "Brake" purpose to stop the load in motion.**
**Use this built-in brake for "holding" purpose only. That is to hold the stalling status.**

For the brake release timing at power-on ,or braking timing at servo-off/servo-alarm while the motor is in motion ,refer to chapter 7.1.2 timing chart on power-up.
You can follow the diagram about the wiring below :



About the wire of brake ,there should be an 24VDC for brake, the brake will be loosed with the 24VDC input, and the driver give an output signal to control the connection or disconnection of the 24VDC , pin 31 and pin 35 of CN1 is the control signal , and it is forbidden to connect these signal directly for the power of 24VDC , it will destroy the hardware of servo driver.

And if you connect the pin31 and pin35 for controlling the brake , just make sure the setting value of Pr4.13. The default is 00000303h , if the driver works in torque mode , this value should be changed to 00030303h .

# *7.2 Trial Run*

After installation and connection is completed , check the following items before turning on the power:

Wiring ? (especially power input and motor output)

Short or grounded ?

Loose connection ?

Unstable mounting ?

Separation from the mechanical system ?

## *7.2.1 Jog Control*

It is unnecessary to connect control signal terminal CN1 and communication terminal CN4 in Jog run mode. It is recommended that motor runs at low speed for safety, while the speed depends on the parameters below: there are two different modes : **speed JOG mode** and **location JOG mode.**

**Table 7.2 Parameter Setup of Velocity JOG**

| No | parameter | name | Set value | unit |
|---|---|---|---|---|
| 1 | PA_001 | Control mode setting | 1 | / |
| 2 | PA_312 | Acceleration time setup | User-specified | millisecond |
| 3 | PA_313 | Deceleration time setup | User-specified | millisecond |
| 4 | PA_314 | Sigmoid acceleration/deceleration time setup | User-specified | millisecond |
| 5 | PA_604 | JOG trial run command speed | User-specified | rpm |

**Table 7.3 Parameter Setup of Position JOG**

| No | parameter | name | value | unit |
|---|---|---|---|---|
| 1 | PA_001 | Control mode setting | 0 | / |
| 2 | PA_312 | Acceleration time setup | User-specified | millisecond |
| 3 | PA_313 | Deceleration time setup | User-specified | millisecond |
| 4 | PA_314 | Sigmoid acceleration/deceleration time setup | 0 | millisecond |
| 5 | PA_604 | JOG trial run command speed | User-specified | rpm |
| 6 | PA_620 | distance of trial running | User-specified | 0.1 rotation |
| 7 | PA_621 | waiting time of trial running | User-specified | millisecond |
| 8 | PA_622 | cycling times of trial running | User-specified | times |

◆JOG trial run operation process

1. set all parameters above corresponding to velocity JOG or position JOG ;

2. Enter EEPROM writing mode, and save the value of modified parameters ;

3. The driver need to restart after the value is written successfully;

4. Enter auxiliary function mode, and go to “ "sub-menu;

5. Press ENT once, and display "";

6. Press once, and display "" if no exception occurs; press once again if "" occurs, it should display ""; If "" still occurs, please switch to data monitoring mode ""sub-menu, find the cause why motor doesn't rotate, fix the trouble and try again;

7. In position JOG mode, the motor will rotate directly; if motor doesn't rotate, switch to data monitoring mode "sub-menu, find the cause why motor doesn't rotate, fix the trouble and try again;

In speed JOG mode, press once, the motor rotates once (hold will make motor rotating to value of PA_604 ), and display ""; press once, the motor rotates once (hold will make motor rotating to value of PA_ 604), and display""; if motor doesn't rotate, switch to data monitoring mode "sub-menu, find the cause why motor doesn't rotate, fix the trouble and try again;

8. Press ENT will exit JOG control in JOG run mode.

## *7.2.2 Position Control*

**Notice :** You must do inspection before position control test run.

**Table 7.4 Parameter Setup of Position Control**

| No | parameter | name | input | value | unit |
|---|---|---|---|---|---|
| 1 | PA_001 | control mode setup | / | 0 | / |
| 2 | PA_312 | Acceleration time setup | / | User-specified | millisecond |
| 3 | PA_313 | Deceleration time setup | / | User-specified | millisecond |
| 4 | PA_314 | Sigmoid acceleration/deceleration time setup | / | User-specified | millisecond |
| 5 | PA_005 | Command pulse input select | / | 0 | / |
| 6 | PA_007 | Command pulse mode select | / | 3 | / |
| 7 | PA_518 | Command pulse prohibit input invalidation | / | 1 | / |
| 8 | PA_400 | SI1 input select | Srv_on | Hex:0003 | / |

◆ Wiring Diagram

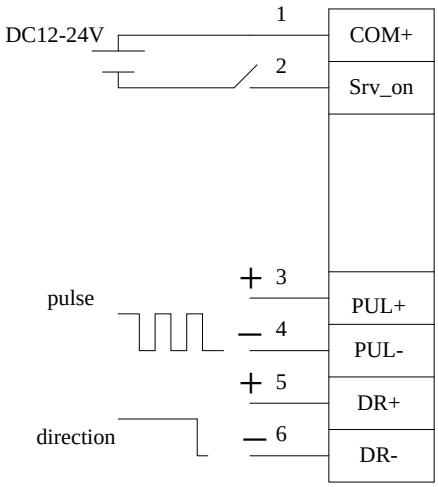



**Figure 7-3 Control Terminal CN1 Signal Wiring in Position Control Mode**

◆**Operation Steps**

1. connect terminal CN1.
2. Enter the power (DC12V to 24V) to control signal (the COM + and COM-).
3. Enter the power to the driver.
4. Confirm the value of the parameters, and write to the EEPROM and turn off/on the power (of the driver)
5.Connect the Srv_on input to bring the driver to servo-on status and energize the motor.
6. Enter low-frequency pulse and direction signal to run the motor at low speed.
7. Check the motor rotational speed at monitor mode whether, ("  "),

   Rotational speed is as per the setup or not, and

   The motor stops by stopping the command (pulse) or not

   If the motor does not run correctly, refer to the Factor of No-Motor running in data monitor mode

   ("  ").

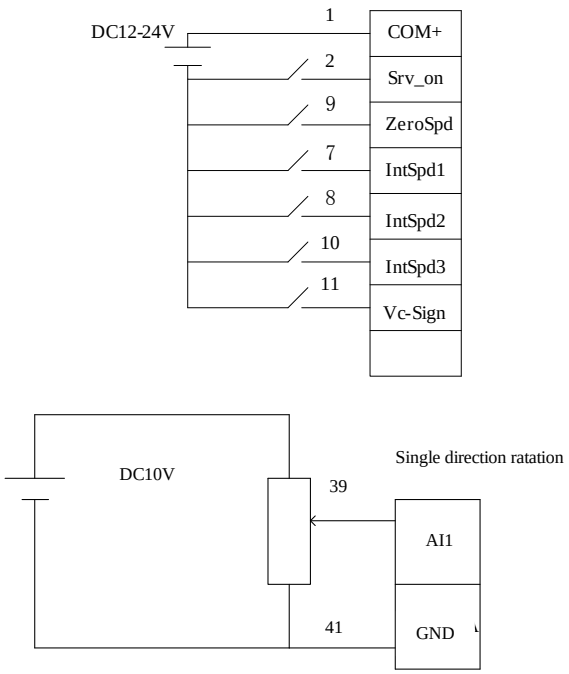
## *7.2.3 Velocity Control*

**Notice :** You must do inspection before velocity control test run.

**Table 7.5 Parameter Setup of Velocity Control**

| No | Parameter | Name | input | Setup value | Unit |
|---|---|---|---|---|---|
| 1 | PA_001 | Control mode setup | / | 1 | / |
| 2 | PA_312 | Acceleration time setup | / | User-specified | millisecond |
| 3 | PA_313 | Deceleration time setup | / | User-specified | millisecond |
| 4 | PA_314 | Sigmoid acceleration/deceleration time setup | / | User-specified | millisecond |
| 5 | PA_315 | Zero speed clamping function select | / | 1 | / |
| 6 | PA_300 | Velocity setup internal and external switching | / | User-specified | / |
| 7 | PA_301 | Speed Command direction selection | / | User-specified | / |
| 8 | PA_302 | Speed command input gain | / | User-specified | Rpm/V |
| 9 | PA_303 | Speed setting input reversal | / | User-specified | / |
| 10 | PA_422 | Analog input I(AI1) offset setup | / | User-specified | 0.359mv |
| 11 | PA_423 | Analog input I(AI1) filter | / | User-specified | 0.01ms |
| 12 | PA_400 | SI1 input selection | Srv_on | hex:0300 | / |
| 13 | PA_401 | SI2 input selection | ZeroSpd | hex:1100 | / |
| 14 | PA_402 | SI3 input selection | IntSpd1 | hex:0E00 | / |
| 15 | PA_403 | SI4 input selection | IntSpd2 | hex:0F00 | / |
| 16 | PA_404 | SI5 input selection | IntSpd3 | hex:1000 | / |
| 17 | PA_405 | SI6 input selection | Vc-Sign | hex:1200 | / |

◆Wiring Diagram




◆**Operation steps**

1. connect terminal CN1.
2. Enter the power (DC12V to 24V) to control signal (the COM + and COM- ,while COM+ is for input signal and COM- is for output signal).
3. Enter the power to the driver.
4. Confirm the value of the parameters, and write to the EEPROM and turn off/on the power (of the driver)
5.Connect the Srv_on input to bring the driver to servo-on status and energize the motor.
6. apply DC voltage between velocity command input ,AI1 and AGND, and gradually increase from 0V to confirm the motor runs.
7. Check the motor rotational speed at monitor mode , ("dd1SPd" )

   Whether rotational speed is as per the setup or not, and

   Whether the motor stops with zero command or not

   If the motor does rotate at a micro speed with command voltage of 0.
8. When you want to change the rotational speed and direction, set up the following parameters again.

   Pr3.00. Pr3.01. Pr3.03

If the motor does not run correctly, refer to the Factor of No-Motor running in data monitor mode ("dd13Ch" ).

## *7.2.4 Torque Control*

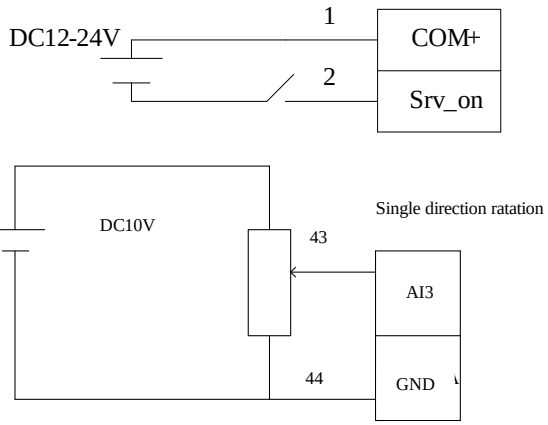
**Notice :** You must do inspection before torque control test run.

**Table 7.6 Parameter Setup of Torque Control**

| No | Parameter | Name | input | Setup value | Unit |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 1 | PA_001 | Control mode setup | / | 2 | / |
| 2 | PA_312 | Acceleration time setup | / | User-specified | millisecond |
| 3 | PA_313 | Deceleration time setup | / | User-specified | millisecond |
| 4 | PA_314 | Sigmoid acceleration/deceleration time setup | / | User-specified | millisecond |
| 5 | PA_315 | Zero-clamp function selection | / | 0 | / |
| 6 | PA_317 | Torque setup internal/external switching | / | 0 | / |
| 7 | PA_319 | Torque command direction input gain | / | User-specified | 0.1V/100% |
| 8 | PA_320 | Torque setup input reversal | / | User-specified | / |
| 9 | PA_321 | Speed limit value 1 | / | User-specified | R/min |
| 10 | PA_400 | SI1 input selection | Srv_on | hex:030000 | / |
| 11 | PA_428 | Analog input 3(AI3) offset setup | / | User-specified | 0.359mv |
| 12 | PA_429 | Analog input 3(AI3) filter | / | User-specified | 0.01ms |

◆Wiring Diagram




**◆Operation Steps**

1. connect terminal CN1.
2. Enter the power (DC12V to 24V) to control signal (the COM + and COM-).
3. Enter the power to the driver.
4. Confirm the value of the parameters, and write to the EEPROM and turn off/on the power (of the driver)
5.Connect the Srv_on input to bring the driver to servo-on status and energize the motor.
6. apply DC voltage between torque command input ,AI1 and AGND, and gradually increase from 0V to confirm the motor runs.
7. Check the motor torque at monitor mode ("d04E09" ), Whether actual torque is as per the setup or not
8. When you want to change the torque magnitude, direction and velocity limit value against the command voltage, set up the following parameters : Pr3.19. Pr3.20. Pr3.21

If the motor does not run correctly, refer to the Factor of No-Motor running in data monitor mode ("d03020" ).

# 7.3 Automatic Control Mode Run

## 7.3.1 Operation Mode Selection

EL5 series AC servo drives support the position, speed, torque three basic modes of operation, and can switch freely between the three basic modes of operation by switch or modify parameters.

**Table 7.7 Parameter setup of Operation Mode Selection**

| No | Mode | Parameter | Specification |
|---|---|---|---|
| 1 | Position mode | PA_001=0 | The position control is performed based on the positional command (pulse train) from the host controller or the command set in the servo driver. |
| 2 | Velocity mode | PA_001=1 | The velocity control is performed according to the analog speed command from the host controller or the speed command set in the servo driver. |
| 3 | Torque mode | PA_001=2 | The torque control is performed according to the torque command specified in the form of analog voltage or the command set in the servo driver. |
| 4 | 1st mode: position mode 2nd mode: speed mode | PA_001=3 | The control mode is switched through external input. |
| 5 | 1st mode: position mode 2nd Mode: torque mode | PA_001=4 | The control mode is switched through external input. |
| 6 | 1st mode: speed mode 2nd Mode: torque mode | PA_001=5 | The control mode is switched through external input. |

The step of changing the operation mode:

1, Switch the driver to Servo Off status.

2, Modify the corresponding parameters of control mode to EEPROM.

Turn off/on the power to make the new mode works after setup completed.

## 7.3.2 Position Mode

The driver is widely used for precise positioning in position control mode.

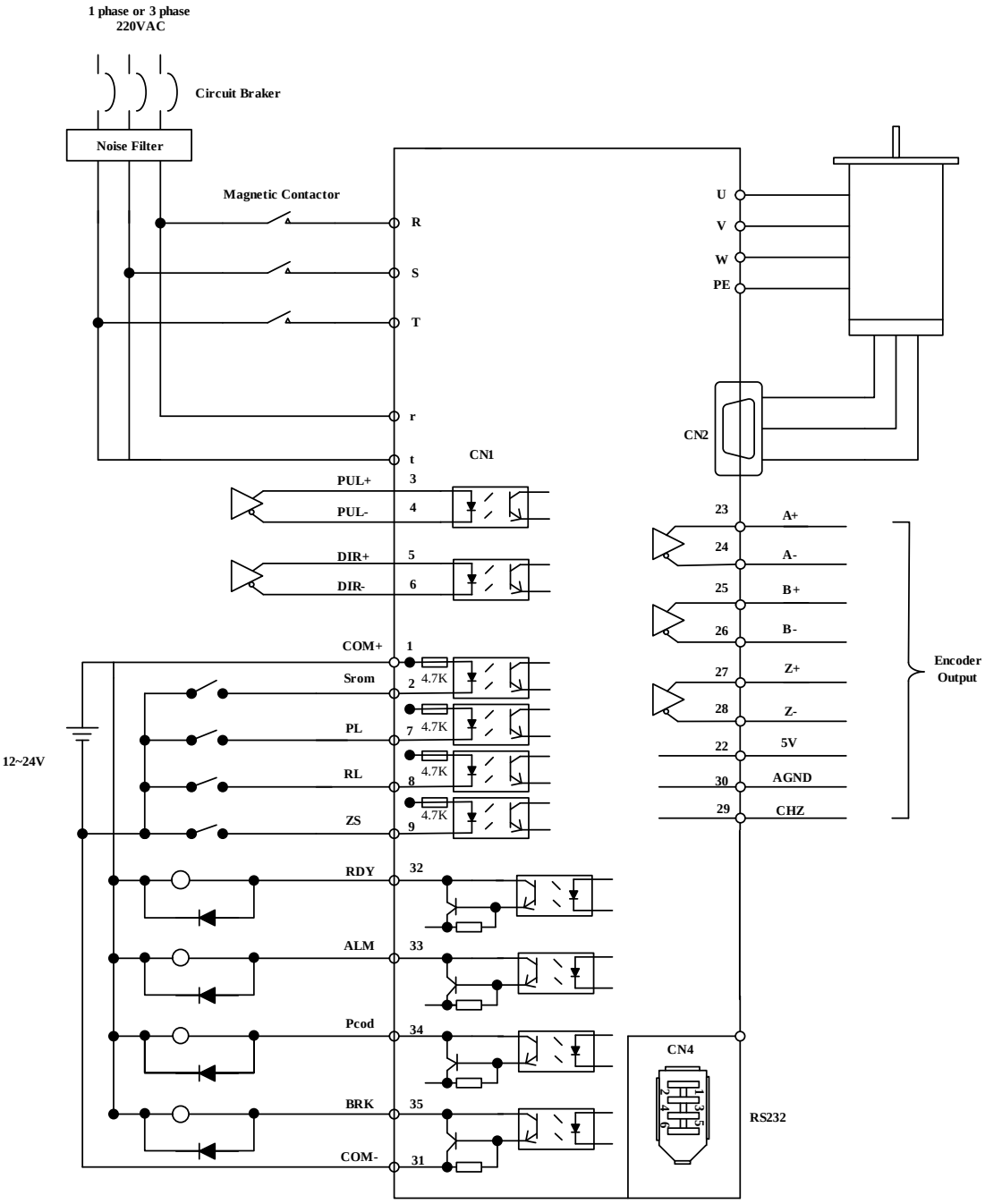



**Figure 7-6 Position Mode Typical Wiring Diagram**

**Note:**

**Single phase 220VAC input is sufficient if the power of driver is no more 1.5kw .**

## Corresponding parameters setup of position control mode

### 1. Process of command pulse input

The positional commands of the following 3 types (pulse train) are available.

◆A, B phase pulse

◆Positive direction pulse/negative direction pulse

◆Pulse + sign

Please set the pulse configuration and pulse counting method based on the specification and configuration of

installation of the host controller.

**Table 7.8 Parameter Setup of Position Command Selection**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_006 | Command pulse polar setting | Please refer to chapter 4 |
| 2 | PA_007 | Command pulse input mode setting | |

**2. Electronic gear function**

The function multiplies the input pulse command from the host controller by the predetermined dividing or multiplying factor and applies the result to the position control section as the positional command. By using this function, desired motor rotations or movement distance per unit input command pulse can be set.

**Table 7.9 Parameter Setup of Electronic Gear Ratio**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_009 | First command frequency double molecular | Please refer to chapter 4 |
| 2 | PA_010 | Command frequency double denominator | |
| 3 | PA_500 | The second command divide double frequency molecular | |
| 4 | PA_501 | The third command divide double frequency molecular | |
| 5 | PA_502 | The fourth command divide double frequency molecular | |

**3. Position command filter**

To make the positional command divided or multiplied by the electronic gear smooth, set the command filter.

**Table 7.10 Parameter Setup of Position Command Filter**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_222 | Positional command smoothing filter | Please refer to chapter 4 |
| 2 | PA_223 | Positional command FIR filter | |

**4. Motor encoder pulse output**

The information on the amount of movement can be sent to the host controller in the form of A and B phase pulses from the servo driver.

**Table 7.11 Parameter Setup of Driver Encoder Pulse Output**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_011 | Encoder pulse output molecular | Please refer to chapter 4 |
| 2 | PA_012 | Pulse output logic reverse | |
| 3 | PA_503 | Pulse output divide frequency denominator | |
| 4 | PA_533 | Pulse regeneration output boundary set | |

**5. Deviation Counter clear**

The deviation counter clear input (CL) clears the counts of positional deviation counter at the position control to 0.

**Table 7.12 Parameter Setup of Deviation Counter Clear**

| No | parameter | name | Setup method |
|---|---|---|---|
| 1 | PA_517 | Counter clear input mode | Please refer to chapter 4 |

**6. Position complete output (INP)**

The completion of positioning can be verified by the positioning complete output (INP).When the absolute value of the positional deviation counter at the position control is equal to or below the positioning complete Range by the parameter, the output is ON. Presence and absence of positional command can be specified as one of judgment conditions.

**Table 7.13 Related Parameter Setup of Position Complete Output**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_431 | Position complete range | Please refer to chapter 4 |
| 2 | PA_432 | Position complete output setup | |
| 3 | PA_433 | INP hold time | |

And the output port should be assigned for "INP", for details of these parameters, refer to PA_410 – PA415.

**7. Command pulse prohibit (INH)**

The command pulse input counting process can be forcibly terminated by using the command pulse inhibit input signal (INH).When INH input is ON ,the servo driver ignores the command pulse ,disabling pulse counting function.

**Table 7.14 Related Parameter Setup of Command Pulse Prohibit**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_518 | Command pulse prohibit input invalid setup | Please refer to chapter 4 |
| 2 | PA_519 | Command pulse prohibit input read setup | |

And the input port should be assigned for "INH", for details of these parameters, refer to PA_400 – PA409.

**8. Other setup for SI/SO function**

For details of SI input function, refer to PA_400 – PA409.

For details of SO output function, refer to PA_410 – PA415.

## *7.3.3 Velocity Mode*

The driver is widely used for accuracy speed control in velocity control mode.
You can control the speed according to the analog speed command from the host controller or the speed command set in servo driver.

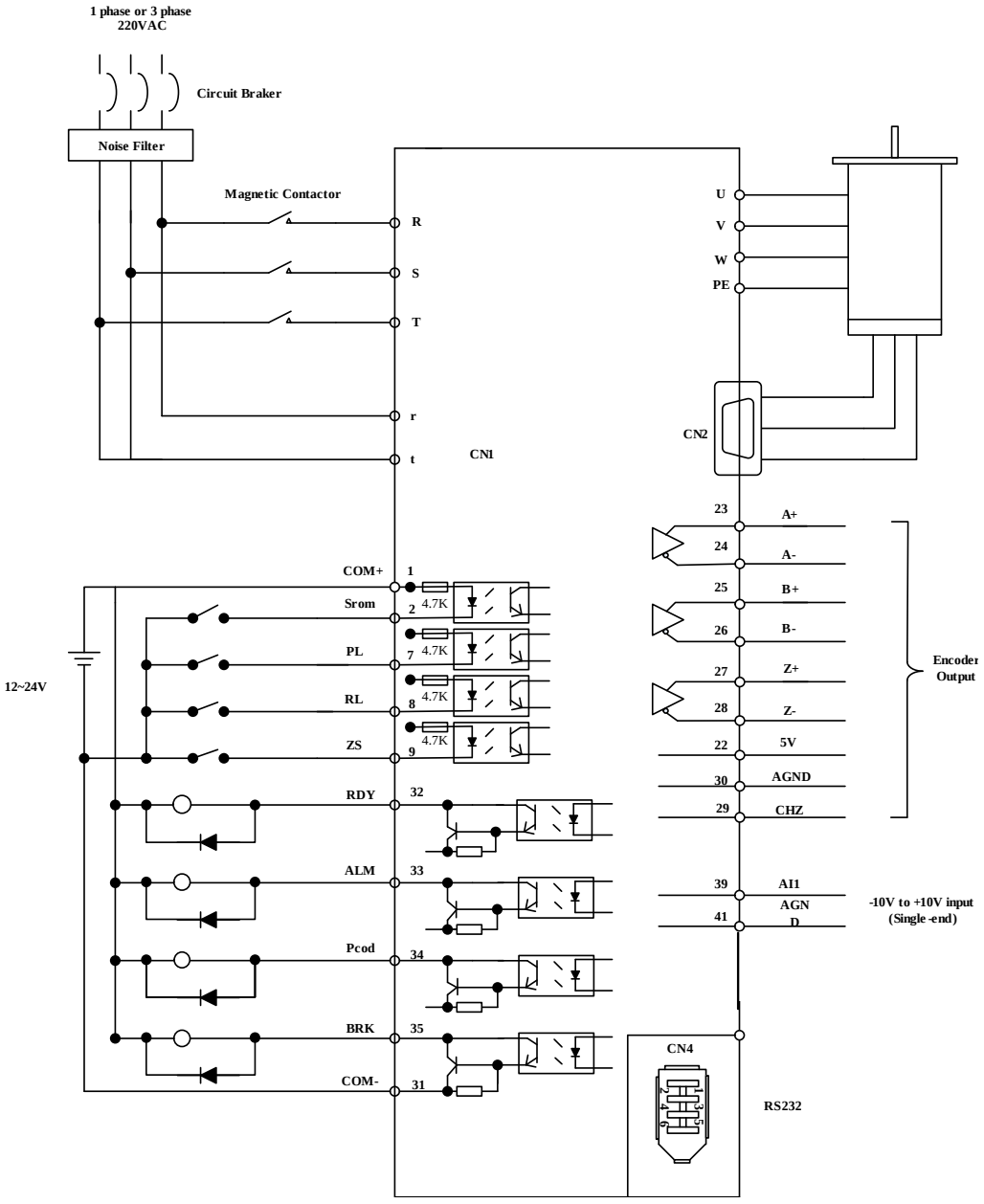



**Figure 7-7 Velocity Mode Typical Wiring Diagram**

**Note:**

**Single phase 220VAC input is sufficient if the power of driver is no more 1.5kw .**

## Relevant parameters setup of velocity control mode

### 1. Velocity control by analog speed command

The analog speed command input voltage is converted to equivalent digital speed command. You can set the filter to eliminate noise or adjust the offset.

**Table 7.15 Parameter Setup of Analog Speed Command**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_300 | Velocity setup internal/external switching | Please refer to chapter 4 |
| 2 | PA_301 | Speed command rotational direction selection | |

| | | | |
|---|---|---|---|
| 3 | PA_302 | Speed command input gain | |
| 4 | PA_303 | Speed command reversal input | |
| 5 | PA_422 | Analog input 1(AI 1) offset setup | |
| 6 | PA_423 | Analog input 1(AI 1) filter | |

**2. Velocity control by internal speed command**

You can control the speed by using the internal speed command set to the parameter. By using the internal speed command selection 1,2,3(INTSPD 1,2,3), you can select best appropriate one

**Table 7.16 Parameter Setup of Internal Speed Commands Carry Out Speed Control**

| No | parameter | name | Setup method |
|---|---|---|---|
| 1 | PA_300 | Velocity setup internal/external switching | Please refer to chapter 4 |
| 2 | PA_301 | Speed command rotational direction selection | |
| 3 | PA_304 | 1st speed setup | |
| 4 | PA_305 | 2nd speed setup | |
| 5 | PA_306 | 3rd speed setup | |
| 6 | PA_307 | 4th speed setup | |
| 7 | PA_308 | 5th speed setup | |
| 8 | PA_309 | 6th speed setup | |
| 9 | PA_310 | 7th speed setup | |
| 10 | PA_311 | 8th speed setup | |

**3. Speed zero clamp (ZEROSPD)**

You can forcibly set the speed command to 0 by using the speed zero clamp input.

**Table 7.17 Parameter setup of speed zero clamp**

| No | parameter | name | Setup method |
|---|---|---|---|
| 1 | PA_315 | Speed zero-clamp function selection | Please refer to chapter 4 |
| 2 | PA_316 | Speed zero clamp level | |

And the input port should be assigned for “ZEROSPD”, for details of these parameters, refer to PA_400 – PA409.

**4. Attained speed output (AT-SPEED)**

The signal AT-SPEED is output as the motor reaches the speed set to Pr4.36”attained speed”

**Table 7.18 Parameter Setup of attained speed output**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_436 | At-speed | Please refer to chapter 4 |

And the output port should be assigned for “AT-SPEED”, for details of these parameters, refer to PA_410 – PA415.

**5. Speed coincidence output (V-COIN)**

The signal is output when the motor speed is equal to the speed specified by the speed command. The motor speed is judged to be coincident with the specified speed when the difference from the speed command before/after acceleration/deceleration is within the range specified by Pr4.35”Speed coincident range”

**Table 7.19 Parameter Setup of Speed Coincidence Output**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_435 | Speed coincidence range | Please refer to chapter 4 |

And the output port should be assigned for “V-COIN”, for details of these parameters, refer to PA_410 – PA415.

**6. Speed command accelerates and decelerates setup**

This function controls the speed by adding acceleration or deceleration instruction in the driver to the input speed command.
Using this function, you can use the soft start when inputting stepwise speed command or when using internal speed setup. You can also use S shaped acceleration/deceleration function to minimize shock due to change in speed.

**Table 7.20 Parameter Setup of Speed Command Acceleration/Deceleration**

| No | Parameter | Name | Set method |
|---|---|---|---|
| 1 | PA_312 | Acceleration time setup | Please refer to chapter 4 |
| 2 | PA_313 | Deceleration time setup | |
| 3 | PA_314 | Sigmoid acceleration/deceleration time setup | |

When the position loop is external to the driver, don't use the acceleration/deceleration time setting. Set these values to 0.

**7. SI/SO function setup.**

For details of SI input function, refer to PA_400 – PA_409.
For details of SO output function, refer to PA_410 – PA_415.

## *7.3.4 Torque Mode*

The torque control is performed according to the torque command specified in the form of analog voltage. For controlling the torque, the speed limit input is required in addition to the torque command to maintain the motor speed within the speed limit.

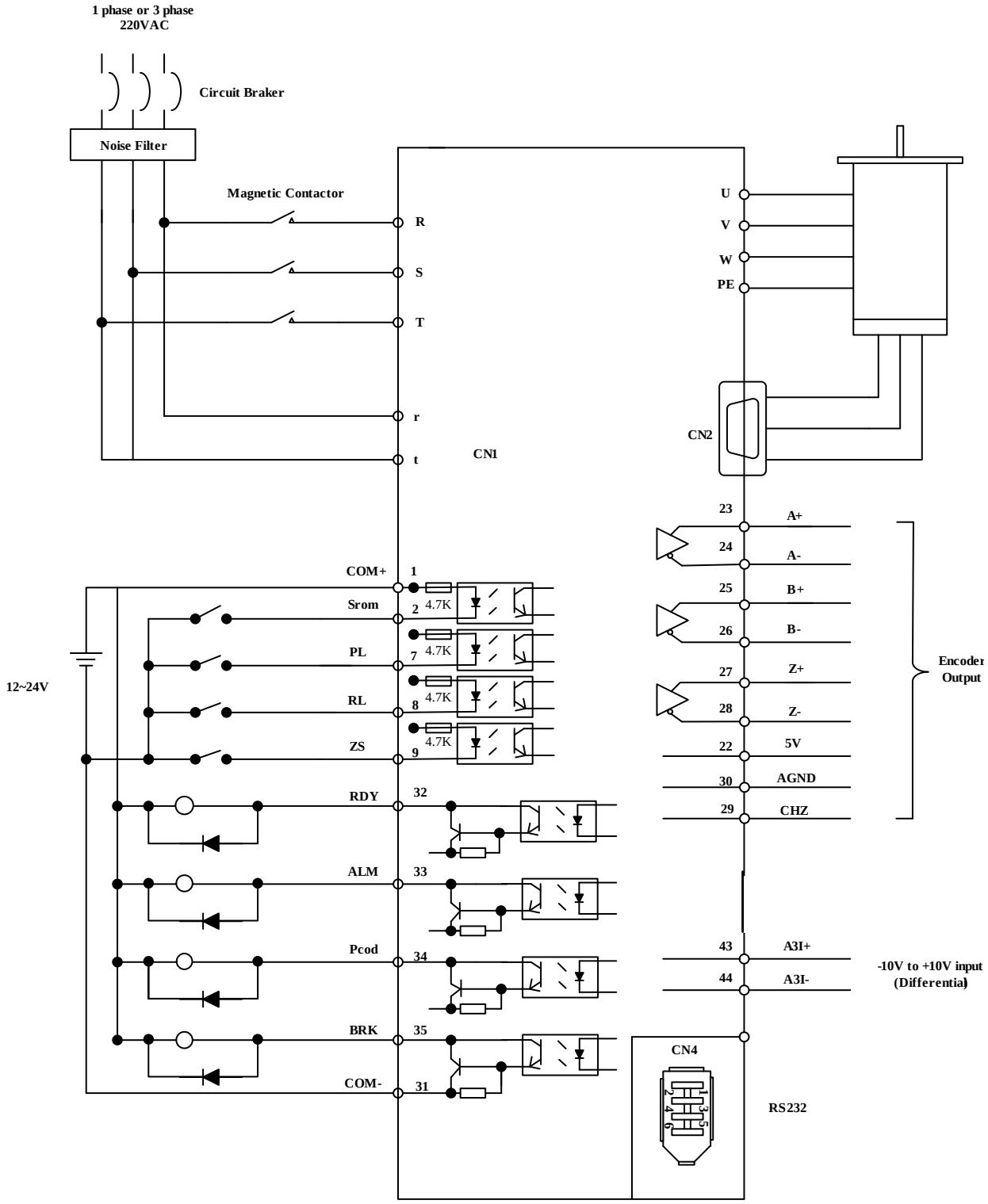



**Figure 7-8 Torque Mode Typical External Wiring Diagram**

**Note:**

**Single phase 220VAC input is sufficient if the power of driver is no more 1.5kw .**

## Relevant parameters setup of torque control mode

### 1. Analog torque command input

**Table 7.21 Parameter Setup of Analog Torque Command Input**

| No | Parameter | Name | Setup Method |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | PA_318 | Torque command direction selection | Please refer to chapter 4 |
| 2 | PA_319 | Torque command input gain | |
| 3 | PA_320 | Torque command input reversal | |
| 4 | PA_422 | Analog input 1(AI 1) offset setup | |
| 5 | PA_423 | Analog input 1(AI 1) filter | |
| 6 | PA_428 | Analog input 3(AI 3) offset setup | |
| 7 | PA_429 | Analog input 3(AI 3) filter | |

**2. Speed limit function**

The speed limit is one of protective functions used during torque control.
This function regulates the motor speed so that it doesn't exceed the speed limit while the torque is controlled.

**Table 7.22 Parameter Setup of Speed Limit Function**

| No | Parameter | Name | Setup method |
|---|---|---|---|
| 1 | PA_321 | Speed limit value 1 | Please refer to chapter 4 |
| 2 | PA_315 | Zero-clamp function selection | |
| 3 | PA_302 | Speed command input gain | |
| 4 | PA_422 | Analog input 1(AI 1) offset setup | |
| 5 | PA_423 | Analog input 1(AI 1) filter | |

**3. SI/SO function set**

For details of SI input function, refer to PA_400 – PA409.
For details of SO output function, refer to PA_410 – PA415.

# Chapter 8 Product Specification

| Notice |
| --- |
| Servo driver must be matched with relevant servo motor, this manual describes shenzhen Leadshine EL5 series servo motor. |

***Contact tech@leadshine.com if you need more technical service .***

## 8.1 Driver Technical Specification

**Table 8.1 Driver Specification**

| Parameter | EL5-D0400 | EL5-D0750 | EL5-D1000 | EL5-D1500 | EL5-D2000 | EL5-D3000 |
| --- | --- | --- | --- | --- | --- | --- |
| Rated output power | 400W | 750W | 1KW | 1.5KW | 2KW | 3KW |
| Rated output current | 2 | 3.7 | 5 | 7.5 | 10.5 | 16 |
| Max output current | 8.5 | 16 | 22 | 25 | 30 | 50 |
| Main power | Single phase or three phase 220V -15%~+10% 50/60HZ | | | | | |
| Control power | Single phase 220V -15%~+10% | | | | | |
| Control mode | IGBT SVPWM sinusoidal wave control | | | | | |
| Feedback mode | 2500P/R incremental encoder/17-bit encoder | | | | | |
| Input pulse | 0-500kHZ,5V differential input | | | | | |
| Adjust speed ratio | 3000:1 | | | | | |
| Position bandwidth | 200HZ | | | | | |
| Electronic gear ratio | 1~32767/1~32767 | | | | | |
| Analog input | -10~10Vdc,input resistance 20KΩ, no isolation | | | | | |
| Velocity bandwidth | 500HZ | | | | | |
| Input signal | Servo enable, over-travel inhibition, gain switching, command pulse inhibition, speed zero clamp, deviation counter clear, alarm clear | | | | | |
| Output signal | Alarm output, servo-ready, at-speed, zero-detection, velocity coincidence | | | | | |
| Encoder signal output | A phase, B phase, Z phase, long-distance drive mode output | | | | | |
| Alarm function | Over-voltage, under-voltage, over-current, over-load, encoder error, position deviation error, brake alarm, limit alarm, over-speed error etc. | | | | | |
| Operation and display | jog, trapezoidal wave test, each parameter and input output signal can be modified and saved, six-bit LED to display rotational speed, current, position deviation, driver type version and address ID value etc. | | | | | |
| Debug software | You can adjust the parameters of current loop, velocity loop, position loop , and change the value of input and output signals and the parameter of motor and save the values to the files which can be downloaded and uploaded, monitor the waveform of velocity and position in the ladder. | | | | | |
| Communication interface | RS-232,RS485 | | | | | |
| Brake mode | Built-in brake 50Ω/50W | | | | | |
| Adapt load inertia | Less than 5 times motor inertia | | | | | |
| weight | About 1.5-3Kg | | | | | |
| environment | Environment | Avoid dust, oil fog and corrosive gases | | | | |
| | Ambient Temp | 0 to +40℃ . | | | | |
| | Humidity | 40% RH to 90%RH, no condensation | | | | |
| | Vibration | 5.9 $m/s^2$ MAX | | | | |

| | | |
|---|---|---|
| | Storage Temperature | -20~80℃ |
| | Installation | Vertical installation |

## 8.2 Accessory selection

1. motor cable
2. encoder cable
3. brake cable
4. software configuration cable
5. control signal terminal CN1 (44 pin)
6. control signal shell CN1

# Chapter 9 Order Guidance

## 9.1 Capacity Selection

To determine the capacity of servo system, we must consider the inertia of load, torque of load, the positioning accuracy, the requirement of the highest speed, consider the selection according to the following steps:

### 1) Calculate Inertia of Load and Torque

You can refer to relative information to calculate inertia of load, torque of load, acceleration/deceleration torque as the next step basis.

### 2) Identify Mechanical Gear Ratio

According to the maximum speed and the highest speed of the motor ,you can calculate the maximum of mechanical reduction ratio, by using it and minimum of motor turning unit ,to calculate if they can meet the requirements of the smallest position unit or not. If the positional precision is high, you can increase the mechanical reduction ratio or select motor with higher capacity.

### 3) Calculate Inertia and Torque.

Convert mechanical reduction ratio of the load inertia and load torque to the motor shaft, while the result shall be not 5 times more than motor inertia. If the requirements can't be matched, you can increase the mechanical reduction ratio (the actual maximum speed reducing) or select larger capacity motor.

## 9.2 Electronic Gear Ratio

In position control mode, the actual speed = command pulse velocity × G ×mechanical reduction ratio.
In position control mode, the actual load minimum displacement = minimum command pulse travel ×G ×mechanical reduction ratio.
【Note 】If the electronic gear ratio of G is not 1, gear ratio division may have the remainder, then there will be position deviation existed, the maximum deviation is the minimum of rotation ( minimum resolution ).

# *Appendix*

## *How to debug the parameter of driver matched with different servo motor*

Generally, user can use EL5 driver with different type of motor, if the motor is with 2500 line incremental encoder , sometimes the default value of Pr715 need to be checked to match the motor firstly , each type of motor with 2500 line encoder has a unique value .

For example, the default setting of Pr715 in EL5-D0400-1 is F , F is for EL5-M0400-1-24 , if user use EL5-M0200-1-24 , then F need to be changed to 13 .

If the motor is with 17bit or 23 bit or 5000 line encoder, no need to care the value of Pr715 , driver can match the motor automatically.

Here is the example for debugging the parameter.

**A.** Choose the right value for each motor (only supported for driver software V2.xx)

| PR7.15 | Motor type | Power |
|---|---|---|
| 18 | EL5-M0100-1-16(-B) | 0.1KW |
| 13 | EL5-M0200-1-24(-B) | 0.2KW |
| F | EL5-M0400-1-24(-B) | 0.4KW |
| 14 | EL5-M0600-1-24 | 0.6KW |
| 1A | EL5-M0750-1-32(-B) | 0.75KW |
| 16 | EL5-M1000-1-32(-B) | 1.0KW |
| 17 | EL5-M1000-1-51(-B) | 1.0KW |

| PR7.15 | Motor type | Power |
|---|---|---|
| 23 | EL5-M1200-1-42(-B) | 1.2KW |
| D | EL5-M1500-1-51(-B) | 1.5Kw |
| 24 | EL5-M1500-1-42(-B) | 1.5KW |
| 25 | EL5-M1800-1-42(-B) | 1.8KW |
| 1B | EL5-M2000-1-51(-B) | 2.0KW |
| 12 | EL5-M2500-1-51(-B) | 2.5KW |
| 1C | EL5-M3000-1-51(-B) | 3.0KW |

**Download new value of parameters** to the driver and save it, and restart the driver to make the new value available.

**NOTICE : If the 200w&400w motor (10 poles ) isn't the white motor which looks like the picture above, just contact the provider of motor to get the information of motor specification.**

**B.** If the version of driver software is V1.xx, you need to do as following :

1. Get the suitable LSR project file from supplier or website .
2. Download the suitable LSR project file to match your motor .
3. Save it and restart the power of driver to make new value available .

# *Contact us*

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